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MANCHESTER 2015

Ninth Triennial Conference of the European Society for the Cognitive Sciences of Music

Royal Northern College of Music
17-22 August 2015

PROGRAMME AND ABSTRACTS
Editors: Jane Ginsborg, Alexandra Lamont and Stephanie Bramley

Escom Manchester 2015

Ninth Triennial Conference of the European Society for the Cognitive Sciences of Music

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All information was correct when the Programme and Abstracts Book went to press. The conference organising committee cannot take responsibility for any changes that have to be made for reasons beyond their control but will make every effort to inform delegates as necessary.

Ninth Triennial Conference of the European Society for the Cognitive Sciences of Music
Programme and Abstracts Book
Edited and designed by Jane Ginsborg, Alexandra Lamont, and Stephanie Bramley
Printed by Chapel Press, Manchester

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Programme at a glance

		RNCM THEATRE	CONCERT HALL
Monday 17 August			
13.00	Registration		
14.00	Pre-conference Workshop		
Tuesday 18 August			
8.00	Registration		
9.45	Welcome	Welcome and Introductions	
10.00	Keynote 1	Séverine Samson. The power of music to probe the emotional brain: Experimental and clinical findings	
11.00	Coffee	Concourses	
11.30	Papers	1A.THERAPY 1	1B. PERFORMANCE 1
13.00	Lunch	Concourses - seating in Brodsky Restaurant / Concert Bar and Cafe	
14.00	Papers	2A. Symposium: Understanding audiences	2B. AMUSIA
16.00	Tea	Concourses	
16.30	Papers	3A. OLDER PEOPLE AND DEMENTIA	3B. COMPOSITION 1
18.00	Concert	Concert Hall	Abelia Saxophone Quartet
19.30	Welcome Reception	Palace Hotel, Manchester	
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9.00	Papers	4A. Symposium: Cognitive motor control of performance	4B. COMPOSITION 2
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11.30	ECR Paper	Hickman Early Career Researcher Award (SEMPRE). Jakubowski. Tracking the tempo of involuntary musical	
12.00	Posters 1	Mezzanine	
13.00	Lunch	Concourses - seating in Brodsky Restaurant / Concert Bar and Café	
14.00	Papers	5A. IMAGERY 1	5B. MODELS
15.00	Keynote 2	Richard Parncutt. Understanding major-minor tonality: Humanities meet sciences	
16.00	Tea	Concourses	
16.30	Papers	6A. IMAGERY 2	6B. TIME AND RHYTHM PERCEPTION
18.00	Meeting		
19.00	Concert	Jazz Trio: Concert Bar and Café	
Thursday 20 August			
9.00	Papers	7A. EFFECTS 2	7B. PITCH AND TONALITY
11.00	Coffee	Concourses	
11.30	Papers	8A. THERAPY 2	8B. MUSICAL DEVELOPMENT 4
13.00	Lunch	Collect packed lunches	
13.30	Excursions	Coaches depart for excursions	
Friday 21 August			
9.00	Papers	9A. Symposium: Music and sadness	9B. PERFORMANCE 2
11.00	Coffee	Concourses	
11.30	Papers	10A. SADNESS	10B. PERFORMANCE 3
13.00	Lunch	Concourses - seating in Brodsky Restaurant / Concert Bar and Café	
14.00	Posters 2	Mezzanine	
15.00	Keynote 3	Suvi Saarikallio. A model of music-related emotional competence	
16.00	Tea	Concourses	
16.30	Papers	11A. EMOTION 2	11B. EFFECTS 3
19.00	Conference Dinner	Coaches depart from RNCM for Gorton Monastery	
Saturday 22 August			
9.00	Papers	12A. EMOTION 3	12B. JAZZ AND POPULAR MUSIC
11.00	Coffee	Concourses	
11.30	ECR Paper	ESCOM Early Career Researcher Award. Greenberg. Rules of Engagement: The structure of	
12.00	Keynote 4	Andreas Lehmann. How to get somewhere in Music - 25 years of research on expert performance	
13.00	Lunch	Concourses - seating in Brodsky Restaurant / Concert Bar and Café	

FORMAN LECTURE THEATRE	CAROLE NASH RECITAL ROOM	CONFERENCE ROOM
		Music & Wellbeing Pre-conference Workshop for PGR students
1C. EXPECTATION	1D. MUSICAL DEVELOPMENT 1	
2C. LISTENING	2D. MUSIC LEARNING 1	2E. BACKGROUND MUSIC
3C. SOCIAL	3D. MUSICAL DEVELOPMENT 2	
4C. EFFECTS 1	4D. MUSIC TRAINING	4E. PREFERENCES AND CROSS-MODALITY
imagery: A naturalistic study		
5C. EMOTION 1	5D. PIANO 1	5E. WORKSHOP 1
6C. SINGING 1	6D. MOVEMENT 1	
ESCOM GENERAL ASSEMBLY		
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9C. PERCEPTION	9D. FLOW	9E. MUSIC PERCEPTION
10C. MUSIC AND THE BRAIN	10D. MUSICAL ABILITY AND SOPHISTICATION	10E. WORKSHOP 3
11C. MEMORY	11D. PIANO 2	11E. AUDIATION
12C. MOTOR	12D. SINGING 2	
musical engagement and its personality and cognitive underpinnings		
and deliberate practice		

Welcome from the ESCOM President

It is with great pleasure that I welcome you to the Royal Northern College of Music, my home institution for the past decade, for the Ninth Triennial Conference of the European Society for the Cognitive Sciences of Music.

The six days of the conference promise a wealth of wonderful experiences: presentations by four distinguished keynote speakers and two recipients of early-career researcher awards, and – in addition to three symposia and three workshops – no fewer than 49 parallel paper sessions and two large poster sessions. The research to be reported and disseminated at the conference has been undertaken within a variety of disciplines including artificial intelligence, cognitive science, education, health and wellbeing, linguistics, music theory, music therapy, neuroscience, philosophy, psychoacoustics, psychology and psychophysics. It is particularly pleasing, given that the conference is taking place in a conservatoire, that different facets of performance and composition, as well as musical development and music learning, are popular topics.

Delegates often report that the most enjoyable and productive aspects of conferences involve the opportunity to meet old friends and make new ones. The conference organising committee has done its utmost to ensure that there will be time to do so, at the welcome reception and conference dinner, but also during the traditional free afternoon and evening, during which excursions have been arranged for you, and in breaks twice a day. As you would expect in a conservatoire, there will also be music!

In closing, I wish to thank all those who have supported the conference financially and otherwise: Visit Manchester; the Institute for Musical Research; the Society for Education, Music and Psychology Research; SAGE Publications; Manchester Metropolitan University; CUK Musical Impact; RNCM Engage. Personally, I am indebted to my colleagues on the ESCOM Executive Committee, and especially Reinhard Kopiez, the Past President, for their advice; my colleagues and students at RNCM; and above all, my co-chair Alexandra Lamont and the other members of the organising committee, Michelle Phillips and Chrissy Brand; and Rachel Hallett and Stephanie Bramley whose administrative assistance in the run-up to the conference has been invaluable.

Jane Ginsborg

Professor Jane Ginsborg
Associate Director of Research, RNCM
President of ESCOM, 2012-2015

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Welcome from the Principal of the Royal Northern College of Music

On behalf of the Royal Northern College of Music I am delighted to welcome you to the vibrant city of Manchester for ESCOM 2015. Manchester is famous for its industrial history, its football teams, its three major universities, and its music, popular and classical; it is home to three professional orchestras. The Royal Northern College of Music was formed in 1972 as the result of a merger between the Royal Manchester College of Music (founded in 1893 by Sir Charles Hallé) and the Northern School of Music (founded 1920); for the past ten years its staff have included music psychologists who have been at the heart of teaching and research, thus supporting both students and colleagues in their music making. It is therefore a particular pleasure to know that so many international researchers in the fields of music perception and cognition, psychology and related disciplines will have the opportunity to meet and to be inspired by one another at ESCOM 2015. You come not only from a broad range of intellectual and musical backgrounds, but from more than thirty countries in Europe and beyond: Australia, China, Japan and New Zealand; the United States of America, and the Russian Federation. I trust you will be stimulated and enlightened by all the presentations you will hear, the discussions in which you will take part, the conversations you will have – and that, especially if you are a first-time visitor, you will enjoy discovering Manchester and the North West of England.

Professor Linda Merrick
Principal, RNCM

Welcome from the Director of Research of the Royal Northern College of Music

It is my great pleasure, as the Director of Research, to be able to welcome you to RNCM. The college has a very strong track record of international and world leading research in the broad disciplines of music cognition and perception, music psychology and music performance research, as well as in composition, musicology and performance. It scored very highly in the recent UK Research Excellence Framework, excelling, in particular, in the impact of its research beyond academia. I am delighted that RNCM is hosting ESCOM 2015 and I am looking forward to meeting delegates during the conference. I am sure you will be stimulated by the range and quality of the conference presentations, benefit from meeting colleagues from all over the world and enjoy live music during your visit to RNCM and Manchester.

Barbara C. Kelly

Professor Barbara Kelly
Director of Research

Introduction by Dr Miren Zubeldia to the recently-constituted Asociación Española de Psicología de la Música y de la Interpretación Musical (AEPMIM: Spanish Association of Music Psychology and Performance)

The Spanish Association of Psychology of Music and Music Performance is the first statewide organisation that brings together professionals from both areas simultaneously, psychology and music. Its main objectives are: to promote research in Psychology of Music by organising events and publications; disseminate knowledge through educational and scientific activities at the institutions of formal and non-formal education; lead projects of integration or social actions in the community; promote cooperation with other similar organisations at the international level; and provide advice on the prevention and treatment of problems resulting from musical performance. AEPMIM gathers professionals interested in a wide range of research areas such as neuroscience and neuropsychology of music, musical learning cultures, music performance anxiety, health and well-being of music performers, music and emotion, psychophysiological responses to music or the music teaching and learning processes.

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SEMPRE and ESCOM Early Career Researcher Awards

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Early Career Researcher Awards are made by the Society for Education, Music and Psychology Research (SEMPRE: www.sempre.org.uk) and the European Society for the Cognitive Sciences of Music (ESCOM: www.escom.org) to early career researchers (full-time and part-time students as well as those who have not yet held a full-time academic position after graduation) who submit high-quality research papers and demonstrate the potential to be leading researchers in the field.

Eleven abstracts were shortlisted on the basis of the scores they had received in the initial review process. Their authors were asked to submit full papers, which were then assessed by the Awards Panel: Reinhard Kopiez, Mary Stakelum, Barbara Tillmann and Graham Welch. Both winners received a prize of £600 and will give their presentations in plenary sessions.

The Hickman Prize (SEMPRE) has been awarded to Kelly Jakubowski, who will present “Tracking the tempo of involuntary musical imagery: A naturalistic study” at 11.30 on Wednesday 19 August.

The ESCOM Early Career Researcher Award has been made to David Greenberg who will present “Rules of engagement: The structure of musical engagement and its personality and cognitive underpinnings” at 11.30 on Saturday 22 August.

Warm congratulations are offered to the authors of all shortlisted abstracts, and the two winners, by the Awards Panel, SEMPRE, ESCOM and the ESCOM 2015 Organising Committee.

Sempre Conference Awards

These awards enable full-time students and part-time students who are not wage-earners to attend ESCOM 2015 by meeting the registration fee and the costs of travel and subsistence, on the basis of merit and need. A total of £10,195 was awarded to the following presenters: Blanka Bogunović, Leonardo Bonetti, Tanor Bonin, Steven Brown, Cynthia-Louise Dellitt, Georgina Floridou, Vaitsa Giannouli, David Greenberg, Kelly Jakubowski, Xuejing Lu, Manuela Marin, Sarah Mawby, Naomi Norton, Lara Pearson, Costanza Preti, Indira Rao, Nora Schaal, Olek Shpenkov, Rhimmon Simchy-Gross, Joel Swaine, Swathi Swaminathan, Oğuzhan Tuğral, Anemone Van Zijl.

Important information for presenters and chairs

Paper presenters

Spoken papers will be allotted 20 minutes plus 7 minutes for questions and a 3- minute break for changing rooms. All talks will run strictly to time. You must carry out a technical check in the venue where you are presenting before your session (8.30-9.00; 11.00-11.30; 13.00-14.00; 16.00-16.30). If your Powerpoint presentation includes separate audio or audiovisual illustrations, these must all be in the same folder. If it is absolutely necessary for you to use your own computer please check that it is compatible with the AV equipment provided at RNCM, and bring a copy of your presentation on a USB/flash drive as back-up. Meet your chair and technical assistant 10-15 minutes before the start of the session in which you are presenting. If you have handouts, please distribute them before your talk. If something goes wrong with the equipment during your talk, please ask the technical assistant to fix it.

Poster presenters

Presenters will be responsible for hanging and removing their own posters. Posters can be put up from lunchtime the day before the session and left up till lunchtime the day after, if presenters are still in attendance. Posters left behind after those times will be taken down and recycled. At least one author of each poster must be available during the timetabled poster session. To maximise your opportunities to talk to delegates about your work it would help to be by your poster during tea and coffee breaks on the day of your poster presentation. If you share a pdf of your poster, labelled with your name, via Dropbox (or equivalent) with research@rncm.ac.uk by 17 August, it will be uploaded to www.escom2015.org after the conference.

Chairs

Your role is to make sure the programme runs to schedule in your session and to support and stimulate a fruitful academic exchange during the question period after each talk. Please bring a watch or other timepiece, come to the allotted room 15 minutes beforehand to meet your presenters and the technical assistant, and agree with your presenters how you will signal times (5 minutes, 1 minutes, and when to stop). You should only announce the names of presenters in your session and the titles of their talks – you do not need to provide any biographical information. Make sure presenters stop talking after 20 minutes to allow sufficient time for the audience to engage. Please agree with presenters in advance which of you will ensure that all who wish to ask questions have the opportunity to do so. If there are any last-minute changes to the programme it is vital that you do not change the timing or order of presentations in your session, as people may be intending to switch rooms between papers. Announce a break if necessary.

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Conference Schedule

		RNCM THEATRE	CONCERT HALL
Monday 17 August			
Registration	13.00		
Workshop	14.00	CONFERENCE ROOM: Music & Wellbeing Pre-conference Workshop for postgraduate students	

Tuesday 18 August			
Registration	8.00		
Welcome	9.45	Welcome and Introductions	
Keynote 1	10.00	Séverine Samson. The power of music to probe the emotional brain: Experimental and clinical findings (Chair: Alexandra Lamont)	
Coffee	11.00		
Papers	11.30	1A.THERAPY 1 Chair: Gunter Kreutz	1B. PERFORMANCE 1 Chair: Brigitta Davidjants
		Benoit, Kotz, Farrugia, Keller, Obrig, Mainka, Dalla Bella. Predicting the benefits of musically cued gait-training in Parkinson's Disease	Chmurzynska. Influence of a priori information on music performance assessment
		Lesaffre, Vets, Moens, Leman. Using auditory feedback for the rehabilitation of symmetrical body-weight distribution after ischemic stroke or brain trauma	Bogunović & Bodroža. Gender identity and personality dimensions as correlates of music performance success
		Fancourt, Perkins, Ascenso, Atkins, Williamon. Psychobiological responses of mental health service users to group drumming	Coorevits, Moelants, Maes, Leman. The influence of tempo on expressive timing: A multimodal approach
Lunch	13.00		
Papers	14.00	2A. Symposium: Understanding audiences	2B. AMUSIA Chair: Lauren Stewart
		Wise. Audience engagement in live concerts: The impact of enhanced access to composers and performers	Pfeifer & Hamann. Web-based testing of congenital amusia with the Montreal Battery of Evaluation of Amusia
		Pitts & Gross. Understanding audiences for the contemporary arts	Sun, Lu, Ho, Johnson, Forde Thompson. Exploring music- and language-syntactic processing in congenital amusia using MEG and EEG
		Burland. Exploring audiences at live coding events	Lu, Sun, Forde Thompson. Deficits in melodic contour visualization in individuals with congenital amusia
		James & Sloboda. Professional classical musicians' awareness of and interactions with their audience: A survey study	Schaal, Pfeifer, Krause, Pollok. Improving pitch memory in congenital amusia with transcranial alternating current stimulation
		Dean, Schubert, Stevens, Vincs. Future directions in measuring real-time audience response - During-performance social interaction	
Tea	16.00		
Papers	16.30	3A. OLDER PEOPLE AND DEMENTIA Chair: Sandra Garrido	3B. COMPOSITION 1 Chair: Kai Lothwesen
		Preti & Boyce-Tillman. The impact of live music on older people in hospitals: Physical, cognitive, social and emotional implications	Ross. Novel compositional devices in Presto by twelve-year-old Sergei Prokofiev
		Crich, Reid, Muller, Mountain, Williamson. The effects of live music on key stakeholders within dementia care home environments	Peruzzolo-Vieira & Carvalho. The composer-performer and the problem of notation in indeterminate music
		Burgoyne, Hofman, van der Maas, Honing. Adaptive music recognition games for dementia therapy	Vieira. Composer and performer in collaboration: Interactive processes involving non-guitarist composers and guitarists
Concert	18.00	Abelia Saxophone Quartet, in CONCERT HALL	
Welcome Reception	19.30	Palace Hotel, Manchester	

FORMAN LECTURE THEATRE	CAROLE NASH RECITAL ROOM	CONFERENCE ROOM
1C. EXPECTATION Chair: Clemens Wöllner	1D. MUSICAL DEVELOPMENT 1 Chair: Andreas Lehmann	
Ockelford. Expectations evoked on hearing a piece of music for the first time: Evidence from a musical savant	Abad, Barrett, Welch: Parental motivations to enrol their children in music early learning programs	
Schubert. Reconsidering expectancy and implication in music: The Veridical Chaining hypothesis	Papasarantopoulos, Poulakis, Anagnostopoulou. A computational analysis of children's songs from different countries	
Cenkerova. Note-by-note melodic expectation: Hymns vs. rock	Voyajolu & Ockelford: Sounds of intent in the early years: A framework of musical development	
2C. LISTENING Chair: Song Hui Chon	2D. MUSIC LEARNING 1 Chair: Blanka Bogunović	2E. BACKGROUND MUSIC Chair: Amanda Krause
Krause & North. How location and user control influence listeners' responses	Petersen & Camp. The musical self-concept of Chinese music students	Bramley, Dibben, Rowe. Exploring the presence, experience and influence of background music in gambling situations
Larrouy-Maestri, Gosselin, Blanckaert, Morsomme. Listeners' tolerance when listening to melodic performances	Liebscher. Effects of retrosequential practice (RSP) on skill acquisition in deliberate practice	Bötsch & von Georgi. The influence of personality, experience and gender on the subjectively perceived effect of music while gaming
Kopiez, Platz, Wolf, Mons, Kreutz. The influence of listening expertise and instrumentation on the differentiation between a real orchestra and orchestra sample libraries (OSL)	Hallam, Creech, Varvarigou, Gomes, Papageorgi, Lanipekun, Rinta. Are there gender differences in instrumental practice?	Hallett & Lamont. A longitudinal study of the effects of pre-exercise music and non-music interventions on exercise adherence
Brown. Myths, beliefs and attitudes towards music piracy: Findings from qualitative research	Kaczmarek. Practice strategies used by highly gifted adolescents from Germany and Poland during instrumental practice	
3C. SOCIAL Chair: Catherine Preston	3D. MUSICAL DEVELOPMENT 2 Chair: Anna Wolf	
Ziv, Shirazi, Lavi. Music and patriotism: The effect of 'national' and 'protest' music on right and left-wing individuals	Okhovat, Luck, Johari Fard. Children's perception of emotion in music (A cross-cultural study)	
Aucouturier & Canonne. Music does not only regulate, but directly and reliably communicates social behaviours	Ribeiro & Santos. Enhancement of numeric cognition in children diagnosed with Developmental Dyscalculia by an Auditory Musical Training	
Davidjants. Music wars between Caucasian nations.		

		RNCM THEATRE	CONCERT HALL
Wednesday 19 August			
Papers	9.00	4A. Symposium: Cognitive motor control of performance	4B. COMPOSITION 2 Chair: Marcus Pearce
		de Melker Worms, Stins, Beek, Loram. The effect of fear on human motor performance	Lothwesen. “Unexpected, innovative, emotional, fascinating, organised”: Exploring implicit theories of creativity in music
		Loram, Bate, Harding, Cunningham, Loram. Does the neck have hierarchical influence in motor performance: Can proactive-selective inhibition targeted at the neck break the vicious cycle?	Stefanou & Cambouropoulos. Enriching the blend: Creative extensions to conceptual blending in music
		Cunningham, Harding, Loram.The use of ultrasound and advanced machine learning to reveal deep muscle states	Saunders. Heuristic models for decision making in rule-based compositions
		Loram, Bate, Loram. Chronic profession-limiting problems in musicians: Underlying mechanisms and neuroplastic routes to recovery	Cambouropoulos, Kaliakatsos-Papakostas, Tsougras. Structural blending of harmonic spaces: A computational approach
Coffee	11.00		
ECR Paper	11.30	Hickman Early Career Researcher Award (SEMPRE). Jakubowski. Tracking the tempo of involuntary musical imagery: A naturalistic study Chair: Alexandra Lamont	
Posters 1	12.00	Mezzanine	
Lunch	13.00		
Papers	14.00	5A. IMAGERY 1 Chair: Laura Bishop	5B. MODELS Chair: Rytis Ambrazevičius
		O’Shea & Moran. Exploring the relationship between motor execution and imagery in expert pianists using chronometry and pupillometry	Arom. Modelling of Georgian traditional polyphony
		Farrugia, Smallwood, Stewart. Frequency and affective evaluation of involuntary musical imagery correlate with resting state networks of spontaneous cognition	Rawbone & Jan. A grammatical model of butterfly schemas in the late-Classical style
Keynote 2	15.00	Richard Parncutt. Understanding major-minor tonality: Humanities meet sciences (Chair: John Sloboda)	
Tea	16.00		
Papers	16.30	6A. IMAGERY 2 Chair: Anemone Van Zijl	6B. TIME AND RHYTHM PERCEPTION Chair: Nicolas Farrugia
		Fachner, Ala-Ruona, Bonde. Guided imagery in music - A neurometric EEG/LORETA case study	de Fleurian, Blackwell, Ben-Tal, Müllensiefen. Formal measures of complexity predict the accuracy in guessing the end of rhythmic patterns
		Filippidi & Timmers.Conditioning the mind in music: involuntary musical imagery and everyday life music listening	Simchy-Gross & Margulis. Attention, density, and coherence in musical time estimation
		Floridou, Williamson, Stewart and Müllensiefen. Measuring the earworm experience: The involuntary musical imagery scale (IMIS)	Phillips.Towards a combined theory of psychological time during music listening and dynamic attending theory
Meeting	18.00	ESCOM General Assembly in FORMAN LECTURE THEATRE	
Concert	19.00	Jazz Trio, in CONCERT BAR AND CAFÉ	

FORMAN LECTURE THEATRE	CAROLE NASH RECITAL ROOM	CONFERENCE ROOM
4C. EFFECTS 1 Chair: Stephanie Bramley	4D. MUSIC TRAINING Chair: Matthias Heyne	4E. PREFERENCES AND CROSS-MODALITY Chair: Hauke Egermann
Elvers, Fischinger, Steffens. Listening to empowering music: Music-induced manipulations of self-esteem	Bailes, Dean, Broughton. The effects of music training on perceptions of equal-tempered and microtonal intervals: A behavioural and EEG survey	Chon & Huron. Why are violin concertos more popular than bassoon concertos? Predicting the popularity of solo instruments in concertos as a function of pitch height and performer pool size
Maksimainen, Saarikallio. Affect from Art - Subjective Constituents of Everyday Music and Pictures: Overview and early results	Greasley & Gardiner. A survey exploration of the links between levels of musical training and music listening behaviour	Schäfer. Useful music is favoured music: The effect of musical functions on musical preferences
Franěk, Šefara, Mlejnek. The effect of music listening on perception of urban and natural scenes	Degé, Stoll, Schwarzer. Music training and verbal memory: Investigating the mechanism underlying this association in 10- to 12-year-old children	Rieger & Casey. General subjects display cross-modal responses to musical stimuli
Steffens, Steele, Guastavino. The effect of presence of music on soundscape evaluations	Swaminathan & Schellenberg. The association between musical skills and the discrimination of phonemes from a foreign language	Itoh & Nakada. Rainbow colour mapping between pitch classes and colours in synaesthetes and non-synaesthetes
5C. EMOTION 1 Chair: Richard von Georgi	5D. PIANO 1 Chair: Costas Tsougras	5E. WORKSHOP 1
Casas-Mas. Emotional development in guitar instrumentalists of advanced level in cultures of classical, flamenco and jazz	Roussou. The piano accompanist portrayed through the eyes of a soloist	Pearce, M. IDyOM: A computational model of auditory expectation
Kreutz, Bullack, Büdenbender, Roden, Bauer. Psychophysiological responses to 'happy' and 'sad' music: A replication study	Kojucharov & Rodà. Towards an empirically based definition of piano touch: Touch/timbre relationship and key motion measurements	
6C. SINGING 1 Chair: Stefanie Stadler Elmer	6D. MOVEMENT 1 Chair: Dirk Moelants	
Fischinger, Frieler, Louhivuori. Choir acoustics: An empirical case study on the influence of reverberation during choir singing	Senn & Kilchenmann. The effect of microtiming on body movement behaviour when listening to swing or funk music	
Louhivuori, Johnson, Siljander. Comparison of quality of life of older adult choir singers and the general population in Finland	Su. Visual rhythmicity in music-related human movements and its influence on auditory rhythm perception	
Pearson. Hand gesture in South Indian vocal lessons: The exploitation of cross-domain mapping as a pedagogic tool	London, Burger, Thompson, Toiviainen. Speed on the dance floor: Visual and auditory cues for musical tempo	

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		RNCM THEATRE	CONCERT HALL
Thursday 20 August			
Papers	9.00	7A. EFFECTS 2 Chair: Karen Wise	7B. PITCH AND TONALITY Chair: Trevor Rawbone
		Müllensiefen, Floridou, Jakubowski. Can correlations imply causation? Causal modelling and music psychology research	Timmers & Li. Spatial representation of pitch and its dependence on instrumental experience
		Brodsky & Ziv. Car-aoke: Vocal performances indicate distraction effects of in-car music	Miyazaki, Jiang, Makomaska, Rakowski. Cross-cultural comparisons of absolute and relative pitch in music students in different countries
		Cohrdes, Wrzus, Riediger.What do you listen to to calm down? Age-related differences in the selection of music when experiencing different affective states	Leung & Dean. Learning novel music systems through short exposure
		Trahan, Durrant, Müllensiefen, Mulligan, Williamson. How does music help us to sleep?	Bonin & Smilek. Perceptual coherence predicts consonance-dissonance and influences listeners' cognitive and affective responses to music
Coffee	11.00		
Papers	11.30	8A. THERAPY 2 Chair: Stella Kaczmarek	8B. MUSICAL DEVELOPMENT 4 Chair: Steven Brown
		Mawby. Music education and music therapy in schools for children with special educational needs: Similarities, crossovers and distinctions	Herbert & Dibben. Making sense of music: Meanings children and adolescents perceive in musical materials
		Spiro & Himberg. Improvisation and change in music therapy sessions: Exploring individual difference	Herbert & Bagkeris. Tweens and teens' engagement with music: Individual differences and psychological characteristics of subjective experience
		Brooker. Effects of cognitive hypnotherapy and eye movement desensitisation and reprocessing on music performance anxiety in advanced pianists	von Georgi & Hock. Use of music in everyday life and personality: A cross sectional study of a whole sample of school children in Germany
Lunch	13.00	Collect packed lunches	
Excursions	13.30	Coaches depart for excursions	

FORMAN LECTURE THEATRE	CAROLE NASH RECITAL ROOM	CONFERENCE ROOM
7C. TECHNOLOGY Chair: Don Knox	7D. MUSICAL DEVELOPMENT 3 Chair: Naomi Norton	
Prior, Mackay, King. Digital delivery of instrumental lessons in remote rural areas	Stadler Elmer. Song singing: how children apply musico-linguistic rules or a grammar	
Gil, Reybrouck, Tejada, Verschaffel. Students' perceptions of a technology-enhanced learning environment aimed at fostering meta-representational competence in music	Broughton, Barrett, Welch. Australian young children's musical engagement and development in family and community life	
Kivestu & Leijen. Application of video in supporting students' reflection in music instrument study	van Noorden. Social entrainment in the synchronous reproduction of musical pulse: Developments in childhood	
Fulford, Ginsborg, Greasley. Hearing aids and music: The experiences of D/deaf musicians		
8C. MOVEMENT 2 Chair: Nicolas Farrugia	8D. MUSIC LEARNING 2 Chair: Helen Prior	8E. WORKSHOP 2
Haugen. Asymmetrical meter in Scandinavian folk music and dance: A case study of Norwegian telespringar	Giannouli. Solving traditional harmony exercises: A metacognitive perspective	Wilkins. Functional connectivity and the effects of music on the brain: An introduction to network neuroscience techniques and methods for music research
Egermann, Förstel, Lehrbach, Wende. Swinging to the beat - Movement induction in electronic dance music	Preston. Peeling the onion: Interpersonal relationships in the music classroom	
Solberg. 'Moved by the music': Affective arousal, body movement and musical features of electronic dance music	Norton, Ginsborg, Greasley, McEwan. Instrumental and vocal music teachers' views on a multi-disciplinary team approach to health promotion for musicians	

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		RNCM THEATRE	CONCERT HALL
Friday 21 August			
Papers	9.00	9A. Symposium: Music and sadness	9B. PERFORMANCE 2 Chair: Anemone Van Zijl
		Eerola. Music and sadness: Definitions, functions, and rationales for engaging in negative emotions	Bishop & Goebl. Pianists' use of non-verbal audio and visual cues during duet performance
		Peltola & Eerola. Grief, melancholia, and sweet sorrow: Typology of music-related sadness	Moelants & Coorevits. Strategies for synchronization in music performance: The sniff
		Vuoskoski & Eerola. The role of empathy in the enjoyment of sad-sounding music	Hadley, Novembre, Keller, Pickering. Putting yourself in someone else's shoes (or at someone else's piano): A TMS study of the use of simulation for temporally accurate musical turn-taking in duets
		van den Tol, Edwards, Heflick. 'Sad' music as a means for acceptance-based coping: An overview of relevant literature on self-identified sad music and recent studies on research.	Broughton & Davidson. Relationships between performers' intentions and observers' perception of embodied expression in collaborative classical music performance: A case study of a flute and marimba duo
		Garrido. Sad music use in people with tendencies to depression	
Coffee	11.00		
Papers	11.30	10A. SADNESS Chair: Brigitta Davidjants	10B. PERFORMANCE 3 Chair: Dirk Moelants
		Sachs, Damasio, Habibi. The pleasures of sad music: A systematic review	Fabian. A musicology of performance? Complex systems and the non-linearity of expressive variation
		Garrido, Eerola, Garrido, Davidson. Measuring sadness as a response to music in live performance	Van Zijl. Being on stage: Capturing the experience of music performance
			Förstel & Egermann: Performance expertise of DJs
Lunch	13.00		
Posters 2	14.00	Mezzanine	
Keynote 3	15.00	Suvi Saarikallio. A model of music-related emotional competence (Chair: Michelle Phillips)	
Tea	16.00		
Papers	16.30	11A. EMOTION 2 Chair: John Sloboda	11B. EFFECTS 3 Chair: Naomi Ziv
		Koehler & Broughton. The effect of social feedback and listening context on affective responses to music	Van den Tol, Heflick, Wisman. Empathy polarises search for meaning in life after hearing mood-incongruent music
		Davidson & Garrido. My life as a playlist: Investigating emotional experience in music in rituals across time	Groarke & Hogan. The adaptive functions of music listening: Theory and measurement
		Irrgang & Egermann. Describing music-mediated emotion with motion: PDA-measured acceleration data predict perception of GEMS-9 to different degrees	Vuoskoski, Clarke, DeNora. Is music listening able to evoke affiliation?
Conference Dinner	19.00	Coaches depart from RNCM for Gorton Monastery	

FORMAN LECTURE THEATRE	CAROLE NASH RECITAL ROOM	CONFERENCE ROOM
9C. PERCEPTION Chair: Richard Parncutt	9D. FLOW Chair: Ruth Herbert	9E. MUSIC PERCEPTION Chair: Emilios Cambouropoulos
Dellit. Musical accent in action: Does auditory biography influence accent perception in live music performance?	Cohen & Bodner. The relationship between music performance anxiety and flow amongst professional classical musicians, and its clinical implications	Arthurs, Timmers, Beeston. Chord perception and frequency of occurrence: Samples from works by J. S. Bach and the Beatles
Chiller-Glaus, Nuti, MacRitchie. Biases in the perception of dynamics in harpsichord performance	Spangardt, Ruth, Schramm. Influence of personal traits and musicality on flow experience during radio reception	Tsougras & Stefanou. Conceptual blending and meaning construction: A structural/ hermeneutical analysis of the 'Old Castle' from Musorgksy's Pictures at an Exhibition
Hartmann, Lartillot, Toiviainen. Effects of musicianship and experimental task on perceptual segmentation	Zabuska, Ginsborg, Wasley. Engagement with performance and burnout among music performance students	Baker, Müllensiefen, Rindfleish. Parsifal and the effect of narrative on unconscious arousal
Martins, Gingras, Waldmüller, Fitch.The cognitive representation of recursive processes in music	Huber, Leder, Marin. In quest of the autotelic personality among professional orchestral musicians	
10C. MUSIC AND THE BRAIN Chair: Robin Wilkins	10D. MUSICAL ABILITY AND SOPHISTICATION Chair: Suse Petersen	10E. WORKSHOP 3
Toiviainen, Alluri, Burunat, Brattico. Whole-brain functional connectivity during naturalistic music listening: Effect of musical training	Harrison, Musil, Müllensiefen. Constructing adaptive tests of musical ability	Frieler. Introduction to CAMP - Computer-Aided Music Psychology
Burunat, Brattico, Hartmann, Toiviainen. Prominent cerebello-hippocampal connectivity in musicians during music listening	Fiedler & Müllensiefen. Validation of the Gold-MSI Questionnaire to measure Musical Sophistication of German students at secondary education schools	
Omigie, Pearce, Samson. Intracranial evidence of the modulation of the emotion network by musical structure		
11C. MEMORY Chair: Lauren Stewart	11D. PIANO 2 Chair: Vaike Kiik-Salupere	11E. AUDIATION Chair: Laura Bishop
Wöllner & Halpern. Conductors at cocktail parties: Attention and memory in musicians	Alessandri, Williamson, Eiholzer, Williamon. An examination of value judgements in criticism of Beethoven's Piano Sonata recordings	Platz, Kopiez, Lehmann, Hasselhorn, Büring, Wolf, Empacher, Estrada. Edwin Gordon's Advanced Measures of Music Audiation (AMMA): A critical evaluation
Gorin & Majerus. Common serial order processes in musical and verbal short-term memory: Evidence from a novel serial order probe recognition paradigm	Steinbach & Kivestu. Inter-disciplinary integration in piano studies and music theory in one Estonian music school	Estrada, Kopiez, Wolf, Platz. The development of a new assessment of notational audiation by professional musicians
Mooney, Nulli, Halpern, Müllensiefen. Melody recall and recognition: The effect of musical features on memory	Bisesi, Parncutt, Caron, Traube. The relationship between immanent emotion and musical structure in classical piano scores	

		RNCM THEATRE	CONCERT HALL
Saturday 22 August			
Papers	9.00	12A. EMOTION 3 Chair: Hauke Egermann	12B. JAZZ AND POPULAR MUSIC Chair: Elena Alessandri
		Pearce, E, Launay, Dunbar. The icebreaker effect: Singing together creates faster social bonds	Frieler, Schütz, Pfleiderer. Mid-level analysis of monophonic jazz solos: A new approach to the study of improvisation
		Trochidis & Lui. Temporal dynamics and modelling of musical emotions using a multi-component approach	Wopereis, Brand-Gruwel, Boshuizen. The development of improvisational expertise in jazz musicians
		Eerola & Saari. Genres do matter - The influence of contextual knowledge to expressed emotions in music	Oehler, Reuter, Czedik-Eysenberg.Spectral distribution and dynamic range in best-selling popular music recordings
		Céspedes-Guevara & Dibben. The role of embodied simulation in emotional contagion with music	Müllensiefen, Arcidiacono, Rupprecht, Vercammen. The effectiveness of TV ads and the impact of music on ad perception: An electrodermal activity study
Coffee	11.00		
ECR Paper	11.30	ESCOM Early Career Researcher Award. Greenberg. Rules of Engagement: The structure of musical engagement and its personality and cognitive underpinnings Chair:Jukka Louhivuori	
Keynote 4	12.00	Andreas Lehmann. How to get somewhere in Music - 25 years of research on expert performance and deliberate practice (Chair: Jane Ginsborg)	
Lunch	13.00		

FORMAN LECTURE THEATRE	CAROLE NASH RECITAL ROOM	CONFERENCE ROOM
12C. MOTOR Chair: Leon van Noorden	12D. SINGING 2 Chair: Jaan Ross	
Bazanova, Balalov, Fazulzianova, Nikolenko, Petrenko. Alpha EEG/EMG ratio during finger movement as an index of musical ability		
Godøy. Chunking by intermittent motor control in music	Ambrazevicius. Transformations of musical scales in traditional unaccompanied singing	
Swaine. A multidimensional model of arousal and its relevance for music-health research	Kiik-Salupere. Classical singing students and professional classical singers' performance preparation	
Hofmann. Controlling the clarinet: Tongue and finger actions		

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POSTERS 1: Wednesday 19 August

1. Almayev, Skorik. Expectations and tensions induced by primitive rhythms
2. Arman, Tekman. Emotional effects of makams frequently used in classical Turkish music
3. Arndt, Schlemmer, van der Meer. Music in our minds: A pupillometric study of music processing
4. Baksheeva, Bazanova, Kostromina, Nikolenko, Sapozhnikova, Taymanov. Neurophysiological markers of tonalities
5. Boal-Palheiros, Mito. Children and adolescents' singing in everyday life and at school
6. Böhm, Ruth. "You Can Count on Me" – Effects of prosocial music on the affective and cognitive aggression level
7. Bordin, Sellari. The beginners' methods in piano education: Evaluation of motivation and learning in an Italian sample
8. Bunte, Busch. Exploring musical concepts for their relevance to primary school children's music preferences
9. Carlson, Burger, Thompson, London, Toiviainen. Relationship between extraversion, agreeableness, and spontaneous motor tempo
10. Chmurzynska. Metacognitive strategies and pianists' achievement
11. Chon, DeVlieger, Huron. Exploratory study of instrument combinations in orchestral music
12. Damm, Bötsch, von Georgi. Music and socio-political attitude
13. Davidson, Lee, Krause. Musical investment: Assessing and enabling musical participation for positive wellbeing impact with seniors in Australia
14. Krause, Caudwell. The relationship between alcohol consumption behaviour and music listening preferences
15. Eerola, Garrido. Contents of self-selected music for specific mood effects differ between healthy and depressed participants
16. Feichas. The program music in Valle's 26 Characteristic and Concert Preludes for Violin Alone: The performer-audience relation on stage
17. Giannouli. Musical and verbal short-term memory
18. Gingras, Doolittle, Endres, Fitch. Overtone-based pitch selection in hermit thrush song: Implications for the origins of human musical systems
19. Hallam, Creech, Varvarigou, Gomes, Papageorgi, Lanipekun, Rinta. Changes in motivation as expertise develops: Relationships with musical aspirations
20. Iorwerth, Knox. Long distance musical relationships: Experiences of networked music performance
21. Kaczmarek, Wolniewski, Poraj. Psychological profiles of Polish instrumentalists and conductors
22. Lawendowski, Karasiewicz. Musical deficits and specific strengths among Polish dyslexic children
23. Mahlstedt, Vogler, Klemm, Wohlfeil, Tajdini, Kühn, von Georgi. Comparing perceived emotions while expressing and listening to music
24. Matei, Ross, Ginsborg, Broad, Goldbart. Promoting health in music education: Better Practice
25. Paisley, Cassidy, Knox. The design, development and evaluation of a personalised music listening intervention for peoples with dementia in acute care
26. Petrovic. Non-isochronous meter in poetry and music
27. Rao, Hegde, Nagendra. Music based intervention to target stress and cognitive dysfunction in Type 2 diabetes

28. Reid. Interdisciplinary process for collaborative artists: A proposed theoretical model
29. Schotanus. The Musical Foregrounding Hypothesis: How music influences the perception of sung language
30. Susino, Schubert. Which basic emotions are universal in response to music?
31. Tekman. Music as a gender-related social adaptation
32. Timmers, Schiavio, Cowell. Influences of visual activity on memorized tempo of a performance
33. Trent, Gómez. Correlations between musical descriptors and emotions recognized in Beethoven's Eroica
34. Tuğral. A linguistic approach to the syntax of Early Music: Representation of the hexachord system by X-bar method as an excavation tool
35. Vurma. Phonatory strategies of vocalists at singing diatonic scales with various dynamic shaping
36. Weisgerber, Mazy, Constant, Vermeulen. Background music influences the evaluation of moving emotional facial expressions
37. Williams, Kirke, Miranda, Daly, Hallowell, Hwang, Malik, Weaver, Nasuto. Affective calibration of a computer aided composition system by listener evaluation
38. Wolf, Kopiez. Ear training – The development and application of an assessment tool
39. Ziv, Dalal, Kahana. The effect of music on forgiveness

POSTERS 2: Friday 21 August

1. Albrecht, Wöllner. The emotional impact of leitmotifs in opera and film music
2. Ambrazevičius. Dissonance/roughness in Lithuanian traditional Schwebungsdiaphonie
3. Athanasopoulos, Kitsios. The effect of musical culture on pictorial notations of pitch and tempo: How traditional folk and western-trained Greek musicians represent musical shape
4. Avron, Farrugia, Allan, Müllensiefen. How does Progressive Rock sound? Perceptual facets of a complex genre identified using musical similarities
5. Baltazar, Saarikallio. Affect self-regulation through music: Which concepts do we use and how?
6. Bonetti, Costa. Intelligence and mode preference
7. Burger, Thompson, London, Toiviainen. Predicting stimulus tempo and experiment instructions from music-induced movement
8. Chmurzynska. Intra-judge reliability of music performance assessment
9. Cowell, Lamont. Music performance anxiety – Where next?
10. Götz, Lehmann, Tibken, Blatter, Kempert, Schneider. Influence of the home musical environment on phonological competencies in preschool children
11. Greasley, Crook, Fulford. Hearing aids for music: Exploring initial findings from questionnaire and interview studies
12. Greenberg, Baron-Cohen, Rentfrow. Music and autism in everyday life
13. Habibi, Ilari, Damasio, Damasio. Music learning and the developing brain - Report from an ongoing longitudinal study
14. Herrero, Carriedo, Corral, Montoro. Working memory updating executive function and music training
15. Heyne, Derrick. Trombone players seem to use different tongue positions while playing sustained notes, depending on their native languages

16. Hohagen, Wöllner. Self-other judgements of sonified movements: Investigating Truslit's musical gestures
17. Joret, Germeys, Gidron. When words and music meet in the brain: Reviewing effects of music and second language education on executive functions
18. Juslin, Barradas, Eerola. Manipulation of mechanisms underlying emotional reactions to music
19. Juslin, Sakka, Barradas,Liljeström. Idiographic modelling of aesthetic judgments of music
20. Kaczmarek, Jaszczuk. Effectiveness of special musical training (workshops) organized for children at the age between 4 and 7 by Lodz Philharmonic
21. Kaernbach. Testing Vogel's Theory of Tonal Space
22. Kawase. Associations between social skills and ensemble performance in music majors
23. Küssner, de Groot, Hofman, Hillen. Chasing an effect of background music on foreign vocabulary learning: A futile undertaking?
24. Lamont, Perera. The special role of music in wellbeing
25. Larrouy-Maestri, de Christen, Kolinsky. Effect of music and language expertise on the implicit learning of musical and linguistic structures
26. Mittmann. "Limits are relative" – Hearing -impaired children improve their musical potential
27. Nogaj. The psychosocial profile of young musicians on the example of Polish music school students
28. Norton, Ginsborg, Greasley, McEwan. Health and wellness education for musicians: Investigating music teachers' perspectives
29. Peschke, von Georgi. The competence of performance: Mental aspects of succeeding and failing in musicians
30. Podlipniak. The origin of music and the Baldwin Effect
31. Politimou, Franco. Links between musical and linguistic abilities in preschoolers: The role of the family's musical environment
32. Ross, Chow, Jakubowski, Pearce, Müllensiefen. Assessment and modelling of latent and overt absolute pitch
33. Ruth, Spangardt, Schramm. "TV's Got Talent". On reception and economic aspects of German music talent shows
34. Shpenkov, Tukaiev, Zima. Neurodynamics of the human brain during listening to rock music with modified frequency range
35. Sinico, Capparelli Gerling. Writings by internationally renowned flutists on breathing control in the orchestral excerpt from Debussy's Prélude à l'après-midi d'un faune
36. Velardo, Vallati. The effect of repetition and expertise on liking and complexity in contemporary music
37. Vuoskoski, Eerola. Perceived sadness, beauty, and liking: Exploring the interconnections
38. Wilson, Fazenda. A lexicon of audio quality
39. Wopereis, Stoyanov, Kirschner, Van Merriënboer. Congruity and diversity in conceptualizing improvisational expertise: The case of adaptors versus innovators

Tuesday 18 August 2015 **RNCM THEATRE**
09.45 - 10.00 **WELCOME and INTRODUCTIONS**

Tuesday 18 August 2015 **RNCM THEATRE**
10.00 - 11.00 **KEYNOTE 1** **Chair: Alexandra Lamont**

The power of music to probe the emotional brain: Experimental and clinical findings

Séverine Samson
University of Lille, Institut Universitaire de France La Pitié-Salpêtrière Hospital, Paris, France

The extent to which people can process music is of great interest to scientists, clinicians, and caregivers. In this talk, I will address the mechanisms of emotional induction through music from an experimental and a clinical neuroscience perspective. To outline the neural signature of musical emotions, I will first report original findings obtained from neuropsychological data and electrophysiological recordings in patients with medial temporal lesions. Then, the use of music as a therapeutic tool will be discussed by reviewing recent evidence obtained in randomized controlled trials. The aim of these trials was to test the ability for musical activities to improve well-being of patients with dementia such as Alzheimer's disease, compared to other enjoyable activities. All these findings highlight the potential for non-pharmacological treatments to improve the well-being of patients living in residential care homes, as well as to reduce caregiver burden. The data will finally be discussed in light of the methodological constraints and requirements specific to these clinical studies. The work collected here gives a snapshot of an emerging field that applies music both as a probe of emotional brain network and as a tool to examine the therapeutic benefit of music in various clinical contexts.

Séverine Samson leads the Neuropsychology and Auditory Cognition team at the University of Lille - Northern France. This is a team that specializes in the neuropsychological study of perception, memory and non-verbal emotions and especially music, to clarify the neurobiological basis through the analysis of various brain diseases. An important part of this research involves the study of memory and emotional disorders associated with temporal lobe epilepsy in the context of close collaboration with the Pitié-Salpêtrière Hospital and the Paris Institute for Brain and Spine.

Tuesday 18 August 2015 **RNCM THEATRE**
11.30 - 13.00 **SESSION 1A: THERAPY 1** **Chair: Gunter Kreutz**

Predicting the benefits of musically cued gait-training in Parkinson's Disease

Charles-Etienne Benoit[*#], Sonja A. Kotz[*], Nicolas Farrugia[*], Peter Keller[*], Hellmuth Obrig[*], Stefan Mainka[$], Simone Dalla Bella[#]
[*]Department of Psychology, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany
[#]Movement to Health Laboratory (M2H), Montpellier-1 University, Montpellier, France
[$]Neurologisches Fachkrankenhaus für Bewegungsstörungen / Parkinson, Beelitz-Heilstätten, Germany

Auditory cueing is known to improve gait kinematics in patients with Parkinson's Disease (PD). In the presence of rhythmical auditory cues, PD patients walk faster and increase their stride length. These beneficial effects are seen immediately during the stimulation, and can carry over to uncued gait after training. Important individual differences can be observed. Some patients benefit from the training, whereas others don't. A positive response to auditory cueing may be linked to spared timing mechanisms, which allow patients to synchronize their steps to the auditory cues during training. This possibility was examined in 15 PD patients, who were submitted to extensive testing

of perceptual and sensorimotor timing as well as gait kinematics before and after a four-week auditory-cuing training program. Perceptual and sensorimotor timing was evaluated with the Battery for the Assessment of Auditory Sensorimotor and Timing Abilities (BAASTA). Patients' performance was compared to that of 20 healthy controls. Musically cued gait-training led to improvements in most of the patients' gait behaviour, visible one month after the intervention. The performance in a synchronized tapping task before the training was a good predictor of the success of auditory cueing. Patients showing high accuracy and low variability in synchronization were most responsive to the training. Moreover, patients who were most responsive to cues before training were most likely to improve their gait after the training. These findings indicate that individual differences in terms of sensorimotor timing are crucial when deciding on training programs in the rehabilitation of PD.

Using auditory feedback for the rehabilitation of symmetrical body-weight distribution after ischemic stroke or brain trauma.

Micheline Lesaffre, Tim Vets, Bart Moens, Marc Leman
IPEM Department of Musicology, Ghent University, Belgium

This paper addresses the development and preliminary user test of the Music Balance Board, an auditory force plate feedback tool for weight-shift training in patients with impairment in balance function. This newly developed system provides auditory feedback based on real-time sonification of weight distribution. In an exploratory study, twelve patients after ischemic stroke or brain trauma performed standing weight-shifting activities guided by the system. This study aimed at: (1) exploring the potential of interacting with a musical environment as a way to retrain how to keep equilibrium while standing, (2) investigating usage strategies of the Musical Balance Board, and (3) studying various sonification modes with different levels of complexity. A model involving associative, explorative and anticipative sonification strategies was tested. The model supports exploration of the ability of using auditory feedback to facilitate reinforcement learning for technology-assisted rehabilitation. Our results suggest that important requirements for designing sonification modes for balance training in people with brain damage are comprehensiveness, simplicity, attractiveness of the soundscape, and most of all musical pleasure.

Psychobiological responses of mental health service users to group drumming

Daisy Fancourt[*#], Rosie Perkins, Sara Ascenso, Louise Atkins, Aaron Williamon
[*]*Centre for Performance Science, Imperial College / Royal College of Music, UK*
[#]*Psychobiology Group, University College London, UK*

Growing numbers of mental health organisations are developing music-making interventions for service users. However, to date there has been little research into their efficacy. Two previous studies by the authors have demonstrated that group drumming interventions, both across a single session and longitudinally, can affect psychological profile (including state mood profiles and clinical depression and anxiety scores), physiological health (with improvements in cardiovascular response) and immune function (with decreases in the stress hormone cortisol and increases in immune activity measured across nine components of the immune system). However, it remains unknown what aspect of group drumming is responsible for these changes and which cognitive, psychological, physiological and biological mechanisms are at play. Previous research by the authors suggested that four separate factors could influence psychobiological responses to music: aural components of the music, personal response, social activity and physical participation. To test this, 74 mental health service users took part in a randomised cross-over trial involving each of the following activities in varying orders over four weeks: participating in group drumming, watching a live drumming performance, listening to a drumming recording and a control activity (listening to audio stories). Blood pressure, heart rate, salivary cortisol, salivary cytokines (IL-2, IL-4, IL-6, IL-10, MCP-1, TNF-a, TGF-b and IFN-g), and visual analogue mood scales were assessed across each session. Analysis is underway, to be completed by June 2015. However, preliminary data is showing differences across activities and links between perceived emotional response and biological

mechanisms, leading to hypotheses of how physically performing music can influence stress and immune response.

Tuesday 18 August 2015 **CONCERT HALL**
11.30 - 13.00 **SESSION 1B: PERFORMANCE 1 Chair: Brigitta Davidjants**

Influence of *a priori* information on music performance assessment

Malgorzata Chmurzynska
Unit of Psychology of Music, Fryderyk Chopin University of Music, Poland

Music performance assessment of music experts constitutes one of the most important indicators of music performance achievements both during higher music education and during performance competitions. Annually over 350 international piano competitions are held during which the main task of adjudicators is to assess 'here and now' participants' piano performances without taking into account other information about them (e.g. earlier accomplishments from other competitions). However, there is a lot of data that – besides characteristics and quality of the performance itself – many factors have influence on judges' assessment. In this study there is focus on the influence of a priori information about performer/performance, which reaches the judge before he/she assesses them. Such information/prior knowledge (e.g. other achievements, the name of the pedagogue, the name of the conservatory) cannot be eliminated or controlled by organizers. The aim of the study was to investigate experimentally how a priori information affects music performance assessment. Twenty students from professional music schools twice – after a two-week break – assessed the same set of 8 professional piano performances of Chopin's Waltz in A flat major, Op. 34, No 1, each time in a different situation (situation A and B): in situation A it was suggested to the students that the performances were ordered from the best to the poorest, while in situation B there were no suggestions. The results showed that assessment according to situation A was biased: each subsequent performance was assessed lower than the previous one. Assessment according to situation B was assessed more reliably.

Gender identity and personality dimensions as correlates of music performance success

Blanka Bogunović[*], Bojana Bodroža[#]
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Psychological research shows that gender identity roles have a certain place in the personality profile of creative people, especially musicians (Kemp, 1996). The aim of the research was to investigate how gender identity and the Five-Factor Model (FFM) personality characteristics of young music performers relate to their success in music performance. The sample consisted of 264 students of the Faculty of Music in Belgrade, 95 of which were males and 169 females. The participants filled in the NEO-PI-R and adapted version of the Bem Sex-Role Inventory (BSRI). The criteria for success in music performance were represented by objective measures, i.e., frequency of public performances, and frequency in participation and number of awards acquired in competitions during the period of 11 to 14 years of vocal and instrumental tuition, as well as self-perceived music success. Results show that femininity in men is strongly related to music achievement measured through public performance and competitions. Women with pronounced masculinity or femininity perceive themselves as being more successful, even though they are not more successful when objective indicators of music achievement are taken into account. Out of the five-factor model personality dimensions, neuroticism negatively correlates to self-perceived success in music, but only in women. Closer examination of this relationship shows that only the facet of vulnerability to stress contributes to self-perception of being less successful. Additional analyses indicate that gender identity in male music students is not related to personality dimensions. As for female music students, androgynous females have higher scores on extraversion, consciousness, agreeableness, and neuroticism in

comparison to masculine females, while feminine females are higher on neuroticism and lower on conscientiousness than androgynous and masculine females. Findings implicate that gender identity has its role in attaining the complexity and sensitivity of artistic creation, which is then positively related to higher accomplishments.

The influence of tempo on expressive timing: A multimodal approach

Esther Coorevits, Dirk Moelants, Pieter-Jan Maes, Marc Leman
IPEM Department of Musicology, Ghent University, Belgium

In playing music, each individual performance is characterized by specific timing patterns. This variability, often referred to as expressive timing, is known to be interconnected with tempo, as timing patterns appear to be tempo-dependent. Moreover, our sense of musical time and rhythm is bound up with the sensorimotor system that controls our body movements. Therefore, an embodied approach could offer interesting perspectives on the interplay between timing and tempo and provide evidence for the tempo-specific timing hypothesis in music performance. In the current study, we investigated how tempo shapes timing in a duet performance, taking into account audio, body movement and the performer's experience. Eight duos (piano-violin) played two pieces at a pre-defined tempo, after which the start tempo was gradually increased and decreased. An audio recording of the performance was made and the body movements of the violinist were recorded using motion capture. Additionally, feedback of the musicians on their performance was collected by means of short questionnaires. Changing the performance tempo altered the temporal patterning of tone onsets for each violinist, reflecting a personal, idiosyncratic sound. Transitions in tempo could be observed in rhythmic patterns, the spatiotemporal patterning of the body movements of the violinists and their individual performance strategies. Approaching tempo in terms of movement dynamics and performance strategies therefore seems to offer an alternative to understand the different expressions we experience in fast and slow music. The results provide support for the tempo-specific hypothesis and connect it to a broader, embodied perspective and the performer's experience.

Tuesday 18 August 2015 **FORMAN LECTURE THEATRE**
11.30 - 13.00 **SESSION 1C: EXPECTATION** **Chair: Clemens Wöllner**

Expectations evoked on hearing a piece of music for the first time: Evidence from a musical savant

Adam Ockelford
Applied Music Research Centre, University of Roehampton, UK

The purpose of this study is to investigate a hitherto unresearched feature of the 'zygonic' model of implication and expectation in music: in particular, the projections that stem from recently appearing groups of notes. Using an innovative approach, data were gathered from a prodigious musical savant, who attempted to reproduce a novel composition on the piano at the same time as hearing it. The piece was designed to minimise the impact of expectations that may arise from patterns within groups of notes and those that may be perceived as a consequence of tonality, whereby different pitch transitions are felt to occur with different probabilities according to their level of past exposure. The design of the study was informed by 'zygonic' theory, which holds that expectation in music is attributable to the capacity of structural regularities to suggest future continuations, whose perceived likelihood of occurrence, it is believed, is proportional to the number of ways in which their existence is implied in what has gone before. Using this principle, a 'strength of implication' factor was calculated for each note of the stimulus piece (following the first). It was hypothesised that the higher the implication factor, the more likely Derek would be to predict its occurrence (and therefore play it correctly at the appropriate point in time). Data gathered from Derek's performance support the underlying principles of the zygonic model, although they also suggest certain refinements.

Reconsidering expectancy and implication in music: The veridical chaining hypothesis

Emery Schubert
Empirical Musicology Group, The University of New South Wales, Australia

This paper proposes that the most expected event to happen in a piece of music is what actually happens for the particular piece of music under scrutiny – that is, the veridical expectation – regardless of the extent to which it satisfies gestalt or schemata driven likelihoods. If the music is not familiar the music is segmented and matched with existing representations where possible. When no match can be found, the piece requires additional coding, such as further exposure, to allow new mental representations to become established. When segments are established in mental space they are then linked together to form new representations of the piece, but the connection with the earlier source-match is also retained (shared). The linking of the different segments that leads to the representation of the new piece is referred to as veridical segment cross chaining or 'veridical chaining' (VC). The VC hypothesis has several implications, three of which are: (1) Music analysis could focus on tracing the origins of a musical information unit – e.g. a melodic fragment, a particular rhythm pattern, a particular timbre – for a typical or specific individual, rather than assuming that all listeners enact the currently adopted rules of music theory and generalised psychological principles of top down and bottom up processing; (2) the long and/or complex lists of rules/principles of existing music processing theories can be replaced by the single, simple principle of VC which then weaves itself into a vastly complex network, but fundamentally based on the single principle; (3) VC does not need to be in operation at the exclusion of other theories.

Note-by-note melodic expectation: Hymns vs. rock

Zuzana Cenkerová
Institute of Musicology, Slovak Academy of Sciences, Slovakia

Melodic expectation is influenced by a number of factors, including music style. While empirical research on style-related expectations often compares Western and non-Western music, we explored differences between expectations in two distinct Western styles. The question of interest is to what degree the listener's expectation will conform to style-specific rules, as opposed to the more general rules of melodic expectation, such as tonality or proximity. Corpus analysis (note-to-note transition probabilities) was performed to identify main differences between a corpus of hymns and a corpus of rock songs. In a subsequent probe-tone task, listeners were asked to rate on a 1 to 7 scale how well the continuation tone fit into the given style. Every test sample offered two continuations, each frequent in one style but less common in the other. For example, in minor-key melodies, the third scale degree is most often followed by the second scale degree in hymns, but in rock songs, it is most often followed by the tonic. The pattern of responses for the hymn samples displayed a better fit to the style-specific transitions of the corpus than to Krumhansl's tonal hierarchy model. The opposite was true for the rock songs. We assume that in cohesive, well-defined styles, the listeners are more likely to reflect style-specific knowledge in their expectations. In varied, broadly defined styles, however, they will adhere to a general tonal model.

Chair: Andreas Lehmann

Parental motivations to enrol their children in music early learning programs

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Research suggests that families value music and engage in music activities in everyday life for a range of reasons including: as a means of establishing family rituals, changing moods and, modifying behaviours. Recently, there has been an evident rise in the proliferation of, and enrolment in, formal music education programs for young children outside of the home. There is little extant research that identifies the motivations of parents to enrol their children in such formal music programs, or the ways in which such program participation shapes the child's engagement in music in the home or in the role of parenting. This research identifies and makes meaning of the ways in which Australian parents invest in and utilise music through participation in Music Early Learning Programs (MELPs) by analysing interview data specifically generated over a 12-month period of 29 families participating in four MELPs. Findings indicate that reasons include: having a high value for music, following their own childhood experiences with music; having a high value for music despite having little childhood experience with music; belief that early music exposure will support their young child's cognitive and/or psycho-motor development; as a social outlet for the parent; and as a means to bond and engage with their child. Program participation shaped the way parents used music in the home and in the role of parenting, as evidenced in the use of specific techniques from the music classes in the home to manage child behaviour (e.g., tidy up songs), regulate emotion (transition songs), share play time (nurturing songs, repeating activities) and build family traditions (bedtime routines).

A computational analysis study of children's songs from different countries

Nikos Papasarantopoulos*, Nick Poulakis#, Christina Anagnostopoulou#
**Institute for Language and Speech Processing, Athena Research Center, Greece*
#Department of Music Studies, University of Athens, Greece

Children's musical repertoires can be surprisingly rich, varied and musically interesting. This paper sets out to examine children songs from six different countries/nations of Europe, namely Catalunya, England, France, Greece, Spain and Turkey, looking for regularities and patterns. In an attempt to find out what musical characteristics are shared between countries, and what makes each country's music stand out, we calculate several melodic and rhythmic viewpoints, some of which use a pre-existing manual segmentation of the pieces (segmental viewpoints). We filter out distinctive viewpoint patterns by employing a statistical measure that calculates the probability of a pattern occurrence in a corpus (set of songs) compared to an anti-corpus (all the other songs). Results suggest several differentiations as well as similarities among the nations' songs and a discussion in terms of their musicological and ethnomusicological validity is presented.

Sounds of intent in the early years: A framework of musical development

Angela Voyajolu, Adam Ockelford
Applied Music Research Centre, University of Roehampton, UK

Sounds of Intent in the Early Years (SoI-EY), explores the musical development of children up to five years of age. The initial phase of the project investigates the potential applicability of the original Sounds of Intent framework, pertaining to children and young people with learning difficulties, to all children in the early years. Video-recorded observations of fifty-eight children engaging in musical activity, a review of the literature on 'neurotypical' early years musical development and 'zygonic' theory – a musicological theory of how music makes sense to us all – were used as the evidence base from which the early years framework was created. The new stage-related SoI-EY framework centres around four levels of musical development (taken from the original six) and three domains of engagement (reactive, proactive, and interactive). Analysis of the data suggests that children may exhibit different SoI-EY levels of musical development simultaneously, implying that the levels may overlap and that some younger children may demonstrate more advanced musical development than their older peers. Further research is under way to explore the framework with a larger sample of children across England, within a longitudinal design.

Tuesday 18 August 2015 **RNCM THEATRE**
14.00-16.00 **SESSION 2A: SYMPOSIUM – UNDERSTANDING AUDIENCES**

Audience engagement in live concerts: The impact of enhanced access to performers and composers

Karen Wise
Guildhall School of Music and Drama, UK

In the light of decline in audiences for classical concerts there is growing interest in understanding what audiences seek from live performance. Research shows that connection with performers is highly valued by both new and established audiences. Understanding and enriching the experiences of existing audiences is important to artists, particularly in the context of artistic innovation and new music, often seen as challenging and risky. This project explored audience responses to a programme of enhanced engagement events – designed to promote exchange between composers, performers and audiences – and the impact on the concert experience. In collaboration with Britten Sinfonia, we recruited 20 audience members and 22 music students as 'Audience Consultants'. They attended events organised around two concerts, showcasing newly commissioned work. Concert 1 was followed by a research questionnaire on participants' experiences of an open rehearsal and panel discussion, and the performance. Questionnaire data were also gathered from 35 audience members attending the same concert programme at another venue. Concert 2 was followed by a post-concert discussion with the artists in which the Audience Consultants participated. Thematic analysis of qualitative questionnaire data revealed three main themes expressing the value of the events for audience members' live concert experience: 'Orientation', 'Connecting with the Process', and 'Connecting with the People'. Data also illuminate participants' engagement with innovative aspects of programming and staging, and provide indications of impact and challenges. The project gave rich insight into audience members' experiences, with implications for promoting deeper and more meaningful exchange between artists and audiences.

Understanding audiences for the contemporary arts

Stephanie Pitts, Jonathan Gross
Department of Music, The University of Sheffield, UK

The growing body of research with audiences has increased understanding of motivations and experiences in the concert hall and across other art forms, highlighting the personal, social and musical enrichment that people seek in their live arts consumption. Audiences for the contemporary arts, however, remain something of a mystery, both to arts organisations and to researchers: their affiliation away from the 'mainstream' invites investigation of their routes into arts engagement, and their attitude to risk and challenge might be presumed to be different from that of most classical music audiences. This paper reports on the first stage of what we hope will become a nationwide project which aims to understand (i) audience experience of live contemporary arts, (ii) the value of those arts to individuals and society, and (iii) strategies for sustaining and growing audiences across art forms and genres. From October 2014 to May 2015, we worked with Birmingham Contemporary Music Group (BCMG) to build a network of arts organisations across Birmingham, who shared through interviews and discussion groups their challenges for building audiences and developing wider access to contemporary arts events. We have taken a qualitative research approach, through observation, life history interviews and 'audience exchanges', in which participants attended unfamiliar art forms for the first time and reflected on these in group discussion. Our preliminary findings uncover routes into contemporary arts through volunteering and creative practice, and show audience members' fascination with work being made 'now' and with access to the backstage processes of that creation.

Exploring audiences at live coding events

Karen Burland
School of Music, University of Leeds, UK

As an arts practice, live coding has its roots in musical performance, and the fact that its 'liveness' requires the performer to write and modify algorithms in real time (Collins et al., 2003) means that it might be thought of as a kind of improvisation. 2014 saw the tenth anniversary of organized live coding (Magnusson, 2014), and during this decade it has been manifested in a variety of contexts. Whilst there is a growing body of research addressing aspects of live coding from the performer's perspective, little is known about the audiences for these events. Therefore this paper seeks to explore the motivations, experiences, and responses of live coding audiences in a variety of performance contexts. It aims to understand the experience of being a member of a live coding audience and explores: (1) the role and impact of the source code (projected as part of the performance); (2) the impact of the audience on the development of that code; and (3) the audience's response to music being visibly created in the moment. Audiences from a range of live performance events were invited to complete an online questionnaire and some participated in follow-up interviews. Performers were also interviewed which allowed a detailed exploration of the ways in which audiences directly impact upon their coding practices during a live performance. In previously under-explored territory, this is an exciting area of research which sheds new light on the role of audiences, openness and technology in live musical performances.

Professional classical musicians' awareness of and interactions with their audience: A survey study

Mirjam James, John Sloboda
Research & Knowledge Exchange, Guildhall School of Music and Drama, UK

Research suggests that the limited audience inclusion and participation in a performance may be a reason for lack of attendance by younger adults. However, there is little knowledge about how classical musicians view their audience, and how willing they are to interact formally or informally with their audience in the ways that research has indicated as motivating for contemporary audiences. The present paper provides an overview of an opportunity sample of young British classical musicians' perception of their own audience and their willingness to interact with their audiences formally and informally. Fifty-two professional London-based classical orchestral players and singers (mean age = 28), all contracted to contribute to a performance of Haydn's Creation, responded to an online questionnaire, e.g. asking about the contributions an audience made to their recent positive concert experiences, as well as their general attitudes towards recruiting and interacting with audiences. Participants generally saw audience recruitment as primarily the job of the concert promoter and tended to prioritise word of mouth in any personal recruitment undertaken. Two contrasting concepts are manifest in this sample. Some musicians prefer a distant relationship, while others are focused on a positive experience for audiences. But both these groups are unlikely to aim to plan pro-actively to reach out to their audiences. A minority of participants agreed that it is important to know something about the audience before a performance. Those musicians are more likely to engage with audiences in both formal and informal ways.

Future directions in measuring real-time audience response – During-performance social interaction

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#*School of the Arts and Media, University of New South Wales, Australia*
+*Deakin Motion Lab, Deakin University, Australia*

Even in passive audience settings such as classical music concerts, ballet, contemporary dance and films, where the experience occurs with the audience remaining still and silent, and appears to be highly personal and reflective, we simply have not had the tools to investigate systematically whether social interactions are occurring (in the case of the film, among the audience members). Despite major advances both in technology and techniques, tracking continuous response to live performance has several limitations and beckons interesting psychological and philosophical challenges that will engage the research community in the future. In terms of measuring social interaction, such response tools may interfere with the social variables of interest (interaction with performer and other audience member) because of the solitary activity of responding to a self-report device. This paper discusses the state of the art in continuous response methods when investigating audience member reactions while in a live concert setting, and presents some possible ways forward. We argue that many of the most recent tools in continuous response measures used in the bulk of audience response research are inadequate for addressing questions about a range of socially related parameters of audience behaviours. One way forward for future research on real-time audience response to live performance is video and movement analysis tools. We discuss some of the approaches that are available, including video based facial expression coding. These tools will be useful because they relieve the burden of measurement made by the audience.

Web-based testing of congenital amusia with the Montreal Battery of Evaluation of Amusia

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In this article we will present the results of a web-based testing of 117 German undergraduate students with the Montreal Battery of Evaluation of Amusia (MBEA; Peretz et al. 2003). The MBEA is used to assess congenital amusia, a neuro-developmental disorder present in approximately 4% of the population, according to Kalmus and Fry (1980). Recently, criticism has arisen concerning the usage of the MBEA in relation to the prevalence of congenital amusia in the general population and the statistical evaluation of the results (Henry & McAuley, 2010; 2013, Pfeifer & Hamann, 2015). We compare the results of our web-based study to a group of 111 German students that was tested with a computer-implemented MBEA version under laboratory conditions (Pfeifer & Hamann 2015). We found significant differences between the web-based and the laboratory group based on their sum of correct responses. A Signal Detection Theory analysis of the data, which factors out response bias, however, shows that the discriminatory ability of both groups seems to be equal. The results of the current study are used to critically discuss the validity of a web-based MBEA specifically but also web-based testing more generally as a means of diagnosing congenital amusia.

Exploring music-syntactic processing and language-syntactic processing in congenital amusia using MEG and EEG

Yanan Sun*[§], Xuejing Lu[#§], Hao Tam Ho[#§], Blake Johnson*[§], William Forde Thompson[#§]
**UK of Cognitive Science, Macquarie University, Australia*
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[#]*Department of Psychology, Macquarie University, Australia*

The current study is investigating music-syntactic processing and language-syntactic processing in congenital amusia using electroencephalography (EEG) and magnetoencephalography (MEG). For the music experiment, 80 western five-note-melodies were created with a piano timbre. They were randomly mixed with the same 80 melodies ending with an out-of-key note. Another 40 melodies were included that contain one note with a deviant instrument (i.e. guitar). Participants were asked to detect these timbre-deviants. For the language experiment, five-word English sentences were presented orally. The final word was either syntactically incorrect, semantically incongruent, or syntactically / semantically 'correct'. To ensure they attended to the stimuli, participants were occasionally required to answer questions on randomly selected trials related to the sentence they just heard. Brain activity was recorded using concurrent 160-channel MEG and 64-channel EEG. Preliminary EEG results showed that syntactic violations in both music and language elicited similar brain responses in normal controls (ERAN and N5 for the music task and ELAN and N400 for the language task); Amusics showed deficits to some extent in these event-related brain responses in both music and language tasks.

Deficits in melodic contour visualization in individuals with congenital amusia

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 # Department of Cognitive Science, Macquarie University, Australia

People with congenital amusia have difficulty with melodic contour processing, even when the pitch changes involved exceed their threshold for pitch discrimination. Patel et al. (2005) proposed the 'Melodic Contour Deafness Hypothesis', which posits that congenital amusia results from insensitivity to the direction of pitch movement rather than impaired processing of pitch change detection. Given that melodic processing requires both accurate perception of pitch change direction as well as the capacity to represent a succession of contour changes, it is unclear whether impairments in melodic contour processing observed in individuals with congenital amusia occur at a perceptual stage or at a stage of representing a contour pattern in memory. To disentangle these two stages, the present study examined cross-modal mapping using an audio-visual mismatch detection task. Twelve participants with congenital amusia and 12 matched controls were presented with tone sequences (tonal and atonal) and visual contours that corresponded to the melodic contour of the tones (i.e., sequences of dots that vary in spatial height corresponding to pitch changes). Participants were asked to respond as quickly as possible when they detected an audio-visual mismatch. Compared with control participants, amusic individuals made more errors in both tonal and atonal sequences. The finding suggests that individuals with congenital amusia are impaired in perceiving the up-down pattern of a melody. Furthermore, all participants showed a better performance on tonal sequences than atonal ones. In other words, tonal structure facilitated melodic contour processing.

Improving pitch memory in congenital amusia with transcranial alternating current stimulation

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Brain imaging studies have highlighted structural differences in congenital amusia, a life-long disorder that is associated with pitch perception and memory deficits. Additionally, a functional anomaly of decreased low gamma oscillations (30-40 Hz range) in the right dorsolateral prefrontal cortex (DLPFC) during pitch memory in amusics has been revealed. The present study investigated whether applying transcranial alternating current stimulation (tACS) at 35 Hz to the right DLPFC would improve pitch memory abilities in amusia. Nine amusics took part in two tACS sessions and completed a pitch and visual memory task before and during tACS with a target frequency of 35 Hz or a control frequency of 90 Hz. Additionally, matched controls also completed the pitch and visual memory task without stimulation. The results reveal that 35 Hz stimulation facilitated pitch memory in amusics significantly. No modulation effects were found with 90 Hz stimulation or on the visual task. Furthermore, before stimulation amusics showed a selective impairment of pitch memory compared to controls, whereas the visual memory performances were comparable. Interestingly, the amusics' pitch memory performance during 35 Hz stimulation was not significantly different to pitch memory in controls. Taken together, the study shows that modulating the right DLPFC with 35 Hz tACS in congenital amusia leads to an improvement of pitch memory performance supporting the hypothesis that alterations of gamma oscillations within the DLPFC are causally involved in disturbed pitch memory. Furthermore, the study adds to the growing literature that non-invasive brain stimulation is a useful tool for therapeutic interventions.

Tuesday 18 August 2015 **FORMAN LECTURE THEATRE**
14.00 - 16.00 **SESSION 2C: LISTENING** **Chair: Song Hui Chon**

How location and user control influence listeners' responses

Amanda E. Krause, Adrian C. North
School of Psychology and Speech Pathology, Curtin University, Australia

This study uses Mehrabian and Russell's Pleasure-Arousal-Dominance (PAD) model to consider how the individual's degree of control over music selected for a particular listening episode and the location in which the listening takes place influences responses to both the music and overall experience. Participants (N = 216) completed an ecologically valid music listening task subject to experimenter manipulation: their degree of control over music selected was manipulated by either the experimenter providing music or allowing the participants to self-select music and the location was manipulated by asking participants to listen in one of three locations (in the laboratory, on public transportation, or while exercising at the gym). Separate generalized linear mixed method (GLMM) analyses were performed to address the research questions. Results demonstrate a positive relationship between pleasure and dominance and that listeners use arousal-polarization strategies in everyday music listening. Whether the music was self-selected or experimenter-provided affected how much people liked what they heard, how arousing they considered the music to be, and how much control they felt they had over the music. Furthermore, the location and music ratings influenced people's judgments of their overall experience in terms of the PAD domains. This research confirms that the PAD model is a useful framework for understanding everyday music listening and supports the contention that, in a musical context, dominance may be operationalized as control over the music.

Listeners' tolerance when listening to melodic performances

Pauline Larrouy-Maestri*[#], Laura Gosselin[#], Ellen Blanckaert[#], Dominique Morsomme[#]
**Neuroscience Department, Max-Planck Institute for Empirical Aesthetics, Frankfurt, Germany*
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A melodic performance can be slightly out of tune (i.e., enlargement or compression of an interval of ~20 cents) and still be rated as 'in tune' by layman listeners. In order to elucidate the concept of pitch accuracy in melodies, this study aims (a) to clarify the effect of music expertise when listening to familiar vs. non-familiar melodies and (b) to quantify the perceptual thresholds of music experts when listening to melodic performances. For (a), familiar and non-familiar melodic sequences were manipulated, from 'in tune' (deviation of 0 cent) to 'out of tune' (10 to 60 cents, in 10 cent steps). The sequences were presented to 30 non-musicians and 30 musicians, matched in age and gender, using the method-of-limits procedure, in a test/retest paradigm. For each condition, participants were asked to specify whether the presented singing performances were 'in tune' or 'out of tune'. For (b), the same melodies, with smaller manipulations (0 to 30 cents, in 5 cent steps), were presented to 30 musicians using the same procedure. We observed a high test-retest reliability, independent of both familiarity of melody and musical training. As expected, there was an effect of expertise ($p < .001$) on the perceptual thresholds (experts' tolerance of ~10 cents). In addition, we observed a specific profile for music experts, who were particularly sensitive to interval compressions. This study yields the opportunity to refine objective tools for the evaluation of singer pitch accuracy but also to provide pertinent material to investigate the music perception process.

The influence of listening expertise and instrumentation on the differentiation between a real orchestra and orchestra sample libraries (OSL)

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We investigate here the discriminability between music excerpts performed by means of a state-of-the-art OSL and those heard via a commercial recording of the same piece. Additionally, we address the respective influences of musical expertise and the composition's features. Ten short passages (duration about 30 s) from Igor Stravinsky's composition for large-scale orchestra, The Rite of Spring (1913), were presented in two versions: (a) as a synthesis of sampled sounds from the Vienna Symphonic Library, and (b) performed by a traditional ensemble. Synthesised versions from the library were edited by a professional sound engineer and subsequently evaluated by professional conductors to achieve the best possible musical quality. The two versions were randomly presented for identification of the sound source (orchestra or computer) in an online experiment (forced choice paradigm). By means of signal detection theory, we then analysed a total of N = 702 valid data sets from participants who had different degrees of familiarity with library and orchestra sounds (e.g., conductors, composers, music arrangers and producers) and musical sophistication. On average, 69% of the OSL versions and 72% of the live recordings were identified correctly (mean d' = 1.5; SD = 1.1). Listening expertise had a significant influence on listeners' discrimination achievement: listeners dealing with sound professionally (composers/arrangers/orchestra musicians) showed a higher sensitivity (d' = 1.94) compared to non-musicians/hobby musicians (d' = 1.3). Additionally, all listeners were more able to recognize tutti passages in the OSL version higher than passages with more transparent instrumentation.

Myths, beliefs, and attitudes towards music piracy: Findings from qualitative research

Steven Caldwell Brown
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Claims from industry bodies that music piracy harms the music industry tend to centre on the economic losses incurred from illegally sourcing copyrighted works, despite no readily observable evidence to support this. Individuals on either end of the debate who consider music piracy to be good or bad appear to demonstrate confirmation bias, favouring information which supports their beliefs. Noting a major absence of qualitative research into music piracy, this paper discusses the results of a series of studies using varied qualitative methodology to explore the roots of both pro and anti-piracy attitudes. Significantly, music piracy was found to be woven into everyday life, with little regard for the potentially negative consequences it may have on the recorded music industry. Notably, so-called 'music pirates' consistently denied that music piracy was wrong, relying on a pattern of justifications to make sense of their behaviour; the most common was the notion that musicians are "filthy rich" and that this justifies procuring their music illegally. There was also a widespread perception that music is too expensive. Importantly, those individuals engaging in music piracy were found to vary widely in their beliefs and motives. The research highlights the benefits of adopting qualitative methodology, with its novel findings enriching the literature to date by offering insight into how different groups can reach different conclusions when evaluating the same phenomenon. Discussion focuses on the policy implications of appeasing shifting consumer preferences and how to better educate consumers on industry realities.

The musical self-concept of Chinese music students

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Department of Music, Lucerne University of Applied Sciences and Arts, Switzerland

Despite the relevance of the musical self-concept to a person's musical development and achievement, no research so far has explored how the musical self-concept emerges in different societal settings, and in particular in the Chinese music education environment. This study aimed to characterise musical self-concept types in Chinese university music students. The students' (N = 97) musical self-concept was assessed through the Musical-Self-Concept Inquiry (MUSCI) on 12 dimensions covering ability, social, emotional, spiritual, cognitive, and physical aspects. The data were analysed with factor and cluster analyses, leading to an adapted version of the MUSCI and three significantly differing musical self-concept types. The types mainly differed in the students' perception of their musical achievement and ambitions; their rhythm, movement and dancing affinity and skills; their spirituality in relation to music; and the communicative aspect of music. Sociodemographic data and information on professional aims were also included in the interpretation of the clusters. With reference to comparative self-concept research in 'individualistic' and 'collectivist' countries, the differences could partly be explained by these societal views. The findings support and further develop the construct of the musical self-concept while highlighting characteristics specific to a Chinese educational setting. The results offer initial empirical grounds for future investigations of the interdependence between musical self-concept, education, and talent development in societies with differing views of the self.

Role and effects of retrosequential practice (RSP) on skill acquisition in deliberate music practice

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Although most practice methods suggest start practising in lower tempi – usually from the beginning of the musical piece, the design of anterograde practice (AP) seems to bear some problematic implications, concerning the efficiency of the musical learning process. Consequently, Retro Sequential Practice (RSP) has drawn some attention trying to approach those problems alternatively by focusing on the primary automation of the terminal sequences of a musical object and its stepwise (sequential) backward (retro) oriented expansion. Accordingly, the talk will outline the role and effects of anterograde/retrograde orientation on skill acquisition in music practice, explain the effects regarding to related neuroscientific findings and introduce the options and possible benefits of applying RSP for optimizing deliberate music practice. The findings and their interpretation suggest so far, that RSP supports the musical learning process, particularly regarding to accomplishing of complexity and structuring of learning content, specifying of perception and sharpening of imagery, enhancing of retention and accelerating of skill development, strengthening of self-confidence, intrinsic motivation and improving stage presence. Overall, RSP optimizes the musical learning effect by conclusively aligning deliberate practice according to neurophysiological and neuropsychological facts, conditions and phenomena.

Are there gender differences in instrumental music practice?

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This research aimed to consider whether there were gender differences in the amount of practice undertaken by boys and girls, the practice strategies adopted and motivation to practice. 2027 girls and 1225 boys aged 6-19 years, ranging in level of expertise from beginner through to conservatoire entrance level, playing instruments representative of the classical and popular instruments played in the UK completed a self-report Likert scale questionnaire. There were no statistically significant gender differences in weekly practice time or motivation to practice. Factor analysis of statements relating to practice revealed 7 factors with statistically significant gender differences in relation to Factor 1, the adoption of systematic practice strategies, with girls being more systematic; Factor 6, with boys perceiving that they had higher levels of concentration; and Factor 7, with girls reporting more immediate correction of errors. There were no statistically significant gender differences in relation to Factor 2, the organisation of practice, Factor 3, the use of recordings for listening and feedback and the use of a metronome, Factor 4, the use of analytic strategies, and Factor 5, the adoption of ineffective practice strategies, although in relation to Factor 5 there was a statistically significant interaction between gender and level of expertise.

Practice strategies used by musically highly gifted adolescents from Germany and Poland during instrumental practice

Stella Kaczmarek
Music Academy, Lodz, Poland

Practice is the most important activity in the life of every musician. The amount of research on instrumental practice and demand for this topic has increased greatly in the last decade. Studies on musicians` practice strategies started in the 40s thanks to Rubin-Rabson, and in the 80s thanks to Nielsen, Jorgensen, Hallam and Bloom. There are relatively few studies carried out on children or musically highly gifted adolescents. The aim of this paper is to present a recent study on musically gifted adolescents in Germany (Hannover, Cologne and Detmold) and Poland (Lodz). The present study investigates the differences in practice strategies of musically gifted adolescents from both countries. To examine the differences in practice strategies between two groups we prepared one questionnaire. It was developed in the Institute for Giftedness at the University of Paderborn (Fragebogen zur Praxis des Übens, 2008). It consisted of items addressing the use of planning and practice strategies during practice and their content. In the questionnaires young musicians were asked to reflect on their practice behaviour, and the most often used practice strategies, setting the practice goal and the whole process of practising at home. The first analysis showed the difference between German and Polish gifted adolescents. Significant differences between both groups in the content of practice strategies during practice were also found. We have only discovered meaningful dissimilarities in the use of mental strategies between two groups on one scale. The results of this study show the importance of teaching the students the right practice strategies, time management and planning strategies. The analysis suggests that gifted adolescents from Germany and Poland have little knowledge of how to use appropriate practice strategies.

Tuesday 18 August 2015 **CONFERENCE ROOM**
14.00-15.30 **SESSION 2E: BACKGROUND MUSIC Chair: Amanda Krause**

Exploring the presence, experience and influence of background music in gambling situations

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#Department of Psychology, The University of Sheffield, UK

Gambling is a leisure activity, sometimes accompanied by background music. Studies suggest that background music can influence behaviour in a range of everyday contexts including gambling situations. However, further investigation is required to determine which psychological mechanisms may underlie such effects, how music is currently used in gambling environments, the character of gamblers' experiences of music and their music listening habits. This presentation explores the presence, experience and influence of background music in gambling situations from different perspectives, using a mixed-methods approach. Subjective opinions and objective evidence was gathered within three studies: (1) interviews with casino managers, (2) an online questionnaire administered to gamblers and, (3) a laboratory experiment. Studies One and Two identify the functions that music serves within a range of gambling situations. Music enhances the gambling experience, with factors including control, musical preferences and mood being implicated in the way that gamblers and gambling-operators utilise music. The manipulation of music tempo was previously thought to quicken betting speed in laboratory virtual roulette gambling. However this hypothesis was not confirmed when Study Three examined the effect of music tempo alone on betting speed. Therefore there appears to be some circumstances under which the effect of music tempo does not operate, leading to the conclusion that the effects of music characteristics on betting speed may be combinatorial. This research has implications for the way that music's effects on behaviour are investigated in future studies.

The influence of personality, experience and gender on the subjectively perceived effect of music while gaming

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#International Psychoanalytic University Berlin, Germany
#Institute for Music science and Music education, Justus-Liebig-University Giessen, Germany

Few studies have examined the impact of music while gaming (e.g. Lipscomb & Zehnder, 2004, Yamada, 2008, Cassidy & McDonald, 2009). Individual factors like experience and personality have been predominantly ignored. This study investigates the influence of experience with video games, gender and personality on subjectively perceived effects of music during gaming in general via questionnaire. 200 students (108 female, 92 male; $M = 24.2$; $SD = 4.9$) with an average gaming experience of 8.5 years ($SD = 5.6$) completed questionnaires on personality (PANAS-d; SKI) and on subjectively perceived effects of music while gaming (CamQ), which consists the following scales: perceived effects ($\alpha = 0.93$), disturbance of concentration ($\alpha = 0.89$), personal music preferences ($\alpha = 0.90$) and game-external relevance of soundtracks ($\alpha = 0.85$). The hypotheses were tested by multiple regression and covariance analysis. The significance level was set at $\alpha = 0.05$. The results show that the subjectively perceived concentration-disturbance by music is influenced by neuroticism ($\beta = 0.198$; $p = 0.01$). Game-external relevance of soundtracks is influenced by orderliness ($\beta = -0.233$; $p = 0.02$). Regression analysis showed that experience with video games affects the perceived impact of music ($\beta = 0.220$; $p = 0.001$). It seems that emotional lability modulates the ability to concentrate on gaming while listening to music. Gender and experience seem to be important moderating variables: male gamers seem to be more sensitive for music in games. The present study shows that the perceived effect of music depends on individual factors, which should be considered in further research.

A longitudinal study of the effects of pre-exercise music and non-music interventions on exercise adherence

Rachel Hallett, Alexandra Lamont
School of Psychology, Keele University, UK

Regular exercise improves both physical and mental health, but many people struggle to adhere to exercise programmes. Music is widely used during exercise, and its use in pre-event preparation in sport, and to 'get in the mood' for activities such as housework, suggests a possible role for music played before exercise in helping adherence. In this study, a pre-exercise music intervention was compared with an established non-music method, in a longitudinal, randomised, controlled, between-participants, field-based design. It was hypothesised that those using interventions would (a) exercise more than a control group and (b) meet a higher proportion of pre-set exercise goals. Participants (N = 50) were instructed to apply their intervention at the point they would take (or fail to take) action to convert intention to behaviour. Both intervention groups achieved significantly better outcomes than the control group, meeting a higher proportion of their exercise goals and exercising more frequently. There were no significant differences between the outcomes of the two intervention groups. These findings support pre-exercise music listening as a strategy to help adherence, showing music to be comparable to an established, non-musical intervention. Music offers the potential to bridge the intention-behaviour gap in exercise behaviours, and pre-exercise music listening offers a simple, enjoyable tool to help the general public meet their exercise aims. This research opens up a potentially fruitful field combining music psychology and the psychology of health behaviours.

Tuesday 18 August 2015 **RNCM THEATRE**
16.30-18.00 **SESSION 3A: OLDER PEOPLE AND DEMENTIA**
Chair: Sandra Garrido

The impact of live music on older people in hospitals: Physical, cognitive, social and emotional implications

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**iMerc, UCL Institute of Education, UK*
[#]Faculty of Arts, University of Winchester, UK

The aim of the study was to investigate the impact of live and recorded music on the older patients in a hospital. The patients and the hospital staff were observed over 27 days of observations (approximately 68 hours). Overall, 594 participants were observed. Of these 338 were patients, 213 hospital staff and 43 caregivers. Semi structured interviews were conducted with 23 patients, 23 hospital staff and 2 caregivers. Thematic analysis informed by grounded theory was performed on all the data. From the data analysis it emerged that both recorded and live music had four different types of impact on the patients: (1) Physical engagement: Patients engaged with the music at a physical level by tapping their foot or clapping their hands in time with the music, singing along or just moving their lips; (2) Cognitive engagement: The artists were noticed to use a set of techniques, musical and verbal, aimed at eliciting a direct response from the patients. These were to: i) establish an introductory conversation to find out more about the patient; ii) leave a gap in the song to be filled by the patient; iii) give the patients a time-related clue when introducing a song. (3) Social engagement in relation to: i) the interaction with their caregivers; ii) the provision of a more relaxed occasion to interact with the hospital staff; iii) the relationship between the different patients in the bay. (4) Emotional engagement, as the music was often associated with memories and emotions. Music was not only a distraction for these patients but also an occasion to practice mild movements and engage in musical activities that stimulated social and cognitive engagement.

The effects of live music on key stakeholders within dementia care home environments

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Music has both anecdotal and evidence-based promise as an adjunctive intervention in dementia care environments. The charity Lost Chord provides live music sessions in dementia care homes across the UK. The primary aim of this project was to understand how their dementia music sessions are planned and conducted. The secondary aim was to document expectations, perceptions, and hopes relating to music use in dementia care homes from the viewpoints of two key stakeholders; musicians and carers. Our team observed and recorded the development and delivery of nine music-based sessions carried out on-site in dementia care homes in the South Yorkshire area. In each case two observers took individual notes on their observations and video footage was also taken where permission was obtained. Finally, semi-structured interviews were conducted with musician volunteers and care home staff. This study is ongoing and will be completed in July 2015. The main outcome will be a knowledge repository for future investigations into the effects of music provision on the lives of people with dementia and their support network. Qualitative thematic analysis of the observations and interviews will be presented, which focuses on the key stakeholders' perceived effects, hopes and expectations surrounding music use in dementia care. Finally conclusions are pending: this vital early work provides a basis for understanding the relational impacts of providing music sessions as part of dementia care. The results will allow us to generate evidence-based guidelines for the training, development and delivery of music sessions in dementia care homes.

Adaptive music recognition games for dementia therapy

John Ashley Burgoyne*, Abe Hofman#, Han van der Maas#, Henkjan Honing*
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 # Department of Psychology, University of Amsterdam, the Netherlands

In partnership with the Manchester Science Festival, Burgoyne et al. (2014) created Hooked on Music, a citizen-science experiment on long-term musical memory. It takes the form of a timed music recognition game requiring no knowledge of music trivia, only an accurate auditory image. It is currently a static experiment, drawing uniformly for each participant from a sample of popular commercial recording fragments, but it relies on the same game-scoring rule that powers recent developments in item-response theory for exploiting reaction times in computer-adaptive testing (Maris & Van der Maas, 2012). We are investigating how to make Hooked on Music adaptive, predicting the most memorable fragments per participant, using these developments. If so, the game could be extended toward a therapeutic tool for dementia. Dementia patients benefit from personalised music therapy using familiar music (Gerdner, 2005; Sacks, 2007), but when these patients struggle to communicate verbally, it is difficult to identify what music best triggers memories. Because Hooked on Music is a strictly musical game, an adaptive version might overcome this verbal communication barrier. Our new adaptive version of the game will be released in tandem with the Manchester Science Festival this year. This talk will discuss our approach to making the game adaptive, including memorability/ability ratings for multiple musical dimensions, and outline our expected results based on an analysis of data from Hooked on Music 2014 (more than 2 million data points from more than 120 thousand participants).

Novel compositional devices in Presto by twelve-year-old Sergei Prokofiev

Jaan Ross
Department of Musicology, Estonian Academy of Music and Theatre, Estonia

It is well known that compositional abilities by Sergei Prokofiev (1891-1953) appeared rather early, and perhaps it is not an exaggeration to call him a musical Wunderkind. After 1903 when Reinhold Glière was invited to teach him music, Prokofiev started to compose the so-called ditties (pesenka), i.e. short piano pieces. Presto is the fourth ditty of the third series of such works. It was composed in St. Petersburg on 20 March 1904. Presto has no opus number and therefore it is not included in the main list of the composer's works. Its score was published in 1987 by Ricordi. In addition, the performance by Frederic Chiu (HMX 2907301.10) has been used as the auditory source for analysis. This paper is aimed at analysing Presto in an attempt to detect novel expressive devices in a composition by the teenage composer. More or less traditional methods of analysing form, harmony, tonality, rhythm and meter, and compositional devices have been used against the background of aesthetical norms of fin de siècle. The piece has a form ABA preceded by a short introduction. The section A has a ternary structure in its turn. Presto exhibits the stylistic traits which later became overtly characteristic to Prokofiev's music. They are first of all related to the use of scale and tonality. Prokofiev's modulations are also rather unorthodox in their nature.

The composer-performer and the problem of notation in indeterminate music

Samuel Peruzzolo-Vieira, Sara Carvalho
Department of Communication and Art, University of Aveiro (INET-MD), Portugal

This study is centred on composer-performers' indeterminate notation, more specifically in works where the composer is one of the performers involved. Three composer-performers were interviewed on their processes of composing indeterminate chamber music. The topics of the interviews included: musical elements left to performer's choice; practice of collective improvisation; composer's personal expectations; issues on the development of the notation; and collaboration between composer and performer. The material was analysed and organized into four categories: (1) composer-performer writing indeterminate music; (2) considerations of notation; (3) considerations on improvisation; (4) aspects of performance/interplay, liability on other performer's musical taste, and capability of understanding the composer's intention through notation.

Composer and performer in collaboration: Interactive processes involving non-guitarist composers and guitarists

Marlou Peruzzolo Vieira
Department of Communication and Art, University of Aveiro (CAPES, FCT, INET-MD), Portugal

This study discusses composer-performer collaboration in cases involving composers who do not play the instrument they are composing for. The aim is to characterize the interactive process involving non-guitarist composers and guitarists. Eleven semi-structured interviews were conducted, between December 2013 and August 2014, with professional musicians: three non-guitarist composers and eight guitarists. Categorical analysis was undertaken and obtained data was organized according to recurring terms and subjects. This analysis pointed out that composers are interested in bringing new ideas to the guitar while performers are concerned in making the composers' ideas idiomatic, whether playable or not. Moreover, the results suggest an overall concern with modes and levels of understanding and communication involved in the collaboration process.

Tuesday 18 August 2015 **FORMAN LECTURE THEATRE**
16.30-18.00 **SESSION 3C: SOCIAL** **Chair: Catherine Preston**

Music and patriotism: The effect of 'national' and 'protest' music on right and left-wing individuals

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Patriotism is defined as attachment to and pride in one's country. Music plays a significant part in creating and maintaining a sense of national identity. Two types of music can be distinguished: 'national' music, which reinforces a sense of patriotism, and 'protest' music, which criticizes the state's ideology or practices. The aim of the study was to examine the effects of national and protest music on patriotism in left- and right-wing participants. 96 participants (43 males, 53 females, mean age = 29.57) filled out a demographic questionnaire, containing questions regarding political orientation. They then listened either to 3 national songs, 3 protest songs, or no music, completed a patriotism questionnaire, and a questionnaire regarding reactions to the music. Participants were divided into right- and left-wing political orientation. A main effect for political orientation was found: right-wing participants were more patriotic than left-wing participants. An interaction between music and political orientation was found. Whereas music had no significant effect on patriotism in left-wing participants, protest music increased patriotism in right-wing participants. Several main effects of political orientation and interactions with music types were found for song evaluations. Results suggest that music may have an immediate effect on cognitions related to attitudes towards political issues. Given the widespread use of music in propaganda, this study sheds light on the ways in which music can influence the salience of political attitudes. This study is the first to empirically show the effect of different types of music on patriotism.

Music does not only regulate, but directly and reliably communicates social behaviours

Jean-Julien Aucouturier*, Clément Canonne#
**STMS (UMR 9912), IRCAM-UPMC, France*
#Centre Georges Chevrier (UMR 7366), Université de Bourgogne, France

Music's potential for social communication is often argued as a possible cue to its evolutionary origins. However, empirical evidence for this capacity to induce or regulate social behaviours with music only consists of indirect effects – for instance, that background music can reduce conflict or that collective music making increases trust and cooperation. Because these effects can be mediated by other musical effects, such as emotion induction, relaxation or semantic connotations, it remains unknown whether music can directly communicate (i.e. encode, and be decoded as) social cues. In this study, we show that spontaneous dyadic musical interactions can not only mediate, but directly communicate complex positive and negative social attitudes such as conciliation, disdain or insolence, and that such communication relies for a significant part on extra-linguistic cues linked to temporal and harmonic coordination. These results establish that more diverse and complex social behaviour is possible with music than previously believed, which opens avenues for vastly more diversified views on music processing that the intra-personal, performer-to-listener view of musical expression that has dominated the recent literature.

Music wars between Caucasian nations

Brigitta Davidjants
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In the current presentation, I will explore how music is employed in service on nationalist ideas among the Caucasian nations - Armenians and Azerbaijanis – and how national identity construction uses the means of music for organising collective memory. I will focus on two folk tunes common to both nations – Sari Aghjik/Gelin and Shalakho – to show on everyday level the viability of national myths, and how these myths are remarkably similar between Armenian and Azeri case. Construction of national identity can be viewed in terms of constant re-negotiation of boundaries, which are re-invented according to the requirements of the situation. This is also relevant when speaking about Armenians and Azerbaijanis, who include/exclude (un)wanted elements from folk music. My focus is the reception of folk music in social media. Both countries are characterised by half-totalitarian regimes where official media is under control of oligarchy/government. As it makes social media one of the very few places for free discourse, there can also be found elements of peace building between countries. Yet, on the microlevel, social media reflects national myths common among these two nations. I will combine two types of methods: music analysis and discourse analysis. At first, I will describe certain national narratives in Armenian and Azeri musicology. Then, I will give theoretical background to the songs, explaining differences between the versions of different nations. Finally, I will present the web and social media research for analysing the reception of the songs, which I will link with national narratives.

Tuesday 18 August 2015 **CAROLE NASH RECITAL ROOM**
16.30-17.30 **SESSION 3D: MUSICAL DEVELOPMENT 2**

Chair: Anna Wolf

Children’s perception of emotion in music (A cross-cultural study)

Azadeh Okhovat, Geoff Luck, Reza Johari Fard
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Birth and growth in diverse cultures develop people with different preferences and feelings. Here, the focus is on cross-cultural effects of music exposure and subsequent perception. Work by Kastner (1990) and Nawrot (2003) revealed that most Western lullabies and children’s songs are in major mode, and that even very young children – as young as four – demonstrate a positive-major/negative-minor connotation that conforms to the conventional stereotype. The aim here is to analyse the same topic in Finland and Iran where most lullabies are in minor mode. The overarching question addressed is whether or not cultural background, and, more specifically, the mode of the music, a child tends to be exposed to early in life affects later emotional responses to music characterized by different modes. Quantitative data was obtained from 5-8-year-old children and their mothers in mentioned countries. Respondents completed a background questionnaire and then answered four questions about twelve Finnish and Iranian music excerpts representing two modes and three genres. Results show that Iranian children feel more positive (happy or relaxed) in response to minor music than Finnish children, while Iranian and Finnish mothers both feel contentment in response to minor mode. In addition, unlike the Finns, Iranian children prefer to listen to minor mode. These results demonstrate important effects of early music exposure on later emotional responses to music.

Enhancement of numeric cognition in children diagnosed with Developmental Dyscalculia by an Auditory Musical Training

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Studies have suggested that musical training (MT) enhances spatial-temporal reasoning leading to greater learning of mathematical concepts, but knowledge about the effects of MT in children with Developmental Dyscalculia (DD) is scarce. The aim of this study was to determine the efficacy of three months' Auditory Musical Training (AMT), as a strategy to enhance Numeric Cognition (NCog) in children with DD, and compare their performance on two different occasions (Pre-test – before AMT and Post-test – after the end of AMT). Moreover, we examine if the DD group would be grouped in the same cluster after three months of AMT on Zareki-R (Neuropsychological Test Battery for Number Processing and Calculation in Children [NUCALC]). Participants were children from primary school, aged 8 years old, divided into two groups: DD (n = 24), confirmed by the cut-off point in arithmetical task <9, and TD, Typical Development (n = 24). The comparison between groups revealed differences for almost all components of NCog, where DD group had worst scores, except for Number Sense. Analysis within groups revealed increases on Post-test compared to Pre-test only for DD group for Number Reproduction, Comprehension, Line and Mental calculation. Additionally, hierarchical cluster analysis was conducted with all 48 participants. Regardless of their diagnosis, findings support the presence of two subgroups marked by different results on Zareki-R, although in the post-test the number of children in DD group decreased. This result demonstrates the effect of AMT in NCog, which cannot be attributed to developmental factors, as only the DD group had higher scores compared to themselves. The AMT seems to be a useful tool for rehabilitation of DD.

Wednesday 19 August 2015 — RNCM THEATRE
09.00-11.00 — SESSION 4A: SYMPOSIUM - COGNITIVE MOTOR CONTROL OF PERFORMANCE

The effect of fear on human motor performance

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Currently it is poorly understood to what extent fast motor performance can be altered by fear and anxiety. To test fast motor performance, vestibular-evoked whole body balancing responses were induced using galvanic vestibular stimulation (GVS) while standing on a narrow walkway at height to induce fear. This motor performance is closely related to musical performance on stage. We aimed to understand how fear influences basic balancing motor control. For 16 young healthy adults GVS-evoked involuntary balance responses were studied while standing on a narrow walkway at ground level and at a height of 3.85 m to evoke fear of falling. Full-body 3d kinematics and skin conductance was recorded. In each condition 30 GVS impulses of 2 seconds (15 anode-left, 15 anode-right, randomly ordered) were applied. Acceleration peaks in joint angles and mediolateral displacement of body segments within 250 ms after GVS onset were found. The GVS response was fastest and largest in the neck joint and relatively small in appendicular joints. These reflex acceleration peaks were increased at height compared to ground condition for appendicular joints, whereas no height effect was found in neck and lower back joints. These results illustrate how appendicular fast motor performance can be modified through fear and anxiety, whereas early axial fast motor performance seems to be governed by different more task invariant mechanisms. As fear increased the gain of appendicular responses these effects may become detrimental in a vicious cycle of anxiety where a positive feedback loop induces stiffening and ultimately inability to move.

Does the neck have hierarchical influence in motor performance: Can proactive-selective inhibition targeted at the neck break the vicious cycle?

Ian D. Loram*, Brian Bate*, Peter Harding*, Ryan Cunningham*, Alison Loram#
**Cognitive Motor Function Research Group, School of Healthcare Science, Manchester Metropolitan University, Manchester, UK*
#Birmingham Conservatoire of Music, UK

While the function of individual muscles is known, during musical performance individual muscles combine in complex ways that are only partially understood. We seek to understand the relationship between regulation of neck muscles and control of head, trunk and limbs? Our approach is to use ultrasound feedback of the neck muscles to minimize neck muscle change during task performance and observe the indirect effect on whole-body coordination. From a common neutral configuration, twenty-one violinists/violists repeated six progressively demanding tasks including picking up, holding and playing their instrument. Neck feedback resulted directly in general reductions in anticipatory, transient and sustained neck muscle change while allowing successful, task performance. Neck feedback had an indirect global effect reducing anticipatory, adjustments, complex involuntary trunk referenced movement patterns and skin-conductance/EMG cost. This effect is distinct from the effect of gaze alignment which increased physiological cost and reduced laboratory referenced movement. These results demonstrate a causal relationship between regulation of neck muscles and global control of the head, trunk and limbs. The importance for body function in health and disease is evidence for a feedback loop in which neck muscle behaviour can reflect and regulate global motor function.

The use of ultrasound and advanced machine learning to reveal deep muscle states

Ryan Cunningham, Peter Harding, Ian Loram
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Ultrasonography has been used to non-invasively measure human-intelligible parameters from layers of skeletal muscle. Previous research has been able to establish connections between these parameters and non-ultrasound measured parameters (joint angles etc.). However, these relationships have only been established in isolated conditions; i.e. isometric. Intuitively, linear changes in parameters such as fascicle pennation angle correlate with force exertion (isometric case), and joint angle (passive case). A non-linearity presents in the combined case of modulating joint angle and modulating force. On the question of information content of ultrasound, this abstract presents preliminary work on the use of a powerful feature extraction method, namely Restricted Boltzmann Machine (RBM), for modelling the time-invariant states of human calf muscle in combined and isolated cases, without making prior assumptions about the information content. Linear regression models were then used to establish relationships between the model and the externally measured ankle joint angle, force, and surface electromyography (sEMG). Results indicate that RBMs can learn powerful feature representations of muscle states by demonstrating the presence of automatically extracted features that represent independent joint angle, sEMG, and force. Results also indicate that it is possible to extract combined activities directly from the ultrasound by optimising weighted linear combinations of the RBM feature representation.

Chronic profession-limiting problems in musicians: Underlying mechanisms and neuroplastic routes to recovery

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**Birmingham Conservatoire of Music, UK*
 # Manchester Metropolitan University, Manchester, UK

Musicians are subject to a wide range of medical problems related to the physical and psychological demands of their profession. The aim of this study is (i) to establish whether in playing, violinists and violists exhibit a common diagnosable musculokinematic pattern unnecessary for performance, and (ii) to compare practical and ultrasound methodologies for revealing and reducing that pattern in individuals. Twenty-one violinists/violists repeated seven progressively demanding playing tasks in six series involving two external feedback interventions (ultrasound feedback of the neck muscles and expert verbal feedback of movement) based on principles of minimising task-irrelevant a priori selections, and three necessary controls. Analysis of full-body, kinematic and electromyographical data showed progressive reductions in the extent to which a common musculokinematic pattern was exhibited using ultrasound and verbal interventions. Differences were characterised by reductions in most muscle activities and key movements, including elevation and internal rotation of the shoulder, axial rotation of the torso, and anterior and caudal movement of the head. Expert verbal feedback produced more extensive change to the same pattern as ultrasound feedback. Violinists and violists exhibit a common, diagnosable whole-body musculokinematic pattern that is unnecessary for performance and associated with chronic profession-limiting injury. External feedback, targeted at minimising individual a priori musculokinematic selections unnecessary for performance is efficacious in achieving individual change. This methodology has potential for reducing problems resulting from accumulative feedback of mal-adaptive selections within a perception-selection-action feedback cycle, including limitations in performance, and sensory input predisposing occupational dystonia and profession-limiting injury.

Wednesday 19 August 2015 CONCERT HALL
09.00-11.00 SESSION 4B: COMPOSITION 2 Chair: Marcus Pearce

"Unexpected, innovative, emotional, fascinating, organised": Exploring implicit theories of creativity in music

Kai Lothwesen
Institute for Musicology and Music Education, University of Bremen, Germany
University of Music and Performing Arts, Frankfurt, Germany

Explicit theories claim novelty and originality being the most important criteria in conceptualising creativity, yet rather little is known about implicit concepts resulting from individual belief systems. In defining musical creativity, implicit theories have not yet been taken into account. The qualitative approach taken here is a first attempt to make implicit theories of creativity in music visible and comparable to those of other domains. This study aims at 1) collecting free associations of different domains, 2) checking for domain specific differences, 3) making inherent structures visible. Subjects were asked to list attributes of creativity for science, arts, everyday life, and music; data were collected via online-questionnaire. The attributions collected were analysed by means of content analysis to form categories which were then quantified and checked for domain specific differences. In total 106 people took part (61.3% female; mean age = 29.2 years [SD 11.05, range 12-58], 55.7% musicians). 686 different attributes were coded, inductively sorted and pooled into 27 meta-categories drawing on features commonly agreed on in creativity research. A correspondence analysis revealed two dimensions accounting for 78.6% of inerta with a good fit (singularities: dimension 1: .522, dimension 2: .452). The analysis is ongoing; the preliminary results show domain specific associations distinguishing artistic fields from science and everyday life, and specifying the artistic field (arts vs. music). Further research should account for implicit theories to widen domain specific understandings, and check for implications in theoretical conceptualisation and pedagogical approaches in defining and fostering creative behaviour in music.

Enriching the blend: Creative extensions to conceptual blending in music

Danae Stefanou, Emilios Cambouropoulos
School of Music Studies, Aristotle University of Thessaloniki, Greece

In this paper we critically investigate the application of Fauconnier and Turner's Conceptual Blending Theory (CBT) in music, to expose a series of questions and aporias highlighted by current and recent theoretical work in the field. Investigating divisions between different levels of musical conceptualization and blending, we question the common distinction between intra- and extra-musical blending as well as the usually retrospective and explicative application of CBT. In response to these limitations, we argue that more emphasis could be given to bottom-up, contextual, creative and collaborative perspectives of conceptual blending in music. This discussion is illustrated by recent and in-progress practical research developed as part of the COINVENT project, and investigating structural and cross-domain blending in computational and social creativity contexts.

Heuristic models for decision making in rule-based compositions

James Saunders
Department of Music, Bath Spa University, UK

Scores that require participants to negotiate inter-personal relationships during performance encourage the development of individual and collective strategies for decision-making as part of the performance practice. Such strategies might be codified through rules specified in the score or developed more informally through the preferences of the performers. In both cases, models drawn from decision-making theory can be usefully applied to help explain the ways in which composers initiate these processes and how performers respond to them. In particular, heuristics suggest possible explanations for the ways in which such pieces operate in practice. A heuristic is a useful decision-making strategy that "ignores part of the information, with the goal of making decisions more quickly, frugally, and/or accurately than more complex methods" (Gigerenzer & Gaissmaier, 2011, p. 454). By reducing the amount of information to be considered, there is a corresponding reduction in the cognitive effort required to make a decision. This paper considers the creative potential for heuristics as a compositional strategy. It explores implicit uses of heuristics in work by Christian Wolff and Joseph Kudirka, as well as my own recent music. It examines how performer decisions in such pieces create different modes of interaction between individuals and rules. The practice presented in the paper provides possible models for embodying heuristics, and decision-making theories more generally, as a compositional strategy. I contend that defined heuristics are present in existing compositions where performers are required to make judgments based on available information, and that composers have deployed such heuristics intuitively. By making links between current heuristics theory and compositional practice, as well as showing how such theory might actively inform the creation of new work, the paper suggests future possibilities for creative practice.

Structural blending of harmonic spaces: A computational approach

Emilios Cambouropoulos, Maximos Kaliakatsos-Papakostas, Costas Tsougras
School of Music Studies, Aristotle University of Thessaloniki, Greece

This research focuses on concept invention processes and suggests that structural blending is a powerful mechanism that gives rise to novel musical concepts. Structural blending is omnipresent across several formal musical levels, from individual pieces harmoniously combining music characteristics of different pieces/styles, to entire musical styles having emerged as a result of blending between diverse music idioms. In this paper, we focus on conceptual blending in the domain of musical harmony and present primarily computational examples in the following harmonic domains: chord-level blending, chord sequence blending, scale blending, harmonic structure level blending, melody-harmony level blending. Structural blending can be used not only for music analysis and music understanding, but more so it may form the basis for creative / generative music systems; processes of conceptual blending can be incorporated in computational compositional systems, facilitating the creation of original music structures/pieces/styles and contributing to a richer comprehension / experience of music.

Wednesday 19 August 2015 09.00-11.00
FORMAN LECTURE THEATRE
SESSION 4C: EFFECTS 1
Chair: Stephanie Bramley

Listening to empowering music: Music-induced manipulations of self-esteem

Paul Elvers, Timo Fischinger, Jochen Steffens
Music Department, Max Planck Institute for Empirical Aesthetics, Germany

Music may not only elicit basic emotions but may mediate complex psychological states such as mixed emotions, prosociality and even feelings of power. Many people take advantage of music’s powerful effects by using music for mood-regulation, self-development or to cope with personal problems. In order to further investigate music’s uplifting and empowering function, we experimentally examined if music is able to enhance and/or reduce listeners’ self-esteem. It was hypothesized that listening to and aesthetically experiencing music may manipulate listeners’ self-evaluations as a function of music’s expressive properties. The experiment (N = 119) consisted of three experimental conditions, which were expected to manipulate self-esteem in different ways. Nine musical pieces were taken from a pre-study in which different songs were evaluated with regard to their empowering potential. The design combined a within-subject with a between-groups design, measuring both state and implicit self-esteem before and after the music listening. An analysis of variance of state self-esteem manipulation indicated that music listening significantly changed explicit state self-esteem. The results contribute to a broader picture of music-induced positive feelings by showing that music influences self-evaluative judgements and that these effects rely on the expressive properties of the musical pieces. Music perceived as ‘motivating’ and ‘powerful’ enhanced self-esteem, while music perceived as ‘discouraging’ and ‘weak’ did not.

Affect from art – Subjective Constituents of Everyday Pleasure of Music and Pictures: Overview and early results

Johanna Maksimainen, Suvi Saarikallio
Department of Music, University of Jyvaskyla, Finland

Research on the affective reactions to music and pictures has increased, but current knowledge on the subjective mechanisms underlying the emotion-related rewards of everyday art engagement is still fragmented across disciplines. The overt focus of the experimental paradigm on the stimulus properties is also becoming outdated in face of the increasingly personalized usage of the digital audiovisual environments. This paper presents a recently launched research project Affect from Art – Subjective Constituents of Everyday Pleasure of Music and Pictures, which aims for a better mapping of the relevant individual and contextual features that explain the everyday life affective experiences drawn from music and pictures, in order to provide grounds for multidisciplinary and elaborate investigation of the relevant features. The paper presents the results of the project's first pilot study. The study was executed as a semi-structured online questionnaire (N = 109) in order to provide a detailed description of the subjective experience and the engagement features to the music and pictures that the respondents consider significant in their daily life. The preliminary results of the study are presented in this paper, specifically focusing to the questions concerning the subjects' personal affective relation to the object of their choice. The results will be used in further development of the project's research questions and methods.

The effect on music listening on perception of urban and natural scenes

Marek Franěk*, Denis Šefara*, Roman Mlejnek[#]
**Faculty of Informatics and Management, University of Hradec Králové, Czech Republic*
[#]The Prague Conservatoire, Czech Republic

A large body of research was devoted to the way in which music shapes perception of visual stimuli, namely in film and video, In addition, the current research demonstrated that the evaluation of outdoor scenes can be affected by characteristics of the listened music. The present study using the eye tracking method was intended to investigate differences in perception of urban and natural scenes while listening to different types of music. The effects of (1) motivational music, which had a fast tempo and a strong rhythm, (2) non-motivational music, which was slower, but with no strong implication to movement, and (3) no-music condition on perception of various urban and natural scenes were investigated. We were interested, whether particular types of music can influence an extent of perceived visual information and a viewer preference. Thirty-nine participants aged 19-22 years took part in the experiment. They viewed successively 27 photographs. Simultaneously, they listened to either motivational or non-motivational music, or viewed the photographs without music. Participants' gaze was recorded using the Tobii X2-60 eye tracker. The results showed that participants, who listened to the motivational music, took attention to smaller extent to photographs compared to the participants, who listened the non-motivational music or those, who did not listen any music. The data suggest that listening to the fast motivational music while viewing the photographs required larger cognitive load, which resulted in perception of smaller extent of the scene compared to the slower non-motivational music.

The effect of the presence of music on soundscape evaluations

Jochen Steffens*#, Daniel Steele#, Catherine Guastavino#
Max Planck Institute for Empirical Aesthetics, Frankfurt, Germany
#McGill University, School of Information Studies & CIRMMT, Montreal, Canada

Music is an important part of our everyday acoustic environment; but what role does music play in influencing soundscape evaluations and modulating situational variables like mood and attention? An increasingly common method to explore the interplay of music, the listener, and the situation is the Experience Sampling Method (ESM). During our 7-day ESM study, participants were prompted by a smartphone app at 10 near-random times per day within a pre-chosen 12-hour timeframe. They were asked to rate the soundscape and the visual environment. Additionally, they had to report on the predominant sound source(s) occurring in the soundscape and situational variables. Upon completion of the study, participants also filled out standard personality questionnaires. Results with 31 participants show that during musical episodes participants significantly rate the pleasantness and eventfulness of their soundscape higher, pay more attention to their acoustic environment, report better mood states, and even rate their visual environment as more pleasant compared to non-musical episodes. All effects can also be observed when only considering the home environment of the participants where most of the music is consumed. Within a correlational analysis, two person X situation interaction terms were found to be significantly correlated with the prevalence of musical episodes. It can be concluded that music significantly affects the evaluation of our acoustic and even visual environment. The study further provides insight on how people actively design and modify their soundscape by means of music, and how their reasons for doing so are dependent on their personality and the situation.

Wednesday 19 August 2015 — CAROLE NASH RECITAL ROOM
09.00-11.00 — SESSION 4D: MUSIC TRAINING — Chair: Matthias Heyne

The effects of music training on perceptions of equal-tempered and microtonal intervals: A behavioural and EEG survey

Freya Bailes*, Roger T. Dean#, Mary Broughton^
School of Drama, Music and Screen, University of Hull, UK
#The MARCS Institute, University of Western Sydney, Australia
^School of Music, The University of Queensland, Australia

Previous research suggests that music interval perception depends on both psychoacoustic properties and familiarity with the system(s) in which the intervals are used. Our aim was to contrast behavioural and event-related potential (ERP) measures of listeners' responses to unfamiliar microtonal intervals, to determine how these are perceived in comparison to more familiar Western twelve-tone equal-tempered (12-TET) tunings to compare subjective impressions of sounds with the neurophysiological processing of the acoustic signal. Music expertise has been shown to moderate behavioural and ERP responses to 12-TET harmonic intervals, and we hypothesized that musical training would differentially affect perceptions of microtonal intervals. The 20 participants comprised 10 musicians and 10 non-musicians. They listened to two-note chords comprising 12-TET (consonant and dissonant) or microtonal (quarter tone) intervals. ERP and subjective roughness ratings were recorded concurrently; liking ratings were recorded separately. Music experience mediated the perception of differences between dissonant and microtone intervals. While non-musicians gave similar ratings for both dissonant and microtonal intervals, musicians preferred dissonant over the less commonly used microtonal intervals, rating them as less rough. Overall, ERP amplitude was greater for consonant intervals than other intervals, but musicians exhibited greater negativity than non-musicians in the early response, and vice versa for later components. The interaction of musical experience with interval type suggests that musical expertise facilitates the sensory and perceptual discrimination of microtonal intervals from 12-TET intervals, and increases the ability to categorize such intervals, while non-musicians appear to have categorically perceived microtonal intervals as instances of their neighbouring 12-TET counterpart.

A survey exploration of the links between levels of musical training and music listening behaviour

Alinka E. Greasley, Catherine E. Gardiner
School of Music, University of Leeds, UK

There is a growing body of literature on music listening behaviour but few studies have investigated how this differs according to levels of musical training. The current study explored similarities and differences in the music listening behaviour of people with varying levels of musical training (MT). An online questionnaire explored general levels of engagement with music; levels of MT; uses of music; cognitive listening styles; and musical preferences. 657 participants completed the survey (mean age = 29.57; SD = 12.43). High levels of engagement were found across the sample (mean = 19.26 out of total 24) but levels of MT represented a bimodal distribution (mean = 6.21 out of total 17). Results showed significant positive links between level of engagement and most other variables, but different patterns were obtained for MT. There were significant positive links between MT and the use of music listening for work, regulating emotions, and other people's pleasure, but negative links between MT and using music for relaxation or exercise. Those with a higher level of MT were more likely to listen to the structural features of music and rated instrumentation, keys/mode/chords, harmonic decorations, being a live (rather than recorded) performance, and the quality of a recording/performance more highly than those with lower levels of musical training. Overall, data support previous research on everyday music listening, but go beyond previous studies by making detailed comparisons according to varying levels of engagement and musical training. The findings highlight the need to recruit a representative sample in terms of ages and levels of musical training.

Music training and verbal memory: Investigating the mechanism underlying this association in 10- to 12-year-old children

Franziska Degé, Johanna Stoll, Gudrun Schwarzer
Department of Developmental Psychology, Justus-Liebig-University, Germany

A positive association between music training and verbal memory has been demonstrated for adults as well as for children. For adult musicians it was shown that the advantage in verbal memory was due to enhanced verbal rehearsal. We investigated whether an enhanced verbal rehearsal mechanism was responsible for higher verbal memory scores in musically trained children. We tested 45 (31 girls) 10- to 12-year-old children (M = 131.24 months, SD = 6.88 months). Amount of music lessons was assessed to assign children to musician group (n = 24) and non-musician group (n = 21). We measured verbal memory with two wordlists. Children memorized one list under normal conditions and the other list with articulatory suppression. Order of conditions (normal vs. suppression) and list used in the suppression condition was counterbalanced. We controlled for personality, intelligence, motivation, musical aptitude, and socioeconomic status. Children in the musician group did not differ significantly in personality, intelligence, motivation, and musical aptitude from children in the non-musician group. However, musically trained children had a significantly higher SES than untrained children. SES was controlled in further analyses. An analysis of variance with SES as covariate revealed a significant difference between children with and without music training in verbal memory, $F(1, 41) = 4.28$, $p = .045$. In the normal condition musically trained children remembered more words. This significant difference disappeared in the articulatory suppression condition, $F(1, 41) = 1.63$, $p = .209$. An enhanced verbal rehearsal mechanism might be responsible for better verbal memory in musically trained children.

The association between musical skills and the discrimination of phonemes from a foreign language

Swathi Swaminathan, E. Glenn Schellenberg
Department of Psychology, University of Toronto, Canada

In two experiments, we investigated whether musical skills are associated with phonetic perception in a foreign language. Experiment 1 tested musically trained and untrained 6- to 9-year-old children. Experiment 2 studied undergraduate native English speakers with and without music training. In both experiments, participants were tested on their music-perception skills and their ability to perceive Zulu speech contrasts. After controlling for demographic factors, working memory and IQ, rhythm perception skill, but not melody perception, was found to predict Zulu phonetic discrimination. This result suggests an overlap in auditory temporal processing for speech and music. Musically trained children and adults outperformed on the test of melody perception. They did not, however, show a rhythm perception or Zulu phonetic discrimination advantage. This result suggests that music training may not lead to phonetic perception advantages if it does not promote the development of rhythm-perception skill.

Wednesday 19 August 2015 09.00-11.00

CONFERENCE ROOM
SESSION 4E: PREFERENCES AND CROSS-MODALITY
Chair: Hauke Egermann

Why are violin concertos more popular than bassoon concertos? Predicting the popularity of solo instruments in concertos as a function of pitch height and performer pool size

Song Hui Chon, David Huron
School of Music, Ohio State University, USA

In Western classical music, some instruments are more popular for solo roles than others. What accounts for the differences in popularity? An instrument might be preferred for a solo function if there are many virtuoso musicians. And in light of the high-voice superiority effect (Marie & Trainor, 2012), higher-pitched instruments might also expect to be favored. We hypothesize that an instrument will be attractive for a solo use when it can play a high pitch and when there are many skillful performers available. Of the many possible ways in which an instrument can be featured in a solo capacity, perhaps the most unambiguous can be found in the case of solo instruments in concertos. Therefore, we endeavor to predict the distribution of instruments used in classical concertos using the two factors identified above. A list of 6,559 concertos featuring 138 unique solo instruments was obtained from allmusic.com for analysis. The instruments specified as solo instruments in titles were all tallied. A multiple regression was carried out on these instruments' popularity in concertos with regard to highest pitch and performer pool size. The effect of the highest pitch was significant, $\beta = .531$, $p = .017$, but not the performer pool size, $\beta = .306$, $p = .144$. The popularity of high-pitch instruments for solo use suggests the importance of the high-voice superiority effect that the auditory stream of higher pitch tends to carry more cognitive importance.

Useful music is favoured music: The effect of musical functions on musical preferences

Thomas Schäfer
Department of Psychology, Chemnitz University of Technology, Germany

Musical preferences are still hard to explain and predict. During the last two decades, some scholars have suggested that musical preferences should be interpreted in the light of the functions that are served through music. It is known that the degree of functionality and the strength of musical preferences are correlated. However, since correlation does not yet equal causation the aim of the present study was to clarify experimentally if the degree of functionality really determines the strength of musical preferences. 'Social relatedness' was selected as one of the most important functions of music and manipulated in an experimental study. Participants should indicate their favourite musical style and one of their favourite pieces of music that they deemed suitable to create a strong social bonding among the devotees of that style. They were told that other devotees of the same style would subsequently be asked to rate – based on that piece – how much they would like to get to know and take to the person who had named that piece. False feedback was manipulated in two randomized groups. One group received very positive feedback from the other fans; the other group received rather negative feedback. At the end of the study, participants should indicate how much they like the piece they had named. As expected, participants in the high functionality group gave higher preference ratings for their selected piece than participants in the low functionality group. The experiment demonstrates that the degree of music's functionality in everyday life is a significant determinant of musical preferences.

General subjects display cross-modal responses to musical stimuli

Alexandra Rieger, Michael Casey
Bregman Labs, Dartmouth College, USA

Our study explores evidence of cross-modal cognitive perception in non synaesthetic individuals. Although 'cross wired' synaesthetic neural networks are thought to be vastly different from non synaesthetes, the results of our cognitive psycho-musicology study with 40 synaesthetes and 40 non-synaesthetes reveal a spectrum rather than a divide. FMRI experiments have revealed that the cross-modal associations to sounds in synaesthetes are less pronounced, yet still present in the general population. Our research probes theories regarding recruitment of brain pathways for processing sound and initiates the exploration of a quasi-synaesthetic spectrum extending to general listeners, similar to culturally founded synaesthesia.

Rainbow colour mapping between pitch classes and colours in coloured hearing: Synaesthetes and non-synaesthetes

Kosuke Itoh, Tsutomu Nakada
Brain Research Institute, University of Niigata, Japan

Coloured hearing is a type of synaesthesia in which sounds trigger colour sensations. Specific sensations experienced by coloured-hearing synaesthetes are believed to be idiosyncratic and lack universality, as the audiovisual correspondences between sounds and colours are apparently randomly determined for each individual. However, it remains to be clarified with evidence to what extent and in what ways the notion of idiosyncrasy is true in coloured hearing. In coloured hearing, there is a well-known tendency in the general population that high and low pitches are associated with bright and dark/dim colours, respectively. Pitches in music, however, are perceptually organized not simply linearly along the pitch height dimension, but rather in a helical structure reflecting octave equivalence of pitches belonging to the same pitch class (C, D, E, etc.). This work investigated the nature of synaesthetic colour perception/imagery associated with pitch classes. Thirty-two self-reported synaesthetes freely chose, on a computer, colours that corresponded to the seven pitch classes of the diatonic scale. Sixteen subjects without synaesthesia also undertook the same task. Despite the presence of appreciable individual differences, across-subject averaging of the obtained RGB values uncovered an orderly rainbow colour mapping between the pitch classes and hues, beginning with do(C)-red and ending with si(B)-violet. Moreover, a virtually identical colour mapping was revealed in the nonsynaesthetic subjects also. The findings suggest that there is a universal, subliminal cross-modal correspondence (or so-called 'weak synaesthesia') between pitch classes and hues, and that this association is strengthened above some threshold of awareness in synaesthesia.

Wednesday 19 August 2015 **RNCM THEATRE**
11.30-12.00 **HICKMAN EARLY CAREER RESEARCHER AWARD (SEMPRE)**
Chair: Alexandra Lamont

Tracking the tempo of involuntary musical imagery: A naturalistic study

Kelly Jakubowski*, Nicolas Farrugia*, Andrea Halpern[#], Lauren Stewart*
** Department of Psychology, Goldsmiths, University of London, UK*
[#] Department of Psychology, Bucknell University, USA

Involuntary musical imagery (INMI, or 'earworms'), the spontaneous and repetitive occurrence of music in one's head, is a common everyday experience. Previous studies of INMI have relied almost exclusively on self-report evidence regarding its features and phenomenology. The present study aimed to extend existing literature by objectively capturing a specific musical feature of the INMI experience – tempo – during the course of everyday life. This allowed for the investigation of two specific research questions regarding (1) the veridicality of INMI tempo and (2) the relationship between INMI tempo and concurrent affective state. Over the course of four days, participants tapped to the beat of their INMI while wearing a wrist-worn accelerometer that recorded their tapping movements and documented details about their INMI. Across all INMI episodes comprising songs that exist in canonical versions, the mean absolute deviation of the participant's tapped tempo from the original, recorded tempo was 10.8%. Songs heard aloud within the past day were not experienced at a more veridical tempo than songs heard over one week ago. A significant positive relationship between arousal level and the tempo of a concurrent INMI tune was also found. These results indicate that even in an experience as unpredictable as INMI, long-term representations for the tempo of familiar music are remarkably stable. The results also suggest a relationship between a specific musical feature of INMI (tempo) and concurrent level of arousal, providing some first evidence that INMI may play a role in daily mood regulation similar to actual music listening.

Kelly holds undergraduate and master's degrees in violin performance and music theory, as well as an MSc in Music, Mind & Brain from Goldsmiths, University of London. She is currently pursuing a PhD in Psychology at Goldsmiths, which is funded by the Leverhulme Trust and supervised by Prof. Lauren Stewart and Dr. Daniel Müllensiefen. Her PhD research combines behavioural, computational, and qualitative methods to study the temporal and melodic features of musical imagery, including the phenomenon of earworms. Other research interests include melodic memory, absolute pitch, and music and emotion.

Wednesday 19 August 2015 MEZZANINE
12.00-13.00 POSTERS 1

1. Expectations and tensions induced by primitive rhythms

Nikolay A. Almayev, Stanislav O. Skorik
Institute of Psychology, Russian Academy of Sciences, Russian Federation

Studies of tension while perceiving music are currently focused on the tonal structure of compositions. The complexity of a composition as a unique acoustic event limits the exploration of mechanisms of acoustic perception, particularly that of the temporal aspect. The new method that is based on the construction of abstract primitive rhythms is proposed in the paper. Signals of fixed intensity, form and spectrum with the duration of 50, 150 and 300 ms were succeeded by pauses of different length ranging from 100 to 2000 ms. Each sequence looped forming primitive rhythm. A total of 45 stimuli were evaluated by 33 subjects on the 11 Likert-type scales. Most of the subjective scales represented the dimension of expectation-tension and highly correlated with themselves and with the period (tempo). Correlations with the fill factor are mostly non-significant. Dependencies of the subjective scales on period are nonlinear. Irrespective of the duration of the signal (i.e. in all of the three series) there was one turning point at about 950-1050 ms at which a constant decrease of tension with the growth of pause stopped and a multi-directed trend with the more or less significant rise and fall began. Whether this turning point is constant independently of the intensity of the tones is the subject of further exploration.

2. Emotional effects of makams frequently used in classical Turkish music

Ayşe Arman, Hasan Gürkan Tekman
Psychology Department, Uludag University, Turkey

Music can arouse a variety of emotions in listeners. Different values of acoustic cues such as tempo, sound level, sound level variability, F0/pitch level, F0/pitch variability, F0/pitch contour, tone attack, scale, microstructural regularity and harmonic attributes can cause typical basic and complex emotions. Research on emotional effects of music has been conducted primarily on Western tonal music. Turkish music, unlike the tonal and harmonic structure of Western music, is based on modal structures called makams, Emotional effects of makams was the subject of this research. Participants listened to excerpts from two fast and two slow pieces from eleven frequently used makams in classical Turkish Music. For each piece they evaluated their emotional reactions on the Geneva Emotional Music Scale (GEMS-45).

3. Music in our minds: A pupillometric study of music processing

Christin Arndt*, Kathrin Schlemmer#, Elke van der Meer*°
** Department of Psychology, Humboldt-Universität zu Berlin, Germany*
 # Department of Musicology, Katholische Universität Eichstätt-Ingolstadt, Germany
°Berlin School of Mind and Brain

The present study investigated the processing of music with pupillometrics. 25 musicians and 25 non-musicians participated in this experiment and were asked to solve the Audiation task. Behavioural measures to examine speed and accuracy of processing as well as the pupil peak dilation as a measure of resource allocation were collected. In addition, phonological and visual-spatial working memory capacity and crystallized and fluid intelligence were assessed. Musicians solved the Audiation task faster and more accurately than non-musicians. Musicians also outperformed non-musicians in the phonological working memory capacity, as well as in crystallized intelligence. Further and most importantly, musicians exhibited greater task-related pupil peak dilations. Behavioural evidence indicates a general enhancement of both phonological working memory and crystallized intelligence in musicians. The pupillometric findings indicate that musicians compared to non-musicians allocate more cognitive resources while performing musical tasks. Results correspond to findings for experts vs. non-experts in the mathematical domain and emphasize the important contribution of resource allocation in expertise.

4. Neurophysiological markers of tonalities

Yulia Baksheeva*, Olga Bazanova^, Svetlana Kostromina$,
Ekaterina Nikolenko^, Kseniia Sapozhnikova#, Roald Taymanov#
**Department of On-board Radioelectronic Systems, St.Petersburg State University of Aerospace Instrumentation, Russia*
^Laboratory of Affective, Cognitive and Translational Neuroscience, Federal State Budgetary Scientific Institution "Scientific Research Institute of Physiology and Basic Medicine", Novosibirsk, Russia
$Department of Psychology, St.Petersburg State University, Russia
#Sensors and Measuring Systems Laboratory, D.I. Mendeleyev Institute for Metrology, St. Petersburg, Russia

This study has been carried out within the frames of developing the methods for measuring an expected emotional listeners' response to music. It relies upon (1) measurement of EEG response to a musical stimuli and (2) proposed measurement model linking a chord sound perception with an expected listeners' emotion. This measurement model is based on a nonlinear conversion and low-frequency selection. Calculations according to the model have shown that the major chords unlike the minor ones cause intermodulation oscillations within a frequency range of the brain biorhythms. The frequency band is specific for each tonality chord, which allows these oscillations to be considered as neurophysiological markers of tonalities. An ultimate aim of the research is the verification of the measurement model. The aim of the present study is confirming the existence of the neurophysiological markers of tonalities in experiments predicted by the model. Series of identical major and minor tonic triads were presented to participants. The EEGs were recorded in pre-test eyes closed and eyes open conditions in silence, then in eyes closed during the chord presentations. The EEGs were analysed using the discrete-time STFT. When the major and minor chords were presented, an amplitude suppression in individual alpha-frequency range was observed. The major chords caused generation of the EEG amplitude within the frequency bands predicted by the measurement model. This effect manifested itself mainly for the first chord carrying new information. The results of the work confirm the existence of the neurophysiological markers of the tonalities.

5. Children and adolescents' singing in everyday life and at school

Graça Boal-Palheiros*, Hiromichi Mito#
** Music Department, School of Education, Polytechnic of Porto, Portugal*
 # Psychology Department, Meiji Gakuin University, Tokyo, Japan

Research has shown numerous benefits of singing for the intellectual, social, personal and musical development of children and young people. Previous studies suggest that they actively engage in singing in everyday life and at school. However, some dislike school singing because they feel uncomfortable when being exposed and evaluated in singing tests. This study investigated children and adolescents' perceptions of their singing practice in and out of school in order to understand its significance in their lives. It explored the frequency of and their reasons for singing, the repertoire, and their attitudes towards singing in both contexts. Participants were 38 children (8 to 10 years old) and 40 adolescents (12 to 15 years old) from a public school in Portugal. Participants' responses to a questionnaire with open-ended questions were categorized. The results suggest that singing is regularly practised at school, mainly 'didactic' songs, and some Pop and Rock songs. Most participants sing regularly out of school, at home, alone or with family or friends. Not surprisingly, their favourite repertoire is different between the two age groups and from the school repertoire. All participants like to sing Pop and Rock songs and adolescents prefer to sing Hip Hop and Rap songs. Both age groups report liking singing and cite reasons which refer to singing impacting on their emotions, mood, and for enjoyment, and identity purposes. They also enjoy learning at school and singing while listening to music in everyday life. Some participants believe that they sing poorly at school and therefore view singing as a negative experience, which may have relevant implications for music education.

6. "You can count on me" – Effects of prosocial music on the affective and cognitive aggression level

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The primary purpose of this study is to investigate the effects of prosocial music on the aggression state. Based on the General Learning Model by Anderson and Buckley (2006) and the studies by Greitemeyer (2009a, 2009b, 2011) we expect the following: After the reception of a song with prosocial lyrics the recipients experience fewer aggressive thoughts/feelings than recipients who listened to a song with neutral lyrics. An online-based experimental 2x1 between-subjects design was used to compare the influence of prosocial respectively neutral song lyrics on aggression level (N = 381, mean age = 22.36 years old, 52% female). Therefore pairs of songs by the same artists were rated by music experts and students in a first study (Bruno Mars 'Lazy Song' and 'Count On Me'). The songs were comparable in terms of evoked arousal, lyrics comprehension, liking and prominence. The results suggest that listening to prosocial lyrics decreases aggressive thoughts – but there is no effect on aggressive feelings. It is possible that the happy melodies and harmonies in both songs dominate the effects on feelings.

7. The beginners' methods in piano education: Evaluation of motivation and learning in an Italian sample

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The piano teaching methods used in Italy are characterised by paths based on diverse theoretical assumptions and practical indications. The first piano book, whatever its value might be, establishes the initial contact with the instrument, leaving an important impression and drawing the profile of the skills primarily developed. A deeper understanding of these texts in use among beginners can show what their abilities are and the learning strategies proposed by the methods and adopted by teachers. The aim of the research is to identify which methodological choices are most representative in the Italian piano pedagogy over the past 50 years. The findings are based on the data collected from questionnaires administered to 200 pianists aged between 20 and 60. In addition to generic information, they were asked what their first piano book was, which aspects they remembered as the most positive or negative and which aspects they considered to be the most helpful. Data suggest a relevant preference of five beginning methods, which have been analysed according to a series of methodological and analytical criteria. The results indicate a wide methodological area, focused mainly on the initial relationship with the piano and on learning to read music. This study contributes to reflection on two methodological aspects: the development of new repertoires for beginners and the proposal of new methodologies that are able to respect the needs and the emotional world of piano beginners.

8. Exploring musical concepts for their relevance to primary school children's music preferences

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Building on Behne's (1975) construct of musical concepts (beliefs, attitudes, information etc. hold by an individual concerning a musical object) the study explores the development of such concepts and their relevance for primary school children's music preferences. This ties in with the assumption of growing stylistic sensitivity being relevant to age-related changes in 'open-earedness' (Hargreaves, 1982). To investigate the existence, changes and relevance of musical concepts children (n = 31) were interviewed in small groups on their music preferences in second (t1) and fourth grade (t2) using guided interview technique. Content analysis was conducted and musical concept categories were analysed regarding the occurrence and usage of musical concepts as well as possible changes from t1 to t2 and differences between girls' and boys' statements. The interviewed children form a sub-sample of a larger sample of primary school children (N = 735) questioned in a four year longitudinal study on their music preferences measured by a sound questionnaire (Busch et al., 2014). Results of the interview analyses are triangulated with those results. Interview analyses disclose that genre-specific and gender-specific concepts are of relevance for children's music preferences. Changes in musical concepts between t1 and t2 as well as differences between girls' and boys' statements are detected. The concept 'charts music' appears as a new preference orientation in t2. Triangulation shows that musical concepts may explain age- and gender-dependent differences in music preference development. Results can be related to findings on gender associations towards musical instruments and on the development of musical style discrimination.

9. Relationship between extraversion, agreeableness, and spontaneous motor tempo

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There is already more than 100 years' worth of research regarding spontaneous motor tempo (SMT) in tapping and gait, however most of this research has focused on general tendencies, such as defining the average preferred rate for SMT as around 2Hz. There is, however, a lack of research investigating how individual differences such as personality might be related to SMT. Differences in movement features related to personality have previously been found in dance studies, suggesting that personality may indeed be evident in motor responses. Thirty participants, recruited from the University, were instructed to "tap at a comfortable rate" using the spacebar of a keyboard, and Big Five personality traits were measured using the Ten Item Personality Inventory. Participants rating higher in Extraversion tended to have a faster SMT than less extraverted participants during the first trial to slow down during the second trial, and to display higher overall IOI variability Participants rating high on the Agreeableness scale tended to tap more slowly overall. These results suggest that personality traits may be evident in SMT. The IOI variability in more extroverted participants supports previous studies that have associated Extroversion with lower levels of self-monitoring. Furthermore, the results could have implications, for example, for studies of personality and dance.

10. Metacognitive strategies and pianists' achievement

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A lot of research into musicians' practice has explored the issue of metacognitive strategies adopted and used in the process of preparation for a performance. This study investigated the development of metacognitive strategies in practice of advanced pianists: 40 participants (among them also prize-winners) of piano international competitions (all of them are foreigners) and 40 piano students from Polish music academies filled out the questionnaires (via the Internet and in writing) designed to investigate planning strategies, setting goals, monitoring their own progress, ingenuity in applying many forms of practice, styles of explanation of one's own success or failure, a sense of self-efficacy and competence in the instrumental performances. The results reveal that in almost all dimensions the participants of piano international competitions (with higher pianists' achievements) obtained significantly higher scores than piano majors from Polish music academies; they more often and more consequently plan and set the specific goals, are more engaged in self-observing and self-monitoring, show a higher level of optimism, ingenuity in the choice of practice strategies, higher self-evaluation in terms of different music competence. Both groups do not differ in self-efficacy – both have very high scores. But in terms of piano performance's self-efficacy again the first group had higher scores. It was also observed that the participants demonstrate more self-awareness in identification of their strengths and weaknesses while the majority of piano students are not able to assess their own competence.

11. Exploratory study of instrument combinations in orchestral music

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There are a number of classic treatises concerned with orchestration. Although they may recommend certain instrument combinations, there is surprisingly little theorizing concerning the implicit principles that might inform how to combine instruments. In this study we examine patterns of orchestration over the period of 1701 to 2000. The method involved sampling 10 random vertical sonorities from each of 300 orchestral works. Each sonority was coded according to the instruments present, as well as their pitches, dynamic levels, tempo, and date of composition. In order to maintain high data independence, no more than three works by any given composer were sampled. Data collection remains in progress. Although premature, several predictable patterns are already evident. These include, for example, the high popularity of the harpsichord during the 18th century, its decline in the 19th century, and its resurrection among new music composers in the late 20th century. Similarly, the use of more 'exotic' instruments (especially percussion instruments) is a notable trend in the 20th century. Not surprisingly, the ensemble size for orchestral works can be observed to have increased through the 300-year period. We expect to observe some interesting interactions from the longitudinal data, such as for the correlation between pitch and loudness of an instrument or that between pitch and tempo. We presume that our analysis will replicate the instrument combination patterns in Romantic orchestral music observed by Johnson (2011), as well as replicate the musical expression clusters found by Horn and Huron (2012).

12. Music and socio-political attitude

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Rentfrow and Gosling (2003) examined how music preferences are structured and how these dimensions correlate with personality. Following this approach a study (2014) was conducted to examine if an interaction of music preferences and personality can be found in a German sample. Thus, 275 students were questioned online about music preferences (STOMP), personality (PANAS-d-trait; SKI), intellectual self-view (based on the intelligence factors by Thurstone) and additionally socio-political attitude (TEPEE). Furthermore the STOMP dimensions were reanalysed and the obtained results led to a re-construction. Therefore this study at hand tries to replicate the dimensions of music preferences and compares the results with the study conducted in 2014. Thereupon the following music preference dimensions could be constructed by factor- and scale analyses: 1. Rhythmic (α = 0.80): Soul/Funk, Blues, Jazz, Latin/Reggae, 2. Intellectual (α = 0.68): Modern Classic, Classic, Soundtracks, Religious Music, 3. Rock (α = 0.69): Rock, Alternative, Heavy Metal, 4. Pop (α = 0.49): Pop, Rap/Hip-Hop, Techno/Dance, 5. Traditional (α = 0.46): Country/Western, Folk. Presumably the instability of the dimensions could depend on music trends as well as on cultural and sociological differences in the relevance and meaning of certain music preference categories of the particular cultural background. Moreover the intercorrelation of the questionnaires with the replicated music preferences showed that listeners of the categories Rock and Rhythmic seem to have a more open socio-political liberal behaviour and the groups Intellectual and Traditional contrast with a more conservative attitude and yet a higher awareness of values. The group of Pop listeners shows, except the negative self-viewed intelligence, nothing conspicuous.

13. Musical investment: Assessing and enabling musical participation for positive wellbeing impact with seniors in Australia

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Investigations of musical activities for wellbeing impact have grown exponentially over the past decade, yet researchers remain unclear about how music operates for these outcomes. The current work is part of a major nationally funded project that explores these questions across a broad range of contexts, drawing on a population scale sample. The data discussed in this poster focus on the facilitators of musical activities and their participants aged over 70 years of age who have been committed to musical activities for more than seven years. The work investigates the techniques that stimulate musical participation, practices that lead to sustained long-term musical participation; and the specific elements of the participation found to offer wellbeing benefit. The data presented draw on discussions with focus groups. Results show the techniques that stimulate musical participation vary according to context, though facilitator style displays consistent and coherent strategies. Practices for long-term participation are distinct and include addressing a defined social function, establishing a routine within session and agreeing repertoire with participants. Specific participation outcomes include a firm and increasing belief in physical and mental health improvement over time, measurable social capital benefit, and improvements in mood, focus, lucidity, and relaxation; all feeding increasing motivation and self-image in relation to music. The research offers evidence suitable for the development of a model of positive long-term musical investment.

14. The relationship between alcohol consumption behaviour and music listening preferences

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Research has increasingly focused on the relationship between music and alcohol usage behaviours. Similarly, the role of the music industry in promoting alcohol use and consumption has been a topic of inquiry. The aim of this study was to ascertain the relationships between different types of music usage (and listening behaviours) and alcohol consumption behaviour among young adults. It was hypothesized that there would be a positive correlation between music use factors (e.g., cognitive, emotional, social) and drinking expectancies (e.g., negative consequences, confidence, sexual interest). Participants completed an online questionnaire that comprised motives, preferences, and behaviours related to both alcohol and music listening. Finalized results are not available at the present time as the analyses are not yet complete. However, analyses will address the two main research questions: (1) how the use of music may relate to drinking motives; and (2) how preferences for the involvement of music in drinking settings (as well as the importance of controlling the music heard) might differ in different drinking settings (e.g., pre-drinking, drinking during an event, and post-event drinking). Relevant findings will be discussed, followed by a specific consideration of the patterns demonstrated specifically by excessive alcohol consumption behaviours. The results are likely to provide a better understanding of how listening to music is intertwined with young adults' alcohol consumption motives and behaviours, with implications for the considering contextual elements accompanying (excessive) alcohol consumption behaviour.

15. Contents of self-selected music for specific mood effects differ between healthy and depressed participants

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Research suggests that people in a depressed mood may be particularly attracted to mood congruent music. However, there is some evidence that such music does not help all people to achieve their mood improvement goals. People with depression often have low activation thresholds for negative affect and experience it in greater intensity and for longer periods than healthy people. Conversely they may have a higher activation threshold for positive affect and are likely to experience it with less intensity and for shorter periods than others. Thus it is possible that people with depression may experience difference emotional responses to music than healthier people. To determine whether there are any differences in musical features or lyrical content in the music that creates sad and happy affective states between people with tendencies to depression and healthier participants. Over 500 participants nominated a piece of music that made them feel sad and a piece of music that made them feel happy. The acoustic and musical features of the songs were computationally extracted, the genres of the songs were inferred from online social streaming services and reduced to underlying dimensions, and the affective content of the lyrics was scored using affective lexicon methods. Significant differences were found in musical features and lyrical content between the songs selected by depressed and healthy participants. Mental health and mood have a significant impact on both music listening choices and its effects.

16. The program music in Valle's 26 Characteristic and Concert Preludes for Violin Alone: The performer-audience relation on stage

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The aim of the research is to analyse how to improve the communication of the composer's intentions in Flausino Valle's Preludes for Violin Alone. As methodology an experiment was carried out with 18 music students in which they had to relate the name of Valle's Preludes to the Preludes themselves. In addition, another important method in this research was the use of various recitals as a transmission experiment of the poetic message and the composer's intentions. The results found from these recitals and the experiment carried out, suggest the existence of a gap in the relation between the work title and its musical discourse. The intention of the effects produced on the violin may not always be clear, thus showing the need to improve the communication of the performer to the audience, and that through verbal explanation of the music the public can better understand the composer's intentions.

17. Musical and verbal short-term memory

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The goal of the present study is to investigate whether two-voice consonant and dissonant musical stimuli can influence our short-term verbal memory and vice versa. Twenty-four healthy volunteers (12 non-musicians and 12 musicians, 15 men and 14 women, mean age = 26.20, SD = 5.64) participated in the study. The examination material were 20 musical stimuli (10 consonant and 10 dissonant intervals, which were characterized as these according to the classical harmony approach) paired with 20 verbal stimuli (neutral words), which were each time differently linked with the musical stimuli. Participants' memory (for both the sound-word and word-sound pairs) was examined 5 minutes after their initial exposure to the music-word and word-music pairs. Results indicated that for the condition of music prior to words pairs there were no statistically different scores for the musicians and non-musicians. But it was found for the majority of the participants that the listening of dissonant musical intervals (mainly intervals of minor 2nds) preceding neutral words was linked with more accurate responses in the multiple choice task of indicating the missing word from other three alternatives ($p = .005$), in contrast with the pairs of consonant musical intervals and neutral words. This differentiation pattern may be due to the hypothesized stressful impact of musical dissonance on human physiology and the relaxing impact of musical consonance. Also, for the condition of words prior to music pairs, a statistically different recognition pattern was found for non-musicians and musicians, with the latter showing a better performance in recognizing the right tonic interval (consonant and dissonant) which followed the given word ($p < .001$). This differentiation could be interpreted through the prism of music education and experience.

18. Overtone-based pitch selection in hermit thrush song: Implications for the origins of human musical systems

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Many human musical scales, including the diatonic major scale prevalent in Western music, are built partially or entirely from intervals (frequency ratios) corresponding to small-integer proportions drawn from the harmonic series. For a long time, scientists have debated the relative contribution of biology and culture in shaping these pitch systems. One way to address this question is to study animal 'song': if the vocal displays of some animals follow some of the same principles that characterize human musical systems, this might suggest a biological basis for these musical systems. Here, we investigated whether the songs of the hermit thrush (Catharus guttatus), a medium-sized North American songbird whose song has attracted the attention of ornithologists and musicologists for more than a century, use pitches that are related by simple frequency ratios. Seventy-one high-quality recordings of songs of 14 male hermit thrushes were analysed. Pitch relationships were examined using both a simple linear regression model and a Bayesian generative model. The frequencies corresponding to the notes of the hermit thrush songs were, in most cases, simple integer multiples of a base frequency, corresponding to an overtone series. Moreover, after controlling for other possible explanations, our results strongly suggest that hermit thrushes actively select the pitches they sing. Our findings support the idea that some features of human musical systems may be based, at least in part, on biological principles that are shared with other animals such as songbirds. These results may thus have implications for the origins of human musical systems.

19. Changes in motivation as expertise develops: Relationships with musical aspirations

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Much previous research on musical motivation has been small scale and has not taken account of long term musical aspirations. This paper addresses these issues. A total of 3325 young musicians, aged 6-19, across a wide range of expertise (from beginner to higher education conservatoire entry level) playing a wide range of instruments responded to a series of statements on a 7-point Likert scale relating to motivation including: self-beliefs; enjoyment of musical activities; enjoyment of performance; level of support received from parents, friends and teachers; attitudes towards playing an instrument and perceptions of its value; beliefs about the importance of musical ability and long term musical aspirations. A factor analysis of the responses revealed six factors: support and social affirmation; social life and enjoyment of musical activities; enjoyment of performing; self-belief in musical ability; enjoyment of playing, lessons and practice; and disliking practice. Each factor showed a different pattern when considered against the nine levels of expertise identified in relation to independent graded examinations. The six factors collectively predicted a composite score relating to aspirations with a multiple r of .7 with different factors predicting specific musical aspirations more or less strongly. The findings indicate that motivation changes as expertise increases with musical identity becoming more important. The findings have important implications for education.

20. Long distance musical relationships: Experiences of networked music performance

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The research described in this paper examines the effect of networked music performance (NMP) technology on musical communication, and the strategies taken by musicians to overcome the inherent difficulties of working at a distance. In NMP there is a trade-off between sound quality and latency when using lossy compression. Effects of latency have been investigated quantitatively. Acceptable levels of delay from the point of view of musicians' synchronisation reflect the delays experienced by musicians in an acoustic space. The effect of these issues upon the subjective experience of the musician has rarely been the focus of research. By separating musicians geographically, communication is disrupted aurally and visually. This phenomenological study investigates how NMP affects the musicians' experience of performance. Student musicians were physically separated, but connected via an audio and video link, and were asked to perform unrehearsed 'jams', followed by semi-structured interviews. A thematic analysis of the interview data was made and four broad themes emerged: the music itself, the process, the musicians, and technical issues. Musical communication was considered the most important form of communication when performing. The musicians reported that the music they played developed in technicality and creativity as the sessions progressed. Musical communication plays a large role when performing remotely, and when this communication is disrupted creativity is affected, as musicians concentrate on the technical aspects of playing together.

21. Psychological profiles of Polish instrumentalists and conductors

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Both conductors' and orchestra musicians' occupation is seen as hardest among the other activities in the context of music and classical music education. Most information about these two groups of musicians can be found in the increasingly emerging biographies, encyclopaedias and monographs. There are very few studies on the psychological profiles of conductors or professional orchestral musicians. The most popular literature to this topic was made by Kemp (1996, 2009; Kemp & Mills, 2002). The solo, string and wind instrumentalist were surveyed by Davidson (2002, 2003, 2007, 2009), King (2006) and Sawyer (2006). The main objective of the project is to create psychological profiles of orchestral musicians and conductors. Description of their personality traits, psychological abilities, emotional dispositions, and organizational skills is one of the aims of the project. Another research goal is to gather knowledge of their self-esteem, assessments about themselves, professional situation and working environment. The pilot study was conducted by means of eight questionnaires and psychological tests, like SES, NBI, MBJ and AOP. The sample of conductor (N = 50) and other musicians (instrumentalists, orchestra musicians, choir members, N = 50) was collected from the Lodz musical institutions. The first results regarding the level of self-esteem show that conductors have more self-confidence and higher level of narcissism. With regard to the working conditions conductors are however more satisfied with: content and organization of workplace, working hours and leadership. The results can be used for future work on the psychological profile and expand multi-faceted research of professional musicians.

22. Musical deficits and specific strengths among Polish dyslexic children

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Dyslexia is a specific learning disability characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. The causes of these problems have been debated. Current data strongly supports phonological theory of dyslexia, indicating an impairment in phonological functions as the main cause, responsible for difficulties with creating and using mental representations of speech sounds. Not all explanatory theories, however, assume a pure linguistic deficit to be the major problem underlying dyslexia. There has been evidence of timing and temporal processing problems with neurobiological origin, which result in an impairment of auditory and motor abilities, which underlie reading and spelling skills. The present study aims at further examining the nature of dyslexic disturbances and describing selected aspects of musical perception in the context of reading and writing problems. Research has shown deficits of dyslexic students in musical skills. We attempted to identify the relationship between dyslexia and certain measures of musical hearing. 17 dyslexics from primary schools in Tricity in northern Poland and 11 chronological age controls were tested with a battery of phonological, reading and psychoacoustic tests. Children were matched in terms of IQ. The results have shown an impaired rhythm perception in dyslexia, which indicate a short-term musical memory deficit. Thus the STM deficits in dyslexia are not limited to phonological disturbances. It also seems that the ability to recognise pitch structure might be enhanced in dyslectic individuals. This conclusion must be tentative, but it could be a particular strength of this group.

23. Comparing perceived emotions while expressing and listening to music

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Interviews, questionnaires and also neurophysiological studies support the assumption that music evokes emotions in the listeners. Furthermore, some findings indicate that the emotion expressed in the music itself is correlated with the induced emotions of listeners. In this research the hypothesis that the emotions felt by professional musicians during a free-improvisation are transferred to the audience was examined. A group of four professional musicians were instructed to be aware of their emotional state while performing the improvisation, which was recorded and later played to a sample group. Both the musicians and the sample of 32 non-professional-musicians listened to the improvised piece of music. Simultaneously their states of valence and arousal were recorded. The collected software data was analysed by time series analyses and graphical evaluation. Interestingly the musicians could be separated into two groups (positive or negative in valence or arousal) that each had similar trend curves and run contrary to each other. The mean trend curve of the subjects however almost proceeds in between. To interpret these findings, one could question whether a principle of inner-emotional balance in music, which is reflected in the musicians as well as in the mean curve, applies. Further studies and cross-cultural comparisons should explain whether the curves of free-improvisation reflect genuine emotions or cultural learning processes, including musical clichés.

24. Promoting health in music education: Better Practice

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The physical and psychological demands of the training and practice that musicians must achieve to perform to a high standard on their instruments can produce deleterious effects on health and wellbeing, arising mostly from musculoskeletal and neurological causes. The available evidence on promoting musicians' health has been reviewed. Musical Impact, an AHRC-funded research project involving all nine UK conservatoires (2013-2017) seeks to enhance the health and wellbeing of musicians in Britain. Better Practice, one of three sub-projects, asks (1) What can be learned from existing approaches to promoting musicians' health? (2) How can such approaches be adapted, applied and evaluated across educational and professional contexts in the UK and internationally? Given the complexity and context specificity of the interventions and programmes, a realist synthesis approach was applied. Published full-text quantitative and qualitative studies in English were included. Databases were searched for interventions and health programmes targeting musculoskeletal and music performance anxiety issues among musicians. Quality and validity are enhanced by continuous discussion among the reviewers. Few taught courses on health and wellbeing have been evaluated systematically. Zander et al. (2010), using pre-post, longitudinal testing of one programme in Germany, reported a stabilising effect on psychological health, but no effect on physical symptoms. Purpose-designed interventions based on endurance exercises reduced levels of perceived exertion, pain and fatigue (Kava et al., 2010). Current approaches vary widely and present substantial methodological flaws. This project is intended to inform the development and implementation of a new evidence-based programme for promoting health, behaviour change and managing ill-health in musicians.

25. The design, development and evaluation of a personalised music-listening intervention for people with dementia in acute care

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A growing body of evidence supports the use of personalised music-listening (PM) as an economically viable and accessible tool in dementia care and treatment, offering a number of positive outcomes for persons with dementia (PWD), informal carers and healthcare professionals (cf. Sung et al., 2011), thus underscoring the need to translate this knowledge to clinical practice for the purposes of implementation into routine care practice (Gallagher, 2011; Gerdner, 2010). However, a substantial review of the current literature exposes a number of methodological weaknesses across studies with regard to delivery and evaluation (Vink et al., 2011), and a concurrent lack of empiricism and contextualisation within hospital settings, ultimately compromising the extent to which the current findings can be translated to formal healthcare settings. What's more, of the research conducted to-date, the clinical application of PM for PWD has largely been confined to community-dwelling participants (e.g. Park, 2013) and those in residential care settings (e.g. Gerdner, 2010). Thus far individuals in hospital settings have tended to be neglected; no study to-date has sought to investigate the role of PM for PWD in acute hospital settings, despite the ostensible potential for this tool and prevalence of PWD within acute care (Dewing & Dijk, 2014). The presented research shall outline a programme of work that seeks to design and empirically evaluate a PM listening intervention for PWD in acute care, with the overarching aim of identifying factors that shape and constrain implementation and potential outcomes and opportunities for PWD, healthcare professionals and informal carers.

26. Non-isochronous meter in poetry and music

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Musical meter is the measurement of the number of pulses between regularly recurring accents. Poetic meter is a regular alternation of prominent and less prominent syllables. Stress or prominence is the main indicator for hierarchical organization in music and poetry. While poetic meter involves repetition of some basic prosodic unit, musical meter refers to temporal periodicity. Periodic temporal expectancies, caused by a perceptual isochronous pulse, play a basic role in music cognition. While western music usually consists of isochronous meter, Serbian folk music brings richness of regular and irregular alternations of duple and triple rhythmic groups within metrical pattern. Horizontal polymeter, relatively often in Serbian folk music, exists within isochrony (e.g. 2/4+3/4), non-isochrony (7/8+9/8+7/8+10/8) and in the alternation of isochronous and non-isochronous meter (4/8+ 5/8, 6/8+7/8, 3/4+5/8). On the other hand stands vertical polymeter which refer to repeating vertical hemiola, explain the presence of metrical levels and audibility of the isochronous subdivision. The circulation of duple and triple hemiolic ratio presents the main feature of Serbian language, due to the most frequent words are two-syllable and three-syllable. Non-isochronous meter in Serbian folk music seems to originate from non-isochronicity of speech and asymmetry folk poetry. Iambic 7-syllable verse corresponds to 3+2+2 metrical pattern in music, while asymmetric or iambic 8-syllable verse may induce 3+2+3 or 3+3+2 metric patterns. Asymmetric 10-syllable verse, as one of the oldest and most frequent in the Serbian oral tradition, may evoke 10/8 time signature with different duple and triple beat combinations.

27. Music based intervention to target stress and cognitive dysfunction in Type 2 diabetes

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Diabetes affects approximately 9% of the population, of which 85-90% is the non-insulin dependent diabetes mellitus or Type 2 diabetes (T2D). Neural slowing, cortical atrophy, and microstructural abnormalities in white matter tracts and changes in concentrations of brain neurometabolites due to abnormalities in insulin metabolism lead to cognitive deficits observed in T2D. Patients with T2D are at high risk for dementia or stroke. Increased levels of stress are considered to be one of the causal and maintaining factors of T2D. Stress can not only alter or modulate insulin metabolism, but also causes neurochemical and structural changes in the brain and thereby cognitive deficits. Music based intervention has shown promising results in alleviating stress and levels of anxiety in various clinical conditions including T2D. Empirical findings have demonstrated that music listening and active engagement in music engage almost all cognitive functions such as attention, information processing, executive functions, memory and emotion. Neuro music therapy has shown improvement in the cognitive functions in various neurological, neurosurgical and psychiatric conditions. However, there is no study so far examining its effectiveness in T2D. The present review paper, examines the nature of cognitive deficits in T2D, the role of stress and the possible role of music based intervention to target stress and cognitive deficits, thereby limiting the overall dysfunction caused due to this chronic illness. Systematic research work in this direction will have far reaching implications in the treatment of T2D.

28. Interdisciplinary process for collaborative artists: A proposed theoretical model

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The purpose of this paper is to provide a detailed breakdown of an exploratory process that was developed to facilitate collaboration between artists of multiple disciplines. This process places a strong emphasis on collaborative engagement, communication, and play in order to foster an environment where interdisciplinary work is created organically and synchronously among collaborators. In order to test the initial viability of this theoretical approach, 11 artists from varying backgrounds were asked to follow this collaborative model for a period of eight months, during which an original work was to be developed, rehearsed, and performed. This paper will present the preliminary findings following this 8-month implementation, and will substantiate the original theoretical framework with practical implications and suggestions. The ideas put forth in this paper are exploratory in nature and are intended to be viewed as avenues for further investigation and creative inquiry.

29. The Musical Foregrounding Hypothesis: How music influences the perception of sung language

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The question how music influences the perception of lyrics is rather complicated. There are indications that music enhances the perception, comprehension and memorization of sung language, but also that it obstructs language perception and comprehension by withdrawing attention from the words, or undermining their meaning. The linguistic concept of foregrounding might be helpful to understand the paradoxical way in which music seems to affect lyric perception. Foregrounding (the use of stylistic features such as metaphors and parallelisms, etcetera) is supposed to obstruct normal understanding, but, by doing so, to draw attention to the language too. Foregrounding, for example, both slows down reading and increases strikingness and affect ratings. The Musical Foregrounding Hypothesis (MFH) states that matching music to words has a similar effect to language perception as linguistic foregrounding. However, music is far more complex than any stylistic feature. Music consists of components such as rhythm, pitch, harmony, song structure, etcetera, all of which might affect lyric perception independently. This leads to several sub-hypotheses. An MFH-based model for lyric perception explains the relations between the MFH and these sub-hypotheses. Support for some of these sub-hypotheses is found in the existing literature, others should be tested. The MFH offers an interdisciplinary approach to song, and to the relationship between language and music, that might be beneficial to science, education, music, healthcare, advertising and literature.

30. Which basic emotions are universal in response to music?

Marco Susino, Emery Schubert
School of Arts and Media, The University of New South Wales, Australia

Basic emotions such as anger, happiness, and sadness are believed to be communicated cross-culturally, since the work of Paul Ekman, in particular, that suggests facial expressions intending to portray these emotions can be recognised as the intended emotion by viewers from different cultures. However, it is not clear to what extent these findings also apply to the communication of emotion in music. We report our analysis of 10 studies that explicitly investigated emotional communication across cultures. The most frequently investigated basic emotions were happiness/joy and sadness/sorrow, which were manipulated (as independent variables expressed in performance usually by the performing musician under instruction) for eight of the ten studies. In each of these eight studies, these emotions were communicated with statistical reliability across the cultures investigated. Another basic emotion that was regularly examined was anger (in six of the studies), but results were equivocal. Therefore, with the small data set investigated, we made the interim conclusion that this basic emotion is probably not communicable through music. However, we propose that this may and may not necessarily be a cultural issue. We first propose emotion locus constraints that may restrict the ability of music to induce anger. Finally, we propose Music Stereotype Theory as a possible cultural explanation for the findings.

31. Music as a gender-related social adaptation

Hasan Gürkan Tekman
Department of Psychology, Uludag University, Turkey

The adaptive value of music is usually considered in terms of effects on individual reproductive success, early preparation of individuals for managing emotional and social interactions, and organization of social activity. In its social role music can act as a tool for strengthening social identity and group togetherness, for transmission of culture, and also for coordinating activities that are engaged in collectively. Such social uses of music are most of the time closely related to gender roles in a community. This paper aims to delineate the gender-related uses of music that may help survival of a group. One possible gender-related use of music appears to be contributing to defining gender roles as can be seen in musical activities that are segregated by gender in many cultures. A complementary function seems to be providing outlets for acting outside of the prescribed gender roles. Observations of musical traditions in which persons of one gender are permitted to act in ways that are not normally considered appropriate for that gender can be cited in support of this function. I would like to conclude that taking gender-related norms of musical behaviour may be a productive approach to social, and possibly evolutionary, functions of music.

32. Influences of visual activity on memorized tempo of a performance

Renee Timmers, Andrea Schiavio*, Hugh Cowell#*
**Department of Music, University of Sheffield, UK*
#Department of Psychology, University of Stirling, UK

Previous research has shown that the similarity between performances is only to a limited degree predicted by measurements of tempo and intensity. This suggests that in perceiving performance characteristics of music, listeners do not just perceive a performance to be in a particular tempo with particular intensity or with particular variation in tempo and intensity. Instead, listeners may remember the communicated interpretation of the music, including emotional or metaphorical associations. To test this hypothesis, an experiment was designed that manipulates the induced association with a performance and tests the effect on the memory of the performance. Forty participants listened to 12 musical excerpts while watching pictures on the screen. The pictures varied in activation (high, low, or neutral activity). After a set of four performances and a brief distraction task, participants' memory for the tempo of the four performances was tested. The test performance was either in the same tempo or 10% faster or slower. Participants judged the new tempo with respect to the old tempo on a scale from 1-5. A repeated-measures ANOVA showed that only the effect of the tempo of the test stimulus on tempo judgments was significant. The hypothesised effect of activity on memory for tempo was not confirmed. Before it can be concluded that no such effect exists, several aspects of the experimental design will need to be considered in future research.

33. Correlations between musical descriptors and emotions recognized in Beethoven's Eroica

Erika S. Trent*, Emilia Gómez #
**Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology, USA*
#Music Technology Group, Universitat Pompeu Fabra, Spain

Investigations of music and emotion have identified broad musical elements that influence emotions recognized by listeners, such as timbre, rhythm, melody, and harmony. Not many studies have studied the correlation between quantifiable musical descriptors and their associated emotions; furthermore, only few studies have focused on how listeners' demographic and musical backgrounds influence the emotion they recognize. In this preliminary study, participants rated how strongly they recognized the six GEMS emotions (transcendence, peacefulness, power, joyful activation, tension, and sadness) while listening to excerpts from Beethoven's Eroica. Musical descriptors (loudness, brightness, noisiness, tempo/rhythm, harmony, and timbre) were also extracted from each excerpt. Results indicate significant correlations between emotional ratings and musical descriptors, notably positive correlations between key clarity and peacefulness/joyful activation ratings, and negative correlations between key clarity and tension/sadness ratings. Key clarity refers to the key strength associated to the best key candidate; as such, these results suggest that listeners recognize positive emotions in music with a straightforward key, whereas listeners recognize negative emotions in music with a less clear sense of key. The second part of the study computed correlations between demographics and emotional ratings, to determine whether people of similar demographic and musical backgrounds recognized similar emotions. The results indicate that naïve listeners (i.e. younger subjects, and subjects with less frequent exposure to classical music) experienced more similar emotions from the same musical excerpts than did other subjects. Our findings contribute to developing a quantitative understanding of how musical descriptors, and listeners' backgrounds, correlate with emotions recognized by listeners.

34. A linguistic approach to the syntax of Early Music: Representation of the hexachord system by X-bar method as an excavation tool

Oğuzhan Tuğral
Historical Musicology, Istanbul Technical University-Center for Advanced Studies in Music (MIAM), Istanbul

Since 1969, Michel Foucault's method presented in his Archaeology of Knowledge has turned the attention of researchers to the issues of ever-increasing information and knowledge management in science and arts. As an analytical method, the Generative Theory of Linguistics attempts to apply its methods to the discipline of music with the aim of explaining musical structures as a language. Fred Lerdahl and Ray Jackendoff's studies of the 1980s have been developed by David Pesetsky and Jonah Katz within the framework of the Minimalist Program of linguistics. These studies are concerned with common practice in music. The aims of the present study are to point out that while these studies are genuine approaches to music in tonal traditions, they do not address the issue of early periods, i.e. the origins of tonal music, and ask how their theory works for pre-tonal periods. To answer these questions, the present study synthesises aspects of musicology and linguistics. It employs Foucault's archaeological approach and uses Generative Theory's X-bar method to analyse 'early music' repertories, specifically Aquitanian polyphony. The study proposes that early music is based on the hierarchical relationships of the hexachord system. As a first step a novel analytical tool was developed, using a cognitive approach to early music.

35. Phonatory strategies of vocalists at singing diatonic scales with various dynamic shaping

Allan Vurma
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Professional vocalists have to cope with different musical tasks at wide pitch and dynamic range. According to the source-filter theory of voice production, the acoustical properties of the voice depend on the working regime of the vocal folds, as well as on the shape of the vocal tract, which acts as the resonator. It is possible to produce the voice at the same pitch and loudness with different phonatory characteristics, although to maintain the stability of phonation these characteristics must stay within certain limits defined by the laws of physics. The aim of this work was to investigate the phonatory strategies of professional vocalists when singing ascending and descending diatonic scales with various dynamic-shaping tasks. Professional singers and singing students sung diatonic scales at different tonalities over their voice range using different vowels. Three dynamic tasks were used: (1) sempre f, (2) crescendo from p to f, and (3) diminuendo from f to p. A glottogram (EGG) was registered and the acoustical signal was recorded. Different singers used different phonatory strategies which were expressed: (1) by the pattern of how the value of the contact quotient (Qx) measured by the EGG changed in response to the ascending and descending pitches of the scale; (2) on how the value of Qx changed in response to the increasing or decreasing sound pressure level; (3) on how different voice registers were used.

36. Background music influences the evaluation of moving emotional facial expressions

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In our daily lives, emotions are often influenced by music either voluntarily (e.g., MP3 player) or not (e.g., shopping centres, neighbour's party) (Sloboda, Lamont & Greasley, 2009). Several studies investigated how music, as an auditory input, influences the evaluation of emotional words and

faces (Steinbeis & Koelsch, 2010; Vermeulen, et al. 2010). In the present experiment, different affective music samples (happy and sad music) were presented as a musical background while the participants had to rate the emotion of a changing face from neutral to 100% emotion (happiness and sadness). Participants were exposed to three conditions (congruent, baseline and incongruent music-EFE combinations). They were asked to press the space bar when they thought that the facial emotion expression was at 50% of the expressed emotion. We observed a cross-modal facilitation effect, i.e. a more accurate evaluation when the musical primes and the to-be-evaluated targets shared the same emotional content (congruency). Concretely, on average participants were significantly closer to the 50% threshold in the congruent condition (59%) versus 70% in the incongruent condition. We also found that, in the congruent music condition, participants were more accurate to 50% of the emotion expression when it appeared from neutral to emotion (54%) than when the emotion expression disappeared (61%). In conclusion, these observations ascribe an important role to music for the competence of identifying emotions. Furthermore, this study showed that congruent music helps to enhance precision in emotion identification but interferes in emotion disengagement in moving facial expression. .

37. Affective calibration of a computer-aided composition system by listener evaluation

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**Interdisciplinary Centre for Computer Music Research, Plymouth University, UK*
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Affectively-driven algorithmic composition (AAC) is an emerging field combining computer music research and psychological approaches to music cognition (Mattek, 2011; Williams et al., 2014). AAC systems attempt to communicate or induce specific emotions in the listener by creating novel music. The distinction between emotional communication and emotional induction in listeners is well documented in music psychology (Gabrielsson, 2002; Kallinen & Ravaja, 2006; Scherer, 2004) with regards to affective evaluations of music. Moreover, music has been shown to induce physical responses on a conscious, and unconscious level (Grewe, Nagel, Kopiez, & Altenmüller, 2005, 2007). Using biophysiological readings to determine emotional induction in tandem with AAC provides a possible mechanism for reactive, feedback-driven systems that might reliably induce affective states in the listener in accordance to their own preferences and physiological responses. Here we report on a listener evaluation of one such system under development. A series of affective mappings (musical features with emotional responses) were drawn from literature and implemented in an artificial intelligence driven composition system. New material is generated by means of a 16-channel feed-forward artificial neural network (ANN). This material is then manipulated according to an affective mapping, which gives control over five musical sub-features: tempo, mode, pitch range, timbre, and amplitude envelope. Specific variations in each of these musical features are used to imply different affective states in the generated material according to a 4x4 cartesian grid comprising arousal on the vertical axis and valence on the horizontal axis, after the circumplex model of affect (Russell, 1980). Co-ordinates with higher arousal generally include a larger pitch spread (range of notes), faster tempo, and harder timbres, whilst co-ordinates with higher valence generally utilize a major key. The particular ratios which inform this musical feature / affect matrix were derived in a tri-stage listener evaluation, as documented in the extended abstract.

38. Ear training – The development and application of an assessment tool

Anna Wolf, Reinhard Kopiez
Hanover Music Lab, Hanover University of Music, Drama and Media, Germany

Over the last 100 years, many tests have been developed to measure various aspects of musicality. Most of these tests focus on the aspect of musical talent and rely on the paradigm of detecting small discriminations produced by musical stimuli. Less research has been conducted on the assessment of musical skill or competence primarily influenced by practice and effort. Since we lack the

instruments for the objective measurement of musical skills, it is currently impossible to measure the long-term development of musicians or to conduct studies on the characteristics of musical skills. Currently, we are developing and validating an assessment instrument for musical ear training. Tools of Item response theory, in particular, the Rasch model, have been applied to produce items for melodic, harmonic and rhythmic ear training. Items for this test were engineered by experienced professors in music theory. Eighty-one items are currently being validated in an international online study which investigates the influences of instrument, primary musical genre and other background variables. Sixty-six items fit the Rasch model and combine to produce a measure of ear training performance. Item difficulties are normally distributed. No differential item functioning (DIF) could be detected for people playing harmonic instruments, melodic instruments or who have studied music. Until now, it has not been possible to quantify a person's skill in ear training. With this set of originally developed and scrutinised items, researchers can explore the importance of musical hearing for sight-singing, improvisation, playing by ear and many more facets of musical life.

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39. The effect of music on forgiveness

Naomi Ziv, Omri Dalal, Adva Kahana
Psychology, College of Management – Academic Studies, Israel

Forgiveness is a prosocial change in thoughts or emotions towards a transgressor. Apologizing increases forgiveness, especially when the transgressor offers a valid justification. Music has been shown to affect both emotion and cognitive appraisal of individuals and situations. Two studies examined the effect of pleasant and unpleasant music on judgments of severity of a transgression and willingness to forgive. In Study 1, 90 participants read a script describing an employee who planned to renovate his house, and was promised a bonus by his boss, a promise then denied. Participants heard either pleasant, unpleasant, or no music. Severity of the event and willingness to forgive were measured. In Study 2, 90 participants completed the same procedure, but were also given a text describing the boss's apology and explanation, after the music (or no music). In Study 1, a significant effect for music was found on severity judgments: in both music conditions, the event was evaluated as less grave than in the no-music group. In Study 2, a significant effect was found for judgments of severity: Pleasant music led to less severe judgments, followed by the no music group and the unpleasant music group. A significant effect was found for forgiveness: Pleasant music increased tendency to forgive, followed by the no-music group and the unpleasant music group. Results suggest that although music does not seem to affect the evaluation and forgiveness of a seemingly unfair act, it does influence the effect of an explanation of these actions on severity judgment and forgiveness.

Exploring the relationship between motor execution and motor imagery in expert pianists using chronometry and pupillometry

Helen O'Shea, Aidan Moran
School of Psychology, University College Dublin, Ireland

Kinaesthetic motor imagery (MI) is an extraordinary human cognitive capacity allowing individuals to simulate and experience actions without engaging in the physical movements involved. Research has demonstrated that MI enhances skilled-performance, and that actual and imagined actions share similar neural substrates. Jeannerod's simulation theory (1994, 2001), purporting 'functional equivalence' between actual and imagined actions, is a widely accepted explanation for the positive effects of MI. However, chronometric studies have demonstrated that level of expertise and complexity of movement mediate the temporal congruency between actual and imagined actions. Further, the extent to which actual and imagined actions share similar cognitive mechanisms has not been investigated adequately. The present experiments sought to investigate the temporal (using chronometry) and cognitive (using pupillometry) aspects of the relationship between expert pianists' actual and imagined complex piano performances. Nine and seven expert pianists participated in Studies 1 and 2, respectively. Both studies used the same bespoke musical composition (containing complex and less complex stages). In Study 1, SuperLab Software recorded stage durations of the performance in milliseconds. In Study 2, Tobii eye-tracking glasses recorded pupil-size measurements during performances. Results of Study 1 showed that the durations of imagined performances were longer than those for actual performances, and the level of movement complexity did not alter this relationship. Results of Study 2 revealed that there was no statistically significant difference between pupil-size measurements during executed and imagined performances. It was concluded that, although not straightforward, there is a marked relationship between actual and imagined piano playing.

Frequency and affective evaluation of involuntary musical imagery correlate with resting state networks of spontaneous cognition

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**Department of Psychology, Goldsmiths, University of London, UK*
#Department of Psychology, University of York, UK

Involuntary musical imagery (INMI) is the experience of repetitive music in the head beyond one's control. INMI is a spontaneous and frequent phenomenon emerging in daily life, and is triggered in comparable ways than other forms of self-generated thoughts (SGT). Here, we test the hypothesis that INMI may emerge from interactions between auditory networks and functional networks involved in SGT, such as the default-mode network (DMN). In the present study, we related occurrence and evaluation of INMI with intrinsic functional connectivity in 40 healthy adults using resting-state MRI. We found that (1) the connectivity between non primary Auditory cortex, middle Temporal Gyrus and core regions of the DMN (posterior cingulate, precuneus and anteromedial prefrontal cortex) modulated the frequency of INMI episodes, and that (2) increased connectivity between the right parahippocampal cortex and the right inferior temporal gyrus was associated with higher scores in the affective evaluation of INMI episodes, suggesting an involvement of memory retrieval systems. Functional coupling between auditory association areas and core regions of the DMN may influence the occurrence of INMI by modulating their frequency. This data is consistent with previous results on possible triggers of the INMI experience, and are in line with predictions from the theoretical frameworks on SGT. Taken together, these results support the idea that coupling between the core DMN and sensory areas contribute to the emergence of endogenous sensory experiences, while their emotional aspects of such experiences rely on coupling within DMN subsystems (rPHC and lateral temporal cortex).

Wednesday 19 August 2015 **CONCERT HALL**
14.00-15.00 **SESSION 5B: MODELS** **Chair: Rytis Ambrazevičius**

Modelling of Georgian traditional polyphony

Simha Arom
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Georgian traditional polyphony constitutes a unique musical heritage which is renowned for its complexity. It includes a vast body of religious chants and folk songs, mostly in three parts, with harmonic sequences that are unequalled in the world of oral tradition. While many aspects of this polyphony – particularly historical and ethnological aspects – have been studied by Georgian and Russian researchers, the principles of its 'grammar' have never been addressed in a systematic way. The goal of this research is to reveal the rules of the harmonic syntax underlying this polyphony. This study began in 2007 and has thus far included a detailed analysis of about 300 pieces, some one hundred of which have been modelled. In order for it to be culturally valid, the modelling of a form of folk music must be done in close collaboration with upholders of the tradition who have recognized knowledge and experience. This work was done through a series of interactive experiments carried out with the singers of the Basiani State Ensemble, which is internationally known. It appeared that all of the chords and aggregates that occur in the songs fall into two distinct categories: first, those which are random and result solely from the movements of the parts and secondly those which have a structural function. The latter, distributed over the course of the songs, are mostly separated by brief improvised sequences. It is these chords and aggregates that form the harmonic framework, the matrix of each song, its model, which all of the singers carry – consciously or otherwise – in their memories and which, on the cognitive level, guarantees its transmission, and thus its perennity. The methodology developed for this research opens up new perspectives for the modelling of many other polyphonic repertoires that use improvisation.

A grammatical model of butterfly schemas in the late-Classical style

Trevor Rawbone, Steven Jan
School of Music, Humanities, and Media, University of Huddersfield, UK

This paper presents a model of local multiparametric structures termed 'butterfly' schemas, which comprise a number of congruent grammatical features: harmonic progressions that are spatially close in terms of pitch-space theory and which have a chiastic (symmetrical) harmonic tension curve that starts and ends on tonic harmony; a texture that is homogeneous, with regular textural accent; a metrical structure that is uniform in all layers; and harmonic-rhythm ratios that partition the schema simply and proportionally. While some theories of schemas focus on the mental association and statistical correlation of the schema features in a particular time and place or, alternatively, explain schemas as the products of generic tonal grammars, the present paper explains butterfly schemas as grammatically congruent relationships between multiparametric features that are common in a particular geography and history. A survey of European instrumental music, c. 1750-1850, shows that butterfly schemas are more common in the late-Classical period (c. 1750-1800) than the early-Romantic period (c. 1800-1850). This suggests that butterfly schemas are dependent on the grammatically congruent relationships between multiparametric features which are more prevalent in the late-Classical period than the early-Romantic period.

Emotional development in guitar instrumentalists of advanced level in cultures of classical, flamenco and jazz

Amalia Casas-Mas
Faculty of Education, Universidad Internacional de la Rioja, Spain

The general aim of this paper is to analyse emotion and self-regulation in three musical learning cultures in Spain: classical, flamenco and jazz. Our work was based on the theoretical framework of conceptions as implicit theories. Our aim was to use a cultural anthropological approach to see whether we could find differences and similarities in discourse and instrument practice both within and between cultures, using a methodology of constant comparison. We contrast individual discourse and practice in the participants of each culture who had shown the most polarized conceptions (traditional and constructive), in a multiple case study. The six participants were selected based on the results of a previous study. We performed an analysis by using a system of categories, both deductive and inductive. Thus, we present the six case studies, in which we first analyse each learner's discourse, and then his practice, followed by a comparison between the two participants from each culture. We find similarities in the two popular cultures (jazz and flamenco) in that they have more internalization of tools such as private singing. Cultures with a more academic tradition (classical and jazz) expressed more emotions and positive and negative evaluations, and were more perseverant. Flamenco participants made basically positive evaluations, expressed little emotion and showed little perseverance. We confirm learning autonomy in the jazz culture, making explicit and symbolization in the classical culture, and action in the present without attributions in the flamenco culture. The conclusions focus on the contrast between discourse and practice, which establishes distances among musical cultures, but also point towards other learning cultures, more global. We present conceptions and a multitude of learning strategies, which may be of great interest to teachers and learners in more and less formalized cultures. We suggest a line of further research zooming in on the ethnography of the flamenco culture with its orality, observing learners in their natural setting of informal collective learning of music, which could be a crucial contribution to academic formats.

Psychophysiological responses to 'happy' and 'sad' music: A replication study

Gunter Kreutz*, Antje Bullack*, Niklas Büdenbender*, Ingo Roden*, Anna-Katharina R. Bauer#
**Department of Music, Carl von Ossietzky University Oldenburg, Germany*
#Neuropsychology Lab, Department of Psychology, European Medical School, Carl von Ossietzky University Oldenburg, Germany

Previous work produced evidence supporting the so-called 'emotivist' position, which claims that music induces autonomic emotional responses in adult listeners. The present study sought to replicate and extend this work by using sound tracks from movies. A total of 20 participants were exposed to 'happy' and 'sad' pieces of music, while peripheral physiological responses were recorded. In addition, participants filled out questionnaires on music sophistication and provided subjective ratings of induced emotions. Results suggest that the replication was successful overall, showing differential responses to 'happy' and 'sad' music excerpts across emotion processing components including physiological and psychological markers, even in the light of some remaining substantial methodological differences between the previous and the present study. Influences of musical sophistication appeared negligible. Taken together, these results further support the hypothesis that music induces autonomic emotional responses in healthy adults. They also highlight the importance of replication as well as multi-site studies to strengthen the empirical basis of fundamental issues in music psychological research.

Wednesday 19 August 2015 **CAROLE NASH RECITAL ROOM**
14.00-15.00 **SESSION 5D: PIANO 1** **Chair: Costas Tsougras**

The piano accompanist portrayed through the eyes of a soloist

Evgenia Roussou
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The aim of this study was to investigate the views of experienced soloists about the functional and socio-emotional qualities of piano accompanists in the Western duo chamber ensemble. As part of a large-scale interview study, ten professional instrumental and vocal soloists were interviewed about their views on piano accompanists and accompanying. The interview questions concentrated on: a) accompaniment techniques, b) expectations, c) achieving ensemble, d) communication, and e) the accompanist's role in Western duo chamber ensembles. The data were analysed using conventional directed thematic analysis (Hseih & Shannon 2005). Most soloists identified listening as the primary accompaniment technique, with other key skills including adaptability, flexibility, sensitivity to balance, rhythmic precision and technical control. Soloists expected their accompanists to know their music, be easy to work with and sensitive towards the soloist's strengths and weaknesses. To achieve ensemble, soloists expected the accompanist to both follow and lead where appropriate, and communicate visually and aurally. They perceived the accompanist's role in terms of support and understanding. This study highlights a range of qualities and expectations about accompanists in the eyes of soloists, both functional (e.g. listening; rhythm; adaptability) and socio-emotional (e.g. support; sensitivity; understanding). The soloists acknowledged that accompanying is a specialist skill and that the piano accompanist is an integral part of the duo chamber ensemble partnership.

Towards an empirically based definition of piano touch: Touch/ timbre relationship and key motion measurements

Eleonora Kojucharov*, Antonio Rodà#
**Departments of Musicology, University of Ghent, Belgium and Université Paris 8 Saint-Denis, France*
#*Department of Information Engineering, University of Padova, Italy*

The concept of touch in piano pedagogy is generally expressed through adjectival descriptors often linked to imagination and abstraction. Such a metaphorically based reflection determined a rather blurred definition of the term touch, sometimes confused with timbre, even within professional piano performance contexts. Although in last decades the improved MIDI-based data-collection technologies allowed to specifically measure key-control features, an empirically based definition of touch and its relationship with timbre still need to be further deepened. In this direction, the present research aims at (1) providing elements for an adequate scientific understanding of touch; (2) clarifying the relationship between touch and timbre; (3) defining to what extent the parameters of key-velocity, tempo and articulation may vary as a function of different types of touch. Through questionnaires 19 pianists provided a number of piano-touch quality descriptors; the five most used were proposed as example of touch qualities during a recording session involving only five pianists, who played four music excerpts one time for each descriptor. The analysis of pianists' answers in questionnaires allowed an interesting conceptual classification of timbre/touch into five semantic categories: physical-motor, articulatory, sensory, emotional, aesthetic-stylistic. The analysis of recordings showed significant relations in pianists' performance control between key-velocity/articulation parameters and touch; timing-related aspects seemed to be less influenced by touch changes. As an initial step of investigation, this research provides practical basis for further theoretical developments benefiting both a scientific description of touch and pedagogical applications, going towards a deeper awareness about key-motion control among pianists.

Wednesday 19 August 2015 **CONFERENCE ROOM**
14.00-15.00 **SESSION 5E: WORKSHOP 1**

IDyOM: A computational model of auditory expectation

Marcus T. Pearce
Cognitive Science Research Group and Centre for Digital Music, School of Electronic Engineering and Computer Science, Queen Mary University of London, UK

IDyOM – Information Dynamics of Music (Pearce, 2005) – is a computational model of auditory expectation. It acquires knowledge of musical structure through statistical learning of sequential dependencies between notes in the music to which it is exposed. The model generates a conditional probability distribution governing the next note in a sequence, given the preceding notes. The entropy of this distribution reflects the model's uncertainty about the next note, while the information content (the negative log probability) of the note that actually follows reflects how unexpected that note is to the model. With training on an appropriate corpus of music, research using EEG, behavioural and physiological methods has shown that information content and entropy accurately predict listeners' ongoing expectations while listening to music (Egermann et al., 2013; Hansen & Pearce, 2014; Omigie et al., 2012, 2013; Pearce, 2005; Pearce et al., 2010). IDyOM was made publicly available under an open source software license in June 2014. This presentation will include a demonstration and tutorial on using the software for cognitive modelling of musical expectations. The tutorial will cover the following topics: a) installation and running the software; b) importing databases of music; c) extracting symbolic music features (relating to pitch, timing etc. of musical events) from the database; d) running the model to generate probabilistic descriptions of musical structure including examples using different training data, model configurations and musical features.

Wednesday 19 August 2015 **RNCM THEATRE**
15.00-16.00 **KEYNOTE 2** **Chair: John Sloboda**

Understanding major-minor tonality: Humanities meet Sciences

Richard Parncutt
Centre for Systematic Musicology, University of Graz, Austria

Most Western music is based on major-minor tonality (MmT). What is MmT? Why is it like it is? Where does it come from? How does it work? I consider six disciplinary perspectives: history, theory/analysis, philosophy, (psycho-) acoustics, neurophysiology, and psychology. Evidence from philosophy and neuroscience suggests both pitches and intervals are quantifiable phenomenal experiences that depend on both brain/body states/processes and environmental affordances. Musical intervals are categorically perceived, approximate, learned distances; they are psychological and cultural in nature, not mathematical or physical. Historically, in the 13th-16th centuries, settings of the Catholic mass became more polyphonic; since then, polyphony has been used to glorify God/creation and consolidate ecclesiastical power. Psychologically, tones and sonorities that occur often are more stable or may be perceived as cognitive reference points (tonics). Music-theoretically, a passage of tonal music is a prolongation of its tonic. Psychohistorically, MmT emerged in the Renaissance as major/minor triads became the most prevalent sonorities due to their consonance (in psychoacoustics: smoothness, harmonicity). I claim that scales then changed to correspond to pitch patterns evoked by tonic triads, which include implied pitch classes at missing fundamentals (in CEG, A and F; in CEbG, Ab and F) plus leading tones a semitone below roots of tonic triads (which have a different origin). The theory is tested by comparing three datasets – statistical analyses of a historic music database, empirical data from perceptual experiments, and predictions of psychoacoustic models – enabling a nature-nurture comparison (quasi-universal perceptual principles versus musical familiarity).

Richard Parncutt is a music psychologist with qualifications in music and physics from the University of Melbourne and an interdisciplinary PhD in psychology, music and physics from the University of New England, Australia. Since 1998, he has been Professor of Systematic Musicology at the University of Graz, Austria. His research involves music theory, music acoustics, psychoacoustics, sound and music computing, music information retrieval, music sociology, music philosophy, music history, ethnomusicology, music education, interculturality, and interdisciplinarity. His publications address musical structure (pitch, consonance, harmony, tonality, tension, rhythm, meter, accent), music performance (psychology, piano, applications), the origins of tonality and of music, and musicological interdisciplinarity.

Wednesday 19 August 2015 RNCM THEATRE
16.30-18.00 SESSION 6A: IMAGERY 2 Chair: Anemone Van Zijl

Guided Imagery in Music – A neurometric EEG/LORETA case study

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Guided Imagery in Music (GIM) sessions comprise an initial discussion of the client's concerns providing a focus for the GIM experience. The client reclines with closed eyes while the therapist initiates an altered state of consciousness (ASC) induction. The therapist then chooses a pre-determined music program, or spontaneously chooses music to match the client's imagery. As the music plays, the client describes any imagery, feelings, or thoughts. In the present study, EEG was recorded during rest, ASC and a GIM listening program (Imagery). EEG data (Power, Asymmetry) were compared against a normative EEG/LORETA database investigating artefact-free rest, ASC and pivotal parts of the music listening preceding verbal response. GIM EEG data were chosen based on an independent GIM therapist's ratings of separately analysed verbal responses. Differences between rest and ASC induction indicated a brain state change in lower alpha (α) frequency (8-10Hz) with z-scored LORETA α1 power divisions (8⁺9Hz) exhibiting increased values in the cuneus (8Hz) and precuneus (9Hz). Z-scored LORETA power differences (inter-individual rest – ASC) were most prominent in BA 23 (8Hz) and BA 31 (9Hz), indicating involvement of cuneus and posterior cingulate regions in ASC. Verbal GIM responses elicited two nodes of interest during pivotal music listening: (1) high-beta anterior left-temporal (T5) asymmetry decrease (resembling the ASC induction topography), while z-LORETA current density (CD) values increased in BA 37 (Left inferior / Middle temporal lobe on 21-30Hz); (2) right parietal lower α z-score power values and according z-LORETA CD increased in precuneus (resembling the ASC pattern). On lower Alpha right parietal z-score power values and z-LORETA current density increased in precuneus (resembling the ASC pattern).

Conditioning the mind in music: Involuntary musical imagery and everyday life music listening

Ioanna Filippidi, Renee Timmers
Department of Music, University of Sheffield, UK

This study explores the concept of Involuntary Musical Imagery (InMI) being the product of an unconscious conditioning that results from everyday music listening. The systematic pairing in exposure of stimuli may resemble a form of conditioning. The experiment presented here, investigates the prevalence of InMI as the product of associative learning/ conditioning. We attempt to reproduce that systematic pairing of music and certain activities through a series of repetitive exposure to music whilst performing a certain everyday activity, in order to investigate the prevalence of InMI. To control the effect, different activities are paired with either podcast or silence. Expectations were that participants would associate music only with the certain activity that was presented with, and would report InMI only on that activity. Results from the study showed no significant effect of the training, meaning that participants did not extensively have InMI during the activity that was previously paired with music. However, the responses indicate an effect in the predicted direction, suggesting that evidence in favour of the hypothesis might be found with increases of statistical power of the experiment (small sample size, N = 30; or insufficient training). The follow-up of this experiment includes further training time and a larger number of participants.

Measuring the earworm experience: The involuntary musical imagery scale (IMIS)

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Involuntary Musical Imagery (INMI, or earworms) refers to the internal experience of a musical excerpt that spontaneously comes to mind and repeats. Studies so far have mostly focused on the phenomenological aspects of the experience, while few have examined individual differences in relation to INMI. This study aimed to a) develop and validate a new scale that would capture multiple facets of the INMI experience and b) explore the relationship of the scale's factors with potentially related constructs. Exploratory factor analysis on the initial questionnaire (360 individuals) resulted in a 15 item, 4-factor model. Confirmatory factor analysis on that model (2671 participants) showed the best confirmatory fit to the data and good or very good estimates of internal reliability. The items within each factor were related to the following themes, which were used as factor labels: Negative Valence (subjective evaluation of INMI), Movement (embodied responses), Personal Reflections (personal qualities) and Help (beneficial aspects). Participants also completed a wide array of validated questionnaires measuring thinking styles, voluntary auditory imagery abilities and musical behaviours, which showed strong correlations with the new Involuntary Musical Imagery Scale (IMIS). Test-retest reliability (649 individuals) showed good or very good estimates. IMIS is a novel and reliable instrument, which allows for systematic measurement of multiple distinct aspects of the INMI experience. The four IMIS factors represent a range of behaviours, emotions, reactions and evaluations related to INMI and its associations with other scales reflect similarities of the INMI experience with task unrelated thought and music behaviours.

Wednesday 19 August 2015 CONCERT HALL
16.30-18.00 SESSION 6B: TIME AND RHYTHM PERCEPTION

Chair: Nicolas Farrugia

Formal measures of complexity predict the accuracy in guessing the end of rhythmic patterns

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In order to identify whether formal measures of complexity can predict the human judgement of rhythm complexity, we artificially generated 48 rhythmic sequences, and measured their complexity according to five measures from information theory and algorithmic complexity (Shannon entropy, entropy rate, excess entropy, transient information, and Kolmogorov complexity). We designed a rhythm perception experiment, in which 32 participants guessed the last beat of each sequence and indicated the difficulty of doing so, aided by a visual representation of the length of each sequence. The participants completed a short version of the Raven's Matrices and the Gold-MSI questionnaire in order to quantify their general pattern identification ability and several aspects of their musical expertise. The average prediction accuracy for each sequence was correlated with their entropy rate and Kolmogorov complexity, and the average judgement of the task difficulty for each sequence was highly correlated with their entropy rate and Kolmogorov complexity. The participants' overall score on the rhythm perception task was correlated with their self-assessed musical perceptual abilities. Finally, a logistic regression showed main effects of entropy rate, Kolmogorov complexity, and musical training, and interactions between these two measures of complexity and musical training. Our results show that formal measures of complexity capture some aspects of human rhythm perception, and more specifically that the perception of rhythm complexity scales with departure from periodicity. Moreover, we add to the body of evidence showing the effect of musical expertise on music perception. Tentative interpretations are provided, as well as suggestions for further research.

Attention, density, and coherence in musical time estimation

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Attention and expectations have been shown to play an important role in perceptions of time. Attending to nontemporal events makes time seem to pass quickly – the interference effect (Brown, 1997). Moreover, temporal intervals are judged as longer when filled with sine-wave tones (compared to silence) – the filled interval effect (Thomas & Brown, 1974); and musical melodies are judged as longer when they are structurally incoherent (as compared to structurally coherent) – a tenet of dynamic attending theory (Boltz, 1995; Jones & Boltz, 1989). It remains unknown, however, whether these effects depend on focused attention. The present study aimed to explore the role of attention on the temporal effects of density (the degree to which a temporal interval is filled with events) and coherence (the degree to which the events within the temporal interval cohere into a stable structure) in music. Participant heard 45 musical clips altogether (Finale 2012; piano timbre). All of the participants verbally estimated and reproduced (start and stop a timer) the durations of the musical clips, however only the participants in the dual-task group scanned for 'C' symbols while listening. Overall, we found a strong interference effect, such that participants in the single-task group judged the clips as longer than participants in the dual-task group, as well as significant effects of density and coherence in the single-task group, but not in the dual-task group. These results suggest that density and coherence's effect on musical time estimation depend on attention.

Towards a combined theory of psychological time during music listening and dynamic attending theory

Michelle Phillips
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Music listening may influence perception of how much time has passed, with estimates of duration varying according to, for example, whether a concurrent task is employed (Bailey & Areni, 2006), the modality and distance of modulation (Firmino et al., 2009; Ziv & Omer, 2010), and preference for / liking / enjoyment of the piece (Areni & Grantham, 2009). Results have largely been discussed in terms of attention and memory, with few studies exploring the link with timing and entrainment. Music's metrical framework allows musical elements to be attended to, processed and stored efficiently. In models of psychological time, the more attention required to attend to an event, the longer it is often judged to have lasted. Hence music with a strong metrical framework may require less attentional resource, and be deemed shorter than non-metrical sequences. Unpredictable occurrences may harness attention, and therefore lengthen judgement of elapsed duration (Tse et al., 2004). Experienced musicians may give shorter estimates than non-musicians owing to storing the material more efficiently (Phillips & Cross, 2011). Therefore the predictability of musical events within a metrical pattern may be central to exploring how music listening effects perception of elapsed duration. Furthermore, recent models of psychological time based on neurological oscillations invite consideration alongside Jones' 'metric binding hypothesis' (Jones, 2009). This metric binding may allow further flexibility in the allocation of attentional resource during music listening. Timing research does appear to be potentially valuable in exploring results relating to music and psychological time.

Wednesday 19 August 2015 FORMAN LECTURE THEATRE
16.30-18.00 SESSION 6C: SINGING 1 Chair: Stefanie Stadler Elmer

Choir acoustics: An empirical case study on the influence of reverberation during choir singing

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+Department of Music, University of Jyväskylä, Finland

Multitrack recordings of a mixed adult choir with 23 singers were conducted in order to investigate the influence of varied room acoustical conditions on a choir's performance with regard to intonation, loudness, tempo, and timing precision. Headset microphones were used to record each chorister separately while the collected sound of all singers of the choir was presented via headphones exerting acoustic simulations of different rooms with reverberation times (RTs) of 0.0, 1.77 and 4.79 s according to three different singing conditions. The choir was asked to sing the motet Locus Iste composed by Anton Bruckner (1824-1896). Objective measures conducted by single audio track analyses using the monophonic pitch tracker pYIN plugin for Sonic Visualiser revealed that intonation was hardly affected by different simulated room acoustics whereas tempo was notably slower and timing precision was declining when singing in a comparatively large virtual room. Subjective judgments gathered by a questionnaire on the singer's experiences showed a clear preference for singing in the medium sized 'Concertgebouw' (with RT = 1.77 s), while the dry condition of the 'Class Room' (RT = 0.0 s) was felt to be the best to sing in time. The significance of these results and their relationships to other musical and acoustical parameters will be discussed.

Comparison of quality of life of older adult choir singers and the general population in Finland

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#Institute for Health and Aging, Department of Social and Behavioural Sciences, University of California, San Francisco, USA
+Centre of Health and Social Economics, Helsinki, Finland

The overall aim of the study is to compare quality of life (QOL) of older adult choir singers with culturally active (theater, movies etc.) older adults from the general population in Finland. To compare the choir sample with older adults (60-93 years of age) from the Finnish general public, we utilized data from a large population study in Finland (HYPA) that included the same quality of life (QOL) questionnaire used with the choir sample and administered by the Finnish National Institute for Health and Welfare (THL). The choir sample was compared with general population (HYPA) who reported being active or not active/slightly active in other cultural activities. Case control methods were used to match a sample of 109 older adult singers with a sample of 307 older adults from the general population. After controlling for socioeconomic variables, the older choir singers reported significantly higher ratings on the physical QOL, compared with matched older adults from the general population. The results suggest that singing in a choir as an older adult may promote wellbeing. The comparison between impact of choir singing and other cultural activities suggested that choir singing might have more positive impacts on QOL.

Hand gesture in South Indian vocal lessons: The exploitation of cross-domain mapping as a pedagogic tool

Lara Pearson
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In South India, Karnatak vocal teachers gesture spontaneously while demonstrating musical phrases to students, producing a continuous stream of melody and hand movement. This presents a rich ecological setting in which to explore cross-modal relationships between music and gesture. Following from existing research on Indian music and gesture, cross-modality, and gesture in mathematics learning, this paper presents a case study in which two vocal lessons given by different teachers are examined for correspondence between musical pitch and co-occurring hand gestures. The study asks whether mapping can be found in axes other than the vertical, and explores how cross-domain mapping is used by teachers to repair student error. Videos of the lessons were coded for gesture and pedagogic interaction. Teachers' hand gestures were motion-tracked to obtain 2D hand position, pitch was extracted, and plots of each were examined for correspondence and considered in relation to pedagogic goals. Correspondence between pitch and hand position was found during the majority of phrases to varying degrees, both in vertical and horizontal axes. However, mapping was not apparent in all phrases, or consistent throughout phrases. When correcting a student's error, teachers commonly indexed the solution using gesture. The results here suggest that cross-domain mapping is exploited by teachers to help students hear and understand the fleeting ornaments that are typical of the style, but difficult for novices to apprehend.

The effect of microtiming on body movement behaviour when listening to swing or funk music

Olivier Senn, Lorenz Kilchenmann
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A popular theory claims that minute temporal asynchronies (Participatory Discrepancies or PDs) in music performance are crucial for prompting body motion in listeners. This study tested the influence of varying PD magnitudes on beat-related, periodic head motion in listeners of Swing or Funk music. For each style, two series of six stimuli were created: in one series, the PDs were downscaled from original magnitude (as performed by the musicians) to complete quantization. In another series, the PDs were upscaled from original to double magnitude. 160 participants (80 music experts, 80 non-experts) listened to the twelve stimuli in either Funk or Swing style. The intensity of the participants' beat-related, periodic head movement was measured with video-based motion capture technology and Fourier analysis. A mixed-design four-factor ANOVA on the log-transformed head movement data showed a significant interaction between the listeners' expertise, the direction (up-scaling vs. down-scaling), and the magnitude of the PD manipulation. Musical style did not affect the listeners' behaviour. The music experts moved along stronger with PDs scaled down by 60% than with fully quantized PDs. These findings offer partial support for PD theory: PDs seem to have an influence on music experts' body motion behaviour. Their head movement was most intense when they were listening to music with a tight, but not mechanic timing. No support for PD theory was found in the behaviour of the non-experts.

Visual rhythmicity in music-related human movements and its influence on auditory rhythm perception

Yi-Huang Su
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Listening to musical rhythms engages humans' internal motor system even in the absence of explicit movements. This internal sensorimotor coupling may occur similarly when observing rhythmic human movements, such as dance. It is as yet unclear how rhythms in dance movements are visually perceived, and how auditory and visual rhythms are combined perceptually in a music and dance scenario. Here, I examined how visual rhythmicity communicated by a periodic human bouncing movement influenced auditory rhythm perception, and whether the effects suggested audiovisual (AV) integration in the rhythm domain. A further study examined visual timing of dancelike movements involving the limbs, and their relation to auditory rhythmic timing. Several results are shown: First, observing the periodic bouncing movement improved concurrent auditory beat perception and synchronization, and more so when the auditory performance was worse, reflecting the inverse effectiveness in AV integration. Secondly, detection of a temporal deviant in an auditory beat sequence was worse when the visual figure bounced downward (congruently) than upward (incongruently) to the beat, suggesting stronger visual temporal capture of the auditory beat in the former. Finally, visual timing of naturalistic dancelike movements was better for movements with periodic limb trajectories than without, which resembled the beat benefit in auditory timing. This pattern persisted despite irrelevant auditory interferences, indicating that visual movements were not recoded auditorily. Together these results point to multisensory perception in music and dance, whereby visual rhythms derived from dance observation exist in parallel to, and can thus modulate, auditory musical rhythms in perception.

Speed on the dance floor: Visual and auditory cues for musical tempo

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Six classic American R&B songs at 105, 115, or 130 BPM were the primary audio stimuli. Point-light animations of dancers who performed slow/relaxed vs. fast/vigorous interpretations of each song were the video stimuli. Stimuli were presented in audio only, audio+video (A+V), and video-only conditions. Participants rated the tempo in each trial on a 7-point scale. Significant effects of presentation condition ($F(1.88, 100.089) = 22.385$, $p < .001$, $\eta p2 = .297$) and BPM ($F(1.966, 104.193) = 53.119$, $p < .001$, $\eta p2 = .501$) were found. In the audio-only condition participants were able to rank the stimuli in accordance with the three BPM levels. In the A+V condition there were significant main effects for dance interpretation ($F(1, 26) = 28.171$, $p < .001$, $\eta p2 = .520$) and BPM ($F(1.784, 46.379) = 59.221$, $p < .001$, $\eta p2 = .695$): while slow dance interpretations were rated at the same speed as in the audio-only condition, the fast dance interpretations were rated faster. In the video-only condition participants were unable to make consistent tempo ratings. Just as Schutz and Kubovy (2009) argued that causal inferences best explain the influence of vision on audition in contexts where visual information is clearly relevant to the auditory cue, here we have shown how a perceptually relevant visual array can affect auditory tempo judgments.

Wednesday 19 August 2015 FORMAN LECTURE THEATRE
18.00-19.00 ESCOM GENERAL ASSEMBLY

Can correlations imply causation? Causal modelling and music psychology research

Daniel Müllensiefen, Georgina Floridou, Kelly Jakubowski
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The gold standard for the assessment of causal effects is randomized controlled trials (RCTs). However, in many areas of music psychology RCTs can be very difficult to implement because they might be expensive or unethical. Here, it is common to publish tables of correlations even though the interesting questions concern the causal relationships between the measured variables. The aim of this presentation is to introduce modern causal analysis techniques to the music psychology community and to demonstrate how these techniques can help to identify causal relationships between variables from non-experimental datasets. We will describe two general causal analysis approaches – Rubin's causal model and graphical causal models. We demonstrate how causal models can be used a) to identify causal effects by controlling for confounding variables, b) to identify distinct clusters of variables in highly multivariate datasets, and c) to identify the direction of causal effects. We reanalyse published data from previous studies and show how causal modelling can provide additional insights into non- experimental data. Specifically, we show how accounting for confounding variables can greatly simplify the pattern of significant results, how structural relationships between variables in large correlational datasets can be identified and how the causal effects size is often different from the magnitude of the reported correlation coefficients. We also discuss the limitations of this analytic approach and show how causal models differ from more commonly used techniques (e.g. covariate adjustment in multiple regression).

Car-aoke: Vocal performances indicate distraction effects of in-car music

Warren Brodsky, Matan Ziv
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Drivers engage in a host of driving-unrelated tasks while on the road. Most frequently, drivers listen to music and sing-along with the words in a karaoke fashion. At times drivers accompany songs by pounding-out drum-kicks, fingering guitar-licks, singing background, and even dancing in their seat. However, there is controversy over in-cabin music: Does background music facilitate driver performance via increased arousal leading to more focused concentration, or cause distraction placing drivers at greater risk. In an effort to shed light on the debate over the utility of in-car music, the current study explored how driving tasks might subsequently affect vocal performances during simulated driving. Eighteen young drivers recorded two versions of two songs (baseline vs. low-demand, baseline vs. high-demand driving). The results indicate that as the perceptual demands of the primary driving task increase, the performance of the secondary activity (i.e., karaoke-like singing) declines. That is, vocal performances during high-demand driving contained significantly more errors of both intonation/rhythm and lyrics compared to low-demand driving, while both were far less accurate than baseline recordings. Such a picture supports evidence that engaging in music activity does actually preoccupy vital mental resources. In-car music may not necessarily be handled very well, nor is it blocked-out entirely by drivers during high-demand driving – as has been previously reported in some literature. Singing along with in-cabin music background may contribute to increased risk for incidents, events, and near-crashes, and should be reconsidered by traffic scientists investigating human factors, vehicular control, and road safety.

What do you listen to to calm down? Age-related differences in the selection of music when experiencing different affective states

Caroline Cohrdes*, Cornelia Wrzus#, Michaela Riediger*
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#*Johannes Gutenberg University, Mainz*

The age of the listener has been assumed to be one central factor leading to differences in the preference for music and in how far music is used to regulate one's current affect. Previous studies showed that compared to younger adults, older adults are motivated to enhance positive and low arousing affective states and to increase their well-being while listening to music in everyday life. This study employed a novel music selection paradigm to investigate age-related differences in the motivation and efficiency to regulate one's affect when experiencing different states of arousal and valence. We extend previous research by including a continuous behavioural measure of music selection and by taking the age of the listener as well as their regulation motivation into account. 225 participants ranging from adolescents to old age completed a complex task with or without time pressure and with a bogus feedback of either above-average or below-average to induce various levels of arousal and valence. Following that, participants freely browsed a pre-piloted music selection of 128 songs from various decades and genres. Self-reported current affect was rated before and after the mood induction as well as after the music browsing. Furthermore, participants completed 26 items indicating their music-related affect regulation motivation. Results show age differences in the preference for music with divergent levels of valence and arousal as well as in the course of the regulatory process leading to a change in affect after music browsing associated with the affect regulation motivation.

How does music help us to sleep

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Two thirds of UK adults experience regular sleep disruption. Music has significant potential as a sleep aid though, to date, no large-scale study has explored music's impact on individuals with transient insomnia. The present study carried out an Internet survey between May and November 2014 to determine: (1) what kinds of music are listened to in order to promote sleep and (2) the reasons people believe music improves their sleep. The survey comprised basic demographics, aspects of musicality including training and musical engagement (Goldsmiths Musical Sophistication Index: Gold MSI), and sleep quality (Pittsburgh Sleep Quality Index: PSQI). We queried the type of music used for sleep and perceived pathways to effect through open text responses. In total 651 people completed the survey (67% female; mean age = 33.41, range = 18-79), with good sleep quality across the sample (PSQI = 6.61; SD = 3.43) and the majority (59%) reporting music helping them sleep. Results from regression tree models indicated that older individuals who experience high stress report worse sleep quality. Additionally, a classification tree model suggested that younger people with higher musical engagement are more likely to use music for coping with sleep problems. Initial two person thematic analysis on the written responses shows music fulfilling a distractive and/or anxiolytic role; final models of these data will report patterns in the specific music used. These data represent the first large-scale UK based survey to demonstrate what kind, how and why people believe music helps them to sleep.

Thursday 20 August 2015 **CONCERT HALL**
09.00-11.00 **SESSION 7B: PITCH AND TONALITY Chair: Trevor Rawbone**

Spatial representation of pitch and its dependence on instrumental experience

Renee Timmers, Shen Li
Department of Music, University of Sheffield, UK

Three perceptual experiments were run to test the presence of an association between pitch and horizontal location in non-musicians, musicians, and among the latter in flautists and pianists in particular. The first experiment compared participants with different levels of musical training. The second and third experiment examined the effect of instrument and compared pianists with flautists. Brief sounds were presented over speakers that varied in pitch height (9 different pitches) and horizontal location (9 different locations). Participants estimated either the location or the pitch of the sounds using a 9-point rating scale. In Experiment 3, participants played simple exercises including scales and arpeggios on their instrument before doing the listening test. Regression analyses were run to examine the relationships between estimated pitch and stimulus pitch and location. Similarly, the relationships between estimated location and stimulus pitch and location were assessed. Estimated pitch was solely dependent on stimulus pitch. Estimated location depended on stimulus location as well as stimulus pitch. The dependence on stimulus pitch was stronger for participants with high levels of musical training (Experiment 1). This left-right mapping of pitch was equally present in pianists and flautists (Experiment 2). It is stronger for pianists than flautists after performing on their instrument (Experiment 3). The association between horizontal space and pitch may lead to the perceptual illusion of low pitches coming from the left and high pitches coming from the right. This is in particular strong for musicians, and activated after performing on an instrument that reinforces this mapping.

Cross-cultural comparisons of absolute pitch and relative pitch in music students in different countries

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We conducted absolute pitch (AP) and relative pitch (RP) tests on music students in Japan, China, Poland, Germany, and USA. In the AP test, sixty piano tones over a 5-octave range were presented in a nearly random order. In the RP test, a two-chord authentic cadence and a pair of successive tones were presented in 4 different keys. In the AP test, the participants answered AP names, and in the RP test, they wrote down musical interval names or sol-fa names of the last tone relative to the penultimate tone as the tonic. The Japanese participants achieved the highest scores in the AP test, but the lowest in the RP test. In striking contrast, the Western participants showed excellent scores in the RP test, whereas few of them had accurate AP. The poor RP scores of the Japanese participants suggests possible disadvantageous influences of AP on RP learning. It can be speculated that those who had acquired AP in early childhood lose an opportunity to fully develop RP. These results point out the problem of the current music education practice, particularly of the method of ear-training in Japan.

Learning novel music systems through short exposure

Yvonne Leung, Roger Dean
MARCS Institute, University of Western Sydney, Australia

Becoming familiar with a musical pitch system or tuning system involves learning novel pitch interval patterns formed by previously unfamiliar relative pitches (e.g. recurrent pitch interval ratios or interval differences). It was postulated that for Western music listeners, learning would be facilitated if the to-be-learnt systems were structurally similar to their familiar 12-tone equal temperament (12-tet) tuning system. To examine the effectiveness of short exposure in learning, 30 non-musicians were randomly allocated into an Exposure and a No Exposure group. The Exposure group performed a short but attention-demanding task that involved detecting a deviant tone in the second playing of the a repeated melody, which induced exposure, before a Goodness of Fit (GOF) perception task where they had to rate how well a probe tone fit with a just presented melody, while the No Exposure group did not perform the exposure task before the GOF task. In both tasks, melodies were generated from either the Western 12-tet system (Control) or one of three unfamiliar tuning systems that were dissimilar to 12-tet. Results suggest that exposure leads to higher GOF ratings and participants may be able to differentiate the systems, as shown by the systematic difference between their GOF ratings of probe tones from the same tuning system as the melody just heard and the probe tones from the alternative systems.

Perceptual coherence predicts consonance-dissonance and influences listeners' cognitive and affective responses to music

Tanor Bonin, Daniel Smilek
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Our past empirical research has indicated that the continuum of consonance and dissonance can be modulated through psychoacoustic manipulations that alter the perceptual coherence of musical sound. These data led to the Source Dilemma hypothesis, which predicts that dissonance arises when musical stimuli elicit incoherent auditory percepts, while consonance accompanies musical stimuli that elicit coherent auditory percepts. In the present report we sought to replicate our timbrel and spatial manipulations of consonance and dissonance. Additionally, we investigated a corollary prediction that dissonant music requires greater cognitive processing than does consonant music. We tested these predictions with three experiments, in which one of the music's harmonic, timbrel, or spatial psychoacoustic characteristics was manipulated to create coherent and incoherent musical counterparts. In each experiment, participants completed a cognitively demanding task (the visual 2-back task) while listening concurrently to no music, coherent music, or incoherent music. Participants also provided consonance-dissonance and pleasantness-unpleasantness ratings of the musical excerpts. As predicted, perceptual coherence predicted the listeners' affective ratings of the musical stimuli in all three experiments. Additionally, in Experiment 1 we found that incoherent atonal music interfered to a greater extent with cognitive performance on the 2-back task than did coherent tonal music. Surprisingly, however, we found in Experiments 2 and 3 that atonal musics exhibiting timbral and spatial coherence required greater cognitive processing than did their incoherent atonal counterparts, despite the fact that they were rated as less dissonant and unpleasant.

Digital delivery of instrumental lessons in remote rural areas

Helen Prior, Rob Mackay, Andrew King
School of Drama, Music and Screen, University of Hull, UK

The provision of instrumental lessons in North Yorkshire is hampered by its vast area and rural nature, with teachers needing to travel long distances between schools. Internet-based technologies have been successfully used elsewhere to deliver instrumental lessons. A collaboration between the authors, North Yorkshire Music Action Zone and YouCanPlay allowed the delivery of instrumental lessons using Skype in combination with a Roland VR-3EX, an AV Mixer which offers three camera angles and good quality sound. Our aim was to repurpose existing technology to provide instrumental lessons in remote rural communities. We wished to investigate the technical challenges and pedagogical aspects of the delivery, and also compare digitally-delivered and face-to-face instrumental lessons. Data collected included pre- and post-project interviews with teachers, recordings of the teachers' first and last lessons, and post-project questionnaires from pupils and their parents. Results suggested that there were technical challenges relating to sound, video and connection quality, and the physical environment of the lessons, some of which were alleviated by the Roland VR-3EX. Some concerns expressed by teachers in the initial interviews failed to materialize; others were overcome to some extent. Pupils concentrated well, were motivated to practice, and made good progress. Further analysis of the video data is currently under way to compare face-to-face and digitally-delivered lessons. All teachers found the digital teaching more challenging than their usual face-to-face teaching; however all reported that they would undertake similar teaching again. Digital delivery has the potential to provide greater access to instrumental lessons for children in rural communities.

Students' perceptions of a technology-enhanced learning environment aimed at fostering meta-representational competence in music

Vicent Gil*, Mark Reybrouck#, Jesús Tejada*, Lieven Verschaffel#
**University of Valencia, Spain*
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Technology-enhanced learning environments (TELEs) have revealed themselves to be powerful tools for fostering students' learning. Dealing with music by means of invented representations could benefit from TELEs insofar as students' meta-representational competence (MRC) may be fostered. In this respect, MRC has been described in a generic sense as the full complex of abilities dealing with representational issues. The primary concern of this study was to examine students' perceptions of a TELE aimed at fostering their MRC in the domain of music. A basic randomized design comparing a treatment to a control group was used. Participants were 75 students aged 12 enrolled in a middle school music course. An educational intervention was carried out by means of a virtual classroom so that the students allocated to the experimental group were provided with scaffolding, while the control group was not. Students' perceptions of the TELE were measured after the intervention by means of the Constructivist On-Line Learning Environment Survey, which consisted of 24 Likert-type items distributed into six subscales. Chi-square tests were performed so as to compare the experimental and control groups' scores on the survey. An overall effect of the intervention on students' perception of the TELE was found (chi-square = 16.45, df = 4, p = .002). Significant differences between the experimental and the control group were also found for the subscales 'Reflective thinking' (chi-square = 14.24, df = 4, p = .007) and 'Tutor support' (chi-square = 10.78, df = 4, p = .029). The results showed a beneficial effect of scaffolding in TELE as implemented in the present study. Theoretical, methodological and educational implications are discussed.

The application of video in supporting students'reflection in music instrument study

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The usage of active learning methods is increased in nowadays music education and supporting students' reflection has also gained more attention in the music instrument pedagogy recently. The current study applies the previously validated model of supporting reflection in the context of music instrument study in one university in Estonia. The model consists of four cycles and is based on the main processes of reflection (describing, evaluating, relating, and reflecting on the reflection process). The aim of the study is to find out for what extent does the application of the model support students' reflection in music instrument study. If and how does the students' reflection quality change in putting the model into practice? How effective do the participating students see the application of the model to be from music instrument development point of view? Eleven students of the music curricula of Tartu University applied the reflection model in music instrument study. Students' experiences and opinions on the reflection model was collected by focus group interviews. Research results showed that the application of the reflection support model helps the students to describe their instrument play in detail as observers and therefore perceive new aspects that they would otherwise not pay attention to. Research brought out that supporting reflection drives the students to take an active role in their music instrument study and give a deeper meaning to their studies.

Hearing aids and music: The experiences of D/deaf musicians

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Musicians such as Ludwig van Beethoven and more recently Evelyn Glennie show us that even a profound level of deafness is no barrier to the creation or performance of music. While there is a growing literature on the perception of music using cochlear implant technology, there exists comparatively less empirical research about the amplification of music using hearing aid (HA) technology. As part of a recent AHRC-funded project exploring the perception of music using vibrations, an interview study was conducted by the first author to explore issues relating to performing and perceiving music in the presence of a hearing impairment. Semi-structured interviews were conducted with twelve musicians who spoke about their musical background and training, history of hearing loss, and experience of using HAs. Transcripts were coded and analysed using thematic analysis. Overall, satisfaction with digital HAs was low, with pitch and timbre distortion often reported to compromise music listening experiences. Some musicians sought enhanced HAs while some dispensed with them altogether. Preferences for digital or analogue technology were found to relate to musicians' history and level of hearing loss and evidence of dynamic auditory attending was found. The results suggest that musicians who use HA technology draw on a range on strategies to compensate for impaired auditory feedback. Advanced signal processing algorithms within digital HAs have necessarily prioritised speech perception with potentially negative effects on their ability to amplify musical acoustic input. Further research is needed to understand how HA technology and fitting may be improved for music listening.

Song singing: How children apply musico-linguistic rules or a grammar

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Songs are cultural rituals that are governed by rules in order to yield well-formed performances. Traditionally, parents and caretakers intuitively introduce infants and young children into this practice, for instance by lullabies and play songs. Provided that children are engaged in this practice, they start song singing around the end of the first year and during their second year. In order to study the teaching and learning of songs as a trans-generational cultural practice, the formal principles and rules of traditional children's songs have been extracted and initially sketched out as a grammar. This grammar of children's songs draws on music and language as generative systems, and it elucidates the rules how musical and linguistic elements are simultaneously combined into a coherent and well-formed unit. As each language has specific prosodic rules, this grammar so far is restricted to children's songs in a particular language, i.e., German. The application of the grammar is shown by microanalyses of children's song acquisition processes. In a quasi-experimental study, children were asked to learn newly composed songs that tacitly, yet deliberately violate the grammar. Case studies demonstrate the strategies children apply to cope with the violations and to create well-formed songs. Interestingly, children not only show implicit knowledge of the children's songs' grammar, but also exhibit an aesthetic sense of well-formedness. Since the grammar of children's songs encompasses musico-linguistic elements and rules, implications not only concern a structural approach to musical development, but also to language and to the synchronisation of movements.

Australian young children's musical engagement and development in family and community life

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Children's musical engagement and development is shaped by their particular socio-cultural context. However, scant research has examined the musical engagement and development of young children at the cusp of infancy and toddlerhood. The current study investigates the musical activities, uses and practices occurring in Australian young children's everyday lives. A collective case study design involves primarily qualitative longitudinal data. Here we present data from the initial stage of this ongoing study. Fifteen Australian families with a young child (aged 0-12 months) are participants. The primary caregivers have participated in an initial interview, and completed a self-report questionnaire gathering demographic, family, music, health and wellbeing information. Families are capturing musical activities in their child's life through audio-visual recording, and weekly diary. The nature and use of musical activities between caregivers and young children, such as to moderate mood and emotion, are similar across the cases. Families' beliefs, values, musical and cultural backgrounds, and family dynamics shape the existence and prevalence of certain activities. Young children prefer rhythmic and interactive musical activities. Young children are listeners and active participants in informal and formalised contexts, such as library rhyme time. Some mothers express concern for how returning to work might negatively impact on the musical world created with their young children. Australian young children's everyday lives are rich with musical engagement, the particulars of which are shaped by their socio-cultural context. This study contributes to the development of a cultural ecological model that identifies pathways and strategies to support musical engagement and development of Australian young children. The research is funded by an ARC Discovery grant led by Barrett and Welch, 'Being and becoming musical: towards a cultural ecological model of early musical development' (DP130102488).

BACK TO INDEX

Social entrainment in the synchronous reproduction of musical pulse: Developments in childhood

Leon van Noorden
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In order to perform an experiment with very young children it is necessary to give the experiment an ecological and familiar setting. As a consequence this experiment on the skill of tapping in sync with the beat of music was run in little groups of four class mates together. The focus of this talk is the results regarding mutual entrainment between the children. Children between the ages of 3 and 11 years (N = 392) were asked to tap to the beat of 50 second pieces of five common children's songs with a tempo between 80 and 160 beats per minute. To make the task clear to even the youngest children an avatar tapping along with the beat of the music was projected during the first half of each song. The seating had two conditions: peers visible and peers hidden. The children tapped with a little drum stick on a toy drum. Seeing their peers helped the children of 5 to 6 years old to perform better on synchronising with the music task. Children of 8 to 9 performed worse, especially the boys. In many cases the children entrained to each other while synchronising to the beat. Sometimes they lose the synchronisation with the beat completely for a while staying together in time. The entrainment is stronger (i.e. the time interval between the taps of peers are smaller) in the peers visible than in the peers hidden condition. The older children are more likely to entrain to each other than the younger ones.

Thursday 20 August 2015 — RNCM THEATRE
11.30-13.00 — SESSION 8A: THERAPY 2 — Chair: Stella Kaczmarek

Music education and music therapy in schools for children with special educational needs: Similarities, crossovers and distinctions

Sarah Mawby
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Music education and music therapy have long been shown to be beneficial to the education and wider development of children with special educational needs and disabilities (SEND). However, it has been acknowledged that there are many similarities between the two practices when both are provided in schools for children with SEND. As such, it is difficult to ascertain what constitutes music education and what constitutes music therapy in SEND school settings. This research paper explores the similarities, crossovers and distinctions between music therapy and music education in SEND schools by considering qualitative research data gathered from two recent case studies. The research explores practitioners' views of what constitutes music education and what constitutes music therapy within the schools in which they work. Semi-structured interviews were carried out with three key practitioners at each school. Observations of music lessons and music therapy sessions were also conducted. Analysis of interview data was carried out using the principles of Interpretative Phenomenological Analysis. Results show that, despite some key differences in approach, several similarities exist between the practices of music education and music therapy in each SEND school. This is in-keeping with findings from previous research. However, it can also be seen that crossovers between each practice vary widely between the two schools depending on the way in which music therapy is integrated into the curriculum. Whilst generalizations cannot be made from such a small sample, the wider implications and potential impact of these findings are considered and ideas for further research are presented.

Improvisation and change in music therapy sessions: Exploring individual difference

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Music therapy has been suggested to help children with autism (e.g. Geretsegger et al., 2014). Broad comparisons between clients suggest that there are general improvements in aspects associated with communicative behaviour and joint attention. Such findings are usually reached by focusing on subsections of sessions for detailed analysis or by looking at separate outcome measures (e.g. Geretsegger et al., 2014, Kim et al., 2008). We analysed four videos of complete Nordoff Robbins music therapy sessions. One early and one late session of client-therapist pairs were annotated using a previously developed protocol (Spiro et al., 2014) in order to examine whether change can be identified in the individual player's characteristics including, the amount of shared pulse, and where the players are facing. We find that the characteristics that show change are not identical across clients and suggest that charting the range of possibilities of what might or might not change in music therapy for different clients will help reach a more nuanced understanding of the nature of change and interaction in this context.

Effects of cognitive hypnotherapy and eye movement desensitisation and reprocessing on music performance anxiety in advanced pianists

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School of Music, University of Leeds, UK

Many investigative studies have concluded that the cognitive behavioural approach to music performance anxiety (MPA) which focuses on the conscious mind may produce the best outcome; however little research has focused on implicit mental processes for the alleviation of this condition. This study investigated the effect of cognitive hypnotherapy (CH) and eye movement desensitisation and reprocessing (EMDR), therapies which target implicit processes. Fifty-two pianists (Grade 8 and above) from the Universities of Leeds and Sheffield and Leeds College of Music were tested initially in a pilot study of six followed by a further study of 46. Participants were of mixed gender aged 18-26 (49), with three over 30. They were randomly assigned to a therapy or control group. The therapy groups received two hour-long interventions of either CH or EMDR during a two-week period between two concerts. Quantitative data was collected through the Spielberger State-Trait Anxiety Inventory; a self-report questionnaire (SRQ); performance assessment; perception of therapies; and gender differences. Qualitative assessment was conducted through the SRQ and a subjective log of longitudinal performance experiences. The results showed that both therapy groups experienced a significant reduction in both state and trait levels of anxiety at the second performance and that performance was significantly improved in these groups but not in the control. Longitudinal testing of trait anxiety at four months and one year demonstrated that significant decreases from baseline were still maintained. This finding, using a large sample, has not been previously reported and is an important area for future research.

Making sense of music: Meanings children and adolescents perceive in musical materials

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What do young people hear when listening to music? Researchers have often privileged uses and functions of music in daily life, rather than exploring how children and adolescents understand music when they listen. This article reports on the third stage of a mixed-method nationwide UK enquiry concerning young people's subjective experiences of music. The third stage focused on meanings 10-18 year olds perceive in music. Participants with varying levels of musical training (N = 84) listened to 20 short musical extracts (30 s or less), heard through headphones, to which they gave free written responses. Prior general level of musical involvement (listening, playing and training) was assessed using the Music USE questionnaire. 10-c.13 year olds were more likely than older participants to experience induced affect, use first-person pronouns, describe self-in-scenario visualisations, and demonstrate vicarious experience through music. 16-18 year olds often utilized a more objective, detached mode of reporting characterised by a sense of connoisseurship. The mediating cognitive/evaluative effect of formal music education was apparent, both in technical vocabulary used and in an association between self-in-scenario fantasies and less exposure to musical training. Across the age range reports highlighted perceived meanings indirectly related or detached from original source specifications; participants made sense of music in relation to other media experiences, with mental imagery prevalent.

Tweens' and teens' engagement with music in daily life: Individual differences and psychological characteristics of subjective experience

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#Institute of Child Health, University College London, UK

Music is a pervasive presence in the lives of many children and adolescents. The everyday functions of music and the association between aspects of young people's musical engagement (e.g. uses of music, duration of musical training) and individual differences in personality (e.g. openness, conscientiousness) have attracted increasing research attention. Yet, the subjective experiences of this age group are little understood; to date no study has examined the relationship between personality and musical engagement as a multifaceted phenomenon (encompassing production and reception). This paper reports findings from stages one and two of a mixed method nationwide UK study of young people's subjective experiences of music. The aims were to: (1) explore the phenomenology of young people's everyday interactions with music; (2) examine the relationship between musical engagement and age, gender and personality characteristics. Stage 1: 34 participants (aged 10-18) were interviewed, completed a battery of established measures related to personality and engagement and kept unstructured diaries of music-listening experiences for 14 days. Stage 2: 511 participants (aged 10-18) completed a web-based questionnaire on musical engagement (production and reception), which was informed by findings from quantitative and qualitative findings from Stage 1. Openness to experience, conscientiousness and instability were associated with high involvement/attainment in playing an instrument. Imagination/fantasy proneness was associated with certain styles of engaged listening (particularly cognitive/emotional) and with engaged production. Frequency of listening, amount of self-chosen music and dissociative listening increased mid-adolescence, with girls more likely than boys to use music for self-regulatory purposes.

The use of music in everyday life and personality: A cross sectional study of a whole sample of school children in Germany

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#International Psychoanalytic University Berlin, Germany

The use of music (UofM) in everyday life plays an important role as mediator variable with regard to existing affect and emotion, personality, and different behaviour variables. Up to now, just three questionnaires exist which measure UofM. Using the IAAM (Inventory for the Measurement of Activation and Arousal Modulation) the aim of the present study was to evaluate a possible change in the UofM in dependency of personality variables in young school children. It was hypothesized that a remarkable increase in UofM especially for negative affect modulation will occur because emotional development in adolescence. 618 participants (12-19 years) completed the IAAM, the NEO-FFI and further questionnaires. The IAAM measures relaxation, cognitive problem solving, reduction of negative activation, fun stimulation and arousal modulation. Correlation and non-linear regression analyses shows a significant effect only in case of the UofM for positive stimulation in everyday live. Only females show an additional positive effect over the years with respect to the UofM for relaxation. Additional ANOVA analyses result in a clear effect of neuroticism on the first three IAAM scales which measure the modulating of strain, negative feelings and affect. With the restriction of the given cross-sectional design it seems that the UofM is developed also in younger children. No significant increase can be observed in case of the modulation of negative feelings as hypothesized. On the other hand the results indicate an important influence of personality and gender. Especially a high emotional lability causes a high UofM in everyday life.

Thursday 20 August 2015 **FORMAN LECTURE THEATRE**
11.30-13.00 **SESSION 8C: MOVEMENT 2** **Chair: Nicolas Farrugia**

Asymmetrical meter in Scandinavian folk music and dance: A case study of Norwegian telespringar

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Certain traditional Norwegian and Swedish dance tunes in triple meter are referred to as being in so-called asymmetrical meter – that is, the three beats in the measure are of uneven duration. Norwegian telespringar is recognized for a type of asymmetrical meter featuring a systematic long-medium-short duration pattern at beat level. These systematic microtiming patterns are often described in terms of deviations from an underlying isochronous pulse. However, it has been argued that performers' body motion may offer a more perceptually relevant structure of reference than an abstract fixed clock pulse. This study investigates whether the asymmetrical beat patterns previously shown in telespringar music are also represented in the body motion of performers who are playing and dancing. It is reported from two motion capture studies: first, a fiddler playing telespringar on a traditional Hardanger fiddle; second, a couple dancing telespringar. Motion analysis of the fiddler's foot stamping indicates a very regular long-medium-short beat pattern. In addition, the fiddler's upper-body swaying and the vertical motion of the body's centre of gravity in telespringar dancing are in synchrony with the bar level of the music. The fiddler's foot stamping confirm the long-medium-short beat duration hypothesis and support the view that the systematic microtiming features in telespringar are not a matter of deviation from an underlying isochronous pulse. Instead, they actually constitute an essential feature of telespringar.

Swinging to the beat – Movement induction in electronic dance music

Hauke Egermann, Alexander Förstel, Nico Lehrbach, Markus Wende
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Overt beat induction occurs when an individual, listening to rhythmic music, spontaneously starts moving her/his body in a synchronized manner – e.g. by tapping her/his finger or foot. However, it is not well understood which specific rhythmic features increase the likelihood of beat induction. An interesting candidate is the ‘swing’ parameter used in electronic music production, which induces a delay of every second eighth note and thus creates a swinging feeling. We tested within subjects the effects of three experimental factors on the intensity of beat synchronized movements: (1) Movement instruction (none/naïve vs. instructed beat synchronization), 2) the intensity of the swing-parameter, and (3) music excerpt. Three pieces of rhythmic electronic music with six different swing ratios each were randomly played to 18 participants. Bodily expressions of beat induction were measured using a motion capture system with reflectors attached to the subjects’ feet, hands and the head. In the naïve condition, the subjects were told that the reflectors will be used ‘later on’ for another part of the study. In the instructed condition, participants were explicitly encouraged to move to the music. The order of the conditions was randomised between participants. The motion capture data were transformed to the frequency-domain and the individual movement intensities were extracted at frequencies corresponding to the BPM of the stimuli. A repeated-measures Hierarchical Linear Model revealed that both condition and piece have a significant influence on the movement intensities. The swing parameter, however, exhibits only a weak, non-significant relationship with the beat-induction movements.

‘Moved by the Music’: Affective arousal, body movement and musical features of electronic dance music

Ragnhild Torvanger Solberg
Department of Popular Music, University of Agder, Norway

This paper explores the experience of pleasure and the desire to move to Electronic Dance Music (EDM) in two different settings. Additionally, it provides a detailed account of musical features and structural conventions of EDM associated with such experiences. The paper’s point of departure is the preliminary findings from two experimental empirical studies. In experiment 1 an optical motion capture system recorded body movements of 16 participants, dancing together in a club-like atmosphere to a DJ mix. In experiment 2, electrodermal activity, heart rate level and respiration of 24 participants were measured while they listened to EDM excerpts situated still and alone in a lab context. Both studies included questionnaires, gathering information about participants’ self-reported pleasure and bodily and affective appraisal of the music. Results from the dance study show correlations between specific features in the music, intensity of body movements and self-reported affective experience. The physiology study indicated correlations between physiological arousal, self-reported affective experience and the same musical features. Dance participants mentioned the club setting and moving together with others as important in reinforcing their affective experience. Interestingly, the physiology study participants reported about intensely pleasurable experiences and a wish to move despite sitting still and alone. Participants from both studies perceived features related to structural changes as especially pleasurable and causing a wish to move. Regardless of experiment setting and bodily involvement, both studies indicate correspondences between musical features and participants’ degree of movement or wish to move, and the intensity of their affective engagement.

Thursday 20 August 2015 **CAROLE NASH RECITAL ROOM**
11.30-13.00 **SESSION 8D: MUSIC LEARNING 2** **Chair: Helen Prior**

Solving traditional harmony exercises: A metacognitive perspective

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School of Medicine, Aristotle University of Thessaloniki, Greece

Metacognitive experiences in problem solving are very important, but the research so far is focusing on maths or text processing. The aim of this study was to investigate a form of problem solving concerning harmony exercises by examining (a) the effect of university studies (studying musicology or not), educational level (senior high vs. university) and gender on performance on traditional tonal harmony exercises, and (b) on metacognitive experiences, namely feeling of difficulty, estimate of effort, estimate of solution correctness, and confidence. The sample consisted of 50 students of senior high school and 30 university students of both genders, who all had a musical background (at least 8 years of music lessons). They were asked to solve four brief harmony exercises (9 meters each) that differed in the level of difficulty and their form (given basses or given melodies-soprano voice). Half of the participants were provided with theoretical instructions about the appropriate move for the inner voices that was needed for the solution of the exercises. Before and after each exercise they were asked to report on their metacognitive experiences. The analyses revealed a main effect of task as well as interactions of task with direction of studies, educational level, gender and instructions both in performance and metacognitive experiences. The presence of clear instructions interacted with task and affected the reported feeling of difficulty before solving the exercises, but not estimate of effort. After problem solving only the main effect of task was significant. In general the findings, although preliminary, show the importance of studying various aspects of metacognition applied on music education.

Peeling the onion: Interpersonal relationships in the music classroom

Catherine Preston
Sefton Music Hub, UK

The paper applies social penetration theory (Altman & Taylor, 1973; Taylor & Altman, 1987) to investigate how interpersonal relationships influence musical participation and learning outcomes during group music making. The research design draws on constructivist approaches to investigate collaborative learning that show how knowledge is shared and created and aims to highlight the links between musical participation, language and interpersonal relationships. Episodes of class music lessons recorded over three weekly lessons were transcribed and provided the data for analysis using an adaptation of a sociocultural discourse analysis framework. The framework is specifically designed for the study and description of classroom talk and is based on a typology for disputational, cumulative and exploratory talk. The adaptation incorporated both verbal and non-verbal aspects of musical participation. The analyses indicated that relational closeness, integral to social penetration theory, was a feature of successful musical participation when most of the talk was exploratory and/or cumulative.

Instrumental and vocal music teachers' views on a multi-disciplinary team approach to health promotion for musicians

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Performing Arts Medicine (PAM) has developed considerably since the 1980s; however, initiatives for preventing performance-related problems (PRPs) are still rare. Instrumental and vocal teachers have been identified as potential health promotion advocates who could work with representatives of a multi-disciplinary team (MDT) to support students' well-being. There is a lack of research investigating teachers' health-related experiences, beliefs and practices; the present study investigates these in relation to teachers' current and potential activities as health promotion advocates and members of MDTs. Thirteen teachers (selected on the basis of their willingness to participate, location, instrument, genre, and teaching environment) took part in semi-structured interviews. Transcripts were analysed thematically. Preliminary analysis indicates that teachers feel at least partially responsible for their pupils' well-being and assume the role of health promoters even though they do not generally believe that their training prepared them to do so. Interviewees reported learning about health-related topics during the course of their musical education from a wide range of sources, including those nominated in the PAM literature as appropriate members of MDTs. Most interviewees were unfamiliar with the concept of an MDT before the researcher introduced it towards the end of the interview. They were all receptive to the concept and agreed that it is appropriate for teachers to be considered health promotion advocates although they raised potential difficulties associated with developing an MDT approach to health promotion for musicians. Results will be of interest to musicians, providers of teacher training, PAM specialists, music colleges and universities.

Thursday 20 August 2015 **CONFERENCE ROOM**
11.30-13.00 **SESSION 8E: WORKSHOP 2**

Functional connectivity and the effects of music on the brain: An introduction to network neuroscience techniques and methods for music research

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Neuroimaging Laboratory for Complex Systems and Gateway MRI Center, Joint School for Nanoscience and Nanoengineering, University of North Carolina, Greensboro, USA

Network Science, based on graph theory, is a rapidly emerging analysis method for studying complex systems in terms of their components and the interactions between them. Embracing the brain as a complex network now offers a fuller understanding of how structural connectivity can lead to dynamic function. Within the brain, music affects an intricate set of complex neural processing systems. These include structural components associated with sensory processing as well as emotional and functional elements implicated in memory, cognition and mood fluctuation. Because music affects such diverse systems in the brain, it is an ideal candidate for analysis of unique individual responses using a network science approach. Network techniques are robust statistical procedures that can be successfully applied to in vivo neuroimaging data collected in real-time. Analyses can reveal patterns of both structural and functional brain connectivity. Based on the intricate brain systems affected by music, a network neuroscience approach provides a promising new method for studying individualized dynamic responses to music in the human brain. This workshop aims to provide an overview to network science techniques and methods and how they may be successfully applied to neuroimaging data for analysis. Included in this workshop is an overview of a network science approach to the brain as well as current techniques and in vivo data analysis methods. Also included in this workshop are more recent experimental results on the effects of music listening preferences on functional brain connectivity and the Default Mode Network.

Music and sadness: Definitions, functions, and rationales for engaging in negative emotions

Tuomas Eerola
Department of Music, Durham University, UK

Recently sad music and its effects on the listener have received considerable attention in music and emotion research. This symposium directly addresses the central puzzles of this topic, starting from definitions to prevalence and the underlying mechanisms, and the way these are all moderated by individual factors. Characterizations of the music-induced sadness typically reveal a wide range of associated emotions, underscoring the multidimensional nature of the phenomenon. Also, the mechanisms responsible can be complicated and not directly related to the music itself, since memories, lyrics, and social situations have been acknowledged to have strong role. These fundamental issues will be taken up by two first presentations, first of which broadens the scope by introducing non-pleasurable emotions associated with sad music. The second presentation connects and analyses the explanations with individual differences and with empathy in particular. Finally, the rationale for engaging in negative emotions is addressed by two other presentations offering alternate viewpoints. In the first of these, an acceptance-based coping is found to be an important goal in choosing to listen to sad music, and the second underscores the way regulation is impaired when suffering from depression. These two studies are particularly interesting angles to the topic since they not only explain the reasons for sad music listening also implicate both healthy and maladaptive coping tendencies and suggest ways these both are connected to individual differences. This symposium addresses the central issues of music and sadness from divergent perspectives and methods, and each presentation brings novel empirical data about issue under scrutiny.

Grief, melancholy, and sweet sorrow: Typology of music-related sadness

Henna-Riikka Peltola*, Tuomas Eerola#
**Department of Music, University of Jyväskylä, Finland*
#*Department of Music, Durham University, UK*

Sad music and its effects on the listener have received considerable attention in music and emotion research. The dominant psychological view considers sadness as one of the basic emotions that is experienced in the face of an unpleasant event, such as response to a loss. Often a distinction between active grief and passive sadness is been made. In the context of music these two categories are not directly applicable, since it has been shown that sad music induces mainly pleasant or mixed emotions at the most, although maladaptive aspects of sad music listening have also been presented. Hence, there remains a puzzle of how to characterize this elusive set of affects associated with sad music. The present study aims to expose and delineate music-related sadness. Empirical qualitative and quantitative data were collected to examine the emotions induced by sad music. Open-ended answers from 363 participants were analysed using thematic analysis. A follow-up survey of the attitudes, functions, and emotions related to sad music were collected from 1747 participants. The analysis revealed a range of emotions experienced while listening to sad music that were classified into three categories: Sweet sorrow, Melancholia, and Grief. These categories differed depending on the contextual aspects and the type of music that was described. Also, the mechanisms distinguished the categories. A quantitative analysis of the emotion terms and mechanisms associated with the identified categories supported the notion of their distinct qualities. The results suggest that negative emotions, particularly grief, have a place within music-related sadness.

The role of empathy in the enjoyment of sad-sounding music

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#*Department of Music, Durham University, UK*

Not everyone enjoys listening to sad-sounding music. However, those who do may have something else in common as well. By investigating individual differences in the enjoyment of sad-sounding music, we may not only uncover the personality factors that are associated with the pleasure drawn from sad music, but we can learn about the underlying psychological mechanisms as well. One trait that has been implicated in several previous studies is dispositional empathy. In this presentation we will review empirical evidence from three studies, and discuss the implications of the findings. In total, 310 participants took part in three listening experiments. The first of these experiments investigated the enjoyment of unfamiliar, instrumental sad-sounding music, the second experiment investigated the susceptibility to music-induced sadness, and the third investigated the subjective emotional responses evoked by sad music. The enjoyment of (and the emotions induced by) sad-sounding music were measured using rating scales, while the susceptibility to music-induced sadness was measured indirectly using an implicit evaluation test. Dispositional empathy was measured using the Interpersonal Reactivity Index (Davis, 1980). Dispositional empathy – especially the subscales Empathic Concern and Fantasy – was associated with both the enjoyment of sad-sounding music and the susceptibility to music-induced sadness. Empathic listeners' emotional responses to sad music could be characterized as "aesthetic sadness". Our findings suggest that there might be a link between empathically experienced emotions and enjoyment. As empathic people have a stronger tendency to empathize and resonate with those undergoing negative emotions, the same might hold true for sad-sounding music as well.

'Sad' music as a means for acceptance-based coping: An overview of relevant literature on self-identified sad music and recent studies on research

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People's most important self-regulatory reason for listening to SISM is in order 'to be in touch or express feelings of sadness'. But why would people who are already feeling sad want to do so? Previous research indicates that people in a negative affective state may first need to acknowledge their negative feelings before being able to move on to a more positive state. The aim of this research was to find out if SISM can be used in this way when feeling sad. It was hence, predicted that the use of SISM may serve as a form of acceptance-based coping via the recognition of, and identification of, emotional states. Participants (N = 220) recalled an adverse emotional event after which they had listened to SISM when experiencing sadness, and then rated several statements in relation to their music listening experiences. The content of these statements were based on insight from previous research on listening to SISM when feeling sad. The results of our analyses supported the hypothesis: Mores specifically, several parallel multiple mediation analyses indicated that using SISM to get in touch with and express emotions was the most important self-regulatory strategy (of six examined) through which acceptance was achieved across four music selection strategies. Implications for music therapy and emotional coping are discussed.

Sad music use in people with tendencies to depression

Sandra Garrido
Melbourne Conservatorium of Music, University of Melbourne, Australia

Recent research indicates that mood regulation is one of the primary reasons that people listen to sad music, and that it can be a successful strategy for processing negative emotions or obtaining other psychological benefits. However, depression is characterized by impaired capacities to regulate affect. Using Trapnell and Campbell's (1999) discussion of the 'self-absorption paradox' as a framework, this paper presents the results of a series of studies that indicate that people with tendencies to depression may not enjoy the same psychological benefits from listening to sad music that other people can.

Friday 21 August 2015 **CONCERT HALL**
09.00-11.00 **SESSION 9B: PERFORMANCE 2** **Chair: Anemone Van Zijl**

Pianists' use of nonverbal audio and visual cues during duet performance

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#*Institute of Music Acoustics, University of Music and Performing Arts, Vienna, Austria*

Musicians exchange nonverbal auditory and visual signals during duet performance to communicate their intentions and coordinate their actions. When structural characteristics of the music make predicting co-performers' intentions difficult (e.g. following long pauses), musicians may increase their attention to visual signals. Success at interpreting visual signals improves with experience in performing similar actions. Better synchronisation might therefore be achieved when duet pairs play the same instrument than when they play different instruments, especially at moments when successful interpretation of incoming visual signals is critical. This study tested whether attention to visual cues during piano-piano and piano-violin duet performance increases when structural characteristics of a piece make co-performers' timing difficult to predict. The hypothesis that same-instrument pairs (piano-piano) would synchronise more successfully than mixed-instrument pairs (piano-violin) was also investigated. Highly-skilled pianists performed the secondo part to three duets, synchronising with recordings of violinists or pianists playing the primo parts. Secondos' access to incoming audio and visual signals and to their own auditory feedback was manipulated. While the success of secondos' synchronisation with primo recordings depended primarily on the presence of primo audio signals, secondos used primo visual cues particularly effectively at entry and re-entry points in the music. Auditory feedback deprivation did not affect synchronisation. Some differences in the quality of synchronisation achieved by piano-piano and piano-violin duos were observed, but these effects were not consistent across pieces. Factors such as individual differences in the clarity of cueing gestures likely contribute to pianists' success at synchronising with violinists and other pianists.

Strategies for synchronization in music performance: The sniff

Dirk Moelants, Esther Coorevits
IPEM Department of Musicology, Ghent University, Belgium

Synchronization is an essential part of ensemble performance. Musicians use different strategies to start and keep playing together, including counting, explicit gestural cues or sniffing. The latter method is often used when musicians are not able to see each other, functioning as a sonification of a visual cue. Intriguingly, a single sniff does not contain explicit intervallic information. Nevertheless it is commonly used and appears to be a successful method to synchronize onsets in music performance. With this study, we want to gain insight in the practice of sniffing as a method of synchronization: test its efficiency and the relation of the cue with tempo and meter. Twenty pairs of experienced musicians participated in an experiment in which they indicated onsets by sniffing and then clapped together following instructions on a screen. They did not see each other during the experiment. Prescribed actions included both single, isolated claps and simple rhythmic patterns in three different meters (2/4, 3/4, 6/8) and three different tempi (fast, medium, slow). The results show that indicating onsets with a single sniff is fairly successful, asynchronies staying below 200 ms, with an average of 70 ms. A typical sniff had a duration between 300 and 800 ms, getting longer at slower tempi, but a relation with meter was not found. Despite this variation in duration, the time interval between the end of the sniff and the first clap stays relatively constant around 200 ms, with the person who gave the cue usually clapping first.

Putting yourself in someone else's shoes (or at someone else's piano): A TMS study of the use of simulation for temporally accurate musical turn-taking in duets

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#MARCS Institute, University of Western Sydney, Australia

Coupling between sensory and motor representations has been well documented for familiar actions, and is strongest when the series of actions has been previously practised. One explanation for such coupling is the use of internal motor simulations to predict the outcome of both observed and produced acts. In this study we investigated the causal role of simulation in joint musical action, specifically its role in turn-taking. We constructed piano duets in which each pianist used only one of their hands in a series of alternating solos. Participants had one week to memorise the duets, half of which included their co-performer's part. In the experiment pianists played the right hand of these duets with a videoed partner, during which we temporarily disrupted the right dorsal premotor cortex (dPMC) or the supplementary motor area (SMA) using double-pulse transcranial magnetic stimulation around the turn-switch. We analysed the accuracy of the participant's entry, calculated as the mean absolute asynchrony between the participant's first keystroke and the ideal keystroke position. If pianists had previously practised their co-performer's part, stimulation of either the dPMC significantly reduced the absolute accuracy with which they entered for their own part in relation to sham. There was no such difference in performance accuracy for SMA stimulation, or for dPMC stimulation when the co-performer's part had not been practised. This shows that the motor simulation of a partner's part is causally involved in planning the accurate entry of one's own part, and strongly suggests that simulation functions to facilitate temporal coordination in interaction.

Relationships between performers' intentions and observers' perception of embodied expression in collaborative classical music performance: A case study of a flute and marimba duo

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#Melbourne Conservatorium of Music, The University of Melbourne, Australia

Research indicates that performing musicians' bodily movements influence observer perception, and contribute to tightly coordinated collaborative music making. However, there has been little

examination of how duo performers' intentions and cues, embedded in memory during rehearsal to aid recall during performance, might relate to observer perception of performance. The current study investigates how duo performers' intentions and cues relate to observer perception of embodied audio-visual expression in classical music performance. We expected that performing musicians' performance intentions and cues would be detected by observers as embodied expression witnessed in an audio-visual recording of a duo performing live. Two female expert classical musicians (one vocalist, one percussionist) independently analysed an audio-visual performance recording of an expert flute and marimba duo using Laban effort-shape analysis. The female duo performers reflected on, and documented their performance intentions and cues (expression, coordination, or technique), using the performance recording as a prompt. The data were divided into one-second 'bins', which were examined for performer(s) intentions and observers' allied effort-shape analyses. Almost all intentions and cues were matched with observations of embodied expression; about one third by both observers. Observers documented effort-shape analyses in significantly more bins than performers reported intentions, suggesting that characteristics beyond performer intentions and cues, but related to generating the performance, affected perception of the duo performers' embodied expression. Individual differences in the frequency and type of performer intention and observer effort-shape analyses were reported. Understanding how performers' individual and shared intentions are embodied in collaborative music making and perceived by observers may contribute to enhancements in performance training.

Friday 21 August 2015	**FORMAN LECTURE THEATRE**	
09.00-11.00	**SESSION 9C: PERCEPTION**	**Chair: Richard Parncutt**

Musical accent in action: Does auditory-biography influence accent perception in live music performance?

Cynthia-Louise Dellit
School of Creative Arts, University of Newcastle, Australia

This study examined musicians' perceptions of accenting within a complex ecological listening experience. Accent contributes significantly to performers' expressive communication in music performance. Despite agreement concerning complexity, a definition of accent remains elusive. Studies from artificial intelligence, musicology, music psychology, and neuro-cognitive sciences indicate multiple expressive parameters implicated within accenting nuance. Potential relationships between inter-performer accent perception and auditory-biography, i.e. personal listening history, have been little examined. To my knowledge, the current investigation represents a novel research endeavour. The trial was led by the performer-as-researcher using sound stimuli of live music performance. A group of 39 tertiary music performance students listened to excerpts of live music performed consecutively by bassoon, flute, and tin whistle. Listeners were asked to mark beat onsets which they perceived as being highlighted or standing out in some way. Five different accenting patterns, using widely varied accent characters, were presented in randomised order. Data were pre-processed using Signal Detection Theory (SDT), then analysed with general linear models using inference via Bayes factors (BF). The general linear models included factorial ANOVA-equivalents as well as univariate simple effects analyses. The high-voice superiority effect hypothesis was not supported in this context. There was, however, an effect of low-voice superiority such that rhythmic perception rather than melody received enhanced auditory encoding, thereby facilitating perception of the lower-voiced instrument particularly for the listeners with bass instrument experience. Results indicated correlations connecting perceptual accent accuracy scores and auditory-biography, including possible influences of timbral familiarity/unfamiliarity and instrument of specialisation.

Biases in the perception of dynamics in harpsichord performance

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It is widely claimed that it is not possible to vary dynamics on the harpsichord through touch; however, recent studies on single tones show that small dynamic differentiation can be obtained depending on the type of keypress. These differences are perceived accurately in comparisons of single tones; within a musical excerpt, they may be harder to detect, especially if biases exist. This study explores whether preconceptions regarding the ability of the harpsichord to produce dynamics influences perception of such differences. Two experiments are detailed: Experiment 1 uses two participant groups to test the effect of a bias (factor 'cover story') in the perception of two types of musical excerpt (factor 'stimulus set': dynamic variation performed/no dynamic variation performed). Experiment 2 adds a set of artificially manipulated excerpts to the stimuli, and presents all trials to participants in a fully within-groups design. Results of Experiment 1 show a main effect of stimulus set ($F(1, 30) = 24.01$, $p < .001$). Experiment 2 results show a main effect of cover story ($F(1, 81) = 80.67$, $p < .001$), and of stimulus set ($F(2.30, 186.41) = 24.60$, $p < .001$), with no interaction. The main effect of the stimulus set in both experiments demonstrates that it is possible to effect the perception of dynamics in musical excerpts. These results have implications for the understanding of historical performance practices.

Effects of musicianship and experimental task on perceptual segmentation

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#Department of Architecture, Design and Media Technology, Aalborg University, Denmark

The perceptual structure of music is a fundamental issue in music psychology that can be systematically addressed via computational models. This study estimated the contribution of spectral, rhythmic and tonal descriptors for prediction of perceptual segmentation across stimuli. In a real-time task, 18 musicians and 18 non-musicians indicated perceived instants of significant change for six ongoing musical stimuli. In a second task, 18 musicians parsed the same stimuli using audio editing software to provide non-real-time segmentation annotations. We built computational models based on a non-linear fuzzy integration of basic and interaction descriptors of local musical novelty. We found that musicianship of listeners and segmentation task had an effect on model prediction rate, dimensionality and components. Changes in tonality and rhythm, as well as simultaneous change of these aspects were important to predict segmentation by listeners. Our results suggest that musicians pay attention to more features than non-musicians, including more high-level structure interactions. Prediction of non-real-time annotations involved more features, particularly interactions thereof, suggesting high context dependency. The role of interactions on perception of musical change has an impact on the study of neural, kinetic and speech stream processing.

39. The cognitive representation of recursive processes in music

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#Faculty of Medicine, University of Lisbon, Portugal

The human ability to process hierarchical structures has been a longstanding research topic. However, the nature of the cognitive machinery underlying this faculty remains controversial. Recursion, the ability to embed structures within structures of the same kind, has been proposed as a key component of our ability to parse and generate complex hierarchies. Here, we investigated the cognitive representation of both recursive and iterative auditory structures. The experiment used a two-alternative forced-choice paradigm: participants were exposed to four-step processes in which pure-tone sequences were built either through recursive or iterative processes, and had to choose the correct completion. Foils were constructed according to generative processes that did not match the previous steps. A significant proportion of non-musician participants (20 out of 30, binomial test: 67%, $p < 0.05$) scored above chance ($M = 71\%$, $SD = 18\%$). Musicians ($n = 18$) scored significantly higher than non-musicians, suggesting that musical training facilitates the representation of auditory recursive processes. Crucially, participants' performance followed a typical learning curve and was consistent across different foil categories, suggesting that they acquired an abstract rule to solve the task instead of using simple heuristics. Further experiments showed significant correlations between accuracy rates on recursive structures and performance on the Tower of Hanoi, a recursion-based game. Our results indicate that, as with visual recursive structures, humans are able to represent auditory recursive structures, although only musically-trained participants achieved accuracy rates comparable to those observed in the general population with visual recursion processes.

Friday 21 August 2015	**CAROLE NASH RECITAL ROOM**	
09.00-11.00	**SESSION 9D: FLOW**	**Chair: Ruth Herbert**

The relationship between music performance anxiety and flow amongst professional classical musicians, and its clinical implications

Susanna Cohen, Ehud Bodner
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For many classical musicians, music performance anxiety (MPA) is a debilitating phenomenon. Despite the high prevalence of MPA and evidence indicating that MPA tends to be persistent over time, very little help is generally given in the treatment of early symptoms of MPA or in the development of music performance skills. In contrast to the field of MPA, research into peak musical performance and 'flow' (the subjective state often associated with optimal performance) is still in its early stages. There are a handful of studies showing that student musicians experience flow, however the flow experiences of professional musicians have not yet been investigated. Recent studies with students have shown that flow and MPA are antithetical experiences, implying that facilitating flow may provide a useful tool for alleviating MPA, as well as encouraging optimal music performance. Cognitive-Behavioural Therapy based interventions have been found to be most effective in reducing MPA and it has been proposed that music-enhanced interventions maybe particularly effective for treating musicians, however no such interventions for facilitating flow and reducing MPA are currently available. This paper presents the results of a preliminary study investigating the relationship between MPA and flow amongst professional classical musicians. The results provide evidence of a significant negative association between flow and MPA. Based on these findings a proposed music-enhanced CBT-based group intervention to reduce MPA and facilitate flow will be described. The study is part of a PhD research project.

Influence of personal traits and musicality on flow experience during radio reception

Benedikt Spangardt, Nicolas Ruth, Holger Schramm
Department of Media and Business Communication, University of Würzburg, Germany

From an economic perspective, listeners are the most important factor in success for a radio station. The main goal for any Adult Contemporary (AC) or Contemporary Hit Radio (CHR) broadcasting company is therefore to get people to listen to their program, and then not to switch to another station or turn off the radio. When people enjoy a radio program, and especially the music, they are more likely to stay with that radio station. One way to explain how radio stations provide enjoyment through their music programs is the concept of flow. Flow, and thus also enjoyment, can arise during media reception when the challenge of the content and the skill of the content user are balanced. Personal traits, musicality, music genre preferences and the personal listening modes are crucial for the enjoyment and a flow experience during reception, especially when listening to music on the radio. Therefore we ask: Which skills and personal traits are the best predictors for a Flow experience during the reception of a music-based radio program? In a laboratory experimental setting, 392 participants listened to one of eight different radio programs with a music program that systematically varied in terms of complexity and publicity of the songs. Flow experience was measured just after this procedure. Multiple regression showed that the most important predictors for Flow experience are neuroticism and the individual's propensity for motoric listening. The less neurotic listeners are and the more they have a motoric listening mode, the more they enjoy broadcast music programs.

Engagement with performance and burnout among music performance students

Anna Zabuska*, Jane Ginsborg*, David Wasley[#]
**Centre for Music Performance Research, Royal Northern College of Music, UK*
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Long hours spent practising and performing can take their toll, impairing the psychological and physical well-being of music students and thereby affecting their performance. Despite growing interest in the well-being of music students, engagement and burnout reflecting attitudes towards music making remain unexplored in the context of tertiary music education. The study aimed to establish and compare levels of engagement and burnout among performance students at conservatoires in Australia and the UK, and to explore their possible antecedents and health- and practice-related consequences. Basic Psychological Need Theory (Deci & Ryan, 2000), seeking to explain the role of satisfaction of autonomy, competence and relatedness in well-being, was used as the theoretical framework for studying the potential determinants of engagement and burnout. The data were collected using a questionnaire combining several well-established psychological measures. Music performance students (N = 146) at a single conservatoire in Australia (n = 54) and various conservatoires in the UK (n = 92) responded to the questionnaire. Respondents tended to report moderate to high levels of engagement, and burnout was not prevalent in the sample. Overall, there were no differences between students in Australia and the UK in terms of engagement and burnout. Moderate to weak positive correlations emerged between need satisfaction and engagement. Burnout correlated with the satisfaction of all needs negatively and moderately. Associations between engagement and burnout, and need satisfaction were strongest for need for competence. Burnout correlated positively and weakly with physical symptoms and musculoskeletal pain. Correlations between engagement and burnout, and practice, were weak or not significant, respectively. To conclude, the study suggests that competence, and, to a lesser extent, relatedness and autonomy satisfaction may play a role in shaping music-related well-being in performance students, and thus contribute to healthy careers in music.

In quest of the autotelic personality among professional orchestral musicians

Evelyne Huber, Helmut Leder, Manuela M. Marin
Department of Basic Psychological Research and Research Methods, University of Vienna, Austria

Flow is a state of consciousness characterized by complete immersion in an activity for its own sake, leading to altered time perception, loss of self-consciousness, and the feeling of happiness. The concept of an 'autotelic personality', i.e., a disposition to actively search for challenges and flow, was also proposed. The study of flow in the context of work and sports has shed light on the conditions leading to flow (e.g., personality traits such as locus of control) as well as on the positive outcomes of flow (e.g., higher degrees of well-being and resilience). However, little is known about autotelic personalities among musicians. We investigated whether flow among professional musicians would be related to personality traits that have been identified as significant predictors and outcomes of flow in other domains than music. We also examined the relationship between flow and high achievement. 157 professional musicians from ten Austrian symphony orchestras participated in the study. Questionnaires measuring dispositional flow, resilience, emotional self-efficacy, locus of control, the Big Five personality traits, stress reactivity, and implicit motives were administered. Information on the musical background and measures of professional success were collected. Regression analyses revealed significant positive associations between flow states during orchestral performance and age, internal locus of control, emotional self-efficacy, implicit motives and resilience, respectively. The idea that flow is related to high achievement was not supported. Our results show that personality traits related to flow outside the musical domain are also of critical relevance to music performance and thus may be domain-general.

Friday 21 August 2015 — **CONFERENCE ROOM**
09.00-10.30 — **SESSION 9E: MUSIC PERCEPTION**

Chair: Emilios Cambouropoulos

Chord perception and frequency of occurrence: Samples from works by J.S. Bach and The Beatles

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#Computer Science Department, The University of Sheffield, UK

This study investigates the perception of chords in isolation, and considers how their perception is influenced both by the frequency of their occurrence and by their acoustic features. Listeners tend to judge frequently occurring stimuli more favourably and often consider such stimuli to be important cognitive references, which suggests that frequency of occurrence is an important factor in chord perception. Twelve types of chord played in piano and organ timbre were examined, and three approaches were taken. The first approach tested how consonant, pleasant, stable, and relaxing 33 listeners found these chords. The second approach involved counting the number of times each chord type appears in J.S. Bach's Italian Concerto and in 30 best-selling songs by The Beatles in order to gauge listener familiarity. The third approach focused on extracting certain sound features from chords using MIR toolbox. Listeners judged major triads to be the most consonant, while augmented major sevenths were judged the least consonant. Chords in organ timbre were perceived more negatively than those in piano timbre. ANOVA found the significant main effect of Chord Type on C/D ratings: $F(5.59, 167.69) = 32.512$, $p < .001$, and that of Timbre: $F(1, 30) = 17.463$, $p < .001$. There was also a significant interaction between Chord Types and Timbre for Tension ratings: $F(11, 330) = 2.145$, $p = .017$. Chords that were perceived as consonant also tended to appear more frequently in the sample pieces of music. Regression analysis shows that both frequency of occurrence and acoustic features predict listener ratings well.

Conceptual blending and meaning construction: A structural/hermeneutical analysis of the 'Old Castle' from Musorgsky's Pictures at an Exhibition

Costas Tsougras, Danae Stefanou
School of Music Studies, Aristotle University of Thessaloniki, Greece

Conceptual blending is a cognitive theory proposing the combination of diverse conceptual spaces for the creation of novel blended spaces. Musical conceptual blending can be intra-musical, pertaining to the combination of diverse structural elements for the creation of new melodies, harmonies or textures, as well as cross-domain, involving the integration of musical and non-musical spaces for the creation of novel analogies or metaphors. The present paper presents a structural and hermeneutical analysis of 'Il vecchio castello' from Modest Musorgsky's Pictures at an Exhibition in an attempt to disclose both the intra-musical (combination of modal, tonal and colouristic harmonic spaces) and the extra-musical (contextual, symbolic and programmatic aspects) conceptual blending that the work incorporates. The analysis reveals that the piece comprises seven strophes of a song form that emerge from a common melodic core, through the dynamic evolution of harmonic spaces from diatonic modality to impressionistic/colouristic chromaticism and with the combinatorial use of ten harmonization concepts. The reductional/prolongational analysis provides input for two distinct Conceptual Integration Networks, the first describing the intra-musical blending of melodic harmonization and the second proposing the cross-domain blending of the musical and pictorial input spaces into a blended hermeneutical space that projects the work's narrative/programmatic/emotional potential. The proposed analysis shows how musical structure promotes meaning construction through cross-domain mapping. This research suggests that conceptual blending theory as an analytical tool can promote a richer structural interpretation and experience of Musorgsky's work.

Parsifal and the effect of narrative on unconscious arousal

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#Musicology Department, University of Oxford, England

After reading Schopenhauer's The World as Will and Representation, Wagner firmly believed that music held a privileged position in a listener's artistic engagement when compared to other elements such as narrative. This belief poses an operationalizable question: To what extent to does context play in an individual's artistic experience? Our aim was to investigate how contextual information influences an individual's musical experience using measures of explicit and implicit emotional arousal. This experiment used a between subjects design (N = 32) that divided participants naive to Wagner's Parsifal into two groups. The first group was given a narrative that depicted the events from a provocative scene from Parsifal, while the second narrative was created to employ the overused "three-tasks-to-save-the-princess" trope. Both implicit and explicit levels of emotional arousal were measured using skin conductance response and self-reported emotional engagement (Zentner, 2008). After the listening phase, participants were asked to take an explicit memory quiz to probe what musical material they retained. Significant differences were found between groups in skin-conductance response with the provocative scene generating more unconscious arousal as predicted. Additionally, participants significantly rated the false narrative more peaceful and tender. These novel findings using music are consistent with evidence found in other domains of aesthetic appreciation that suggest that context plays a significant role in an individual's engagement with art. These findings also suggest the importance of framing what type of knowledge an audience is given before musical performances in order to fully maximize their emotional engagement.

Friday 21 August 2015 **RNCM THEATRE**
11.30-12.30 **SESSION 10A: SADNESS** **Chair: Brigitta Davidjants**

The pleasures of sad music: A systematic review

Matthew Sachs, Antonio Damasio, Assal Habibi
Brain and Creativity Institute, University of Southern California, USA

Sadness is generally seen as a negative emotion, a response to distressing and adverse situations. Yet in an aesthetic context, sadness is often associated with some degree of pleasure, as suggested by the ubiquity and popularity, throughout history, of music, plays, films and paintings with tragic content. Here, we examine the issue of music that albeit considered as sad is usually experienced as pleasurable. Compared to other art forms, music has an exceptional ability to evoke a wide-range of feelings and is especially beguiling when it deals with grief and sorrow. Why is it, then, that while human survival depends on preventing painful experiences, mental pain often turns out to be explicitly sought through music? In this article we review the facts and interpretations of why and how sad music can become pleasurable. Sadness evoked by music is found pleasurable when (1) it is perceived as non-threatening; (2) it is aesthetically pleasing; and (3) it produces psychological benefits such as mood regulation, recollection of and reflection on past events, and an empathic response. We also review neuroimaging studies related to music and emotion and focus on those that deal with sadness. Finally, we offer a framework to account for how listening to sad music can lead to positive feelings, contending that this effect hinges on correcting a homeostatic imbalance caused by complex interactions of mood, personality, and social context. Further exploration of the neural mechanisms through which stimuli that usually produce sadness can induce a positive affective state could help the development of effective therapies for disorders such as depression, where the ability to experience pleasure is attenuated.

Measuring sadness as a response to music in a live performance setting

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A large proportion of music and emotion studies use either bi-dimensional models or discrete models of emotion for measuring sadness responses in the listener. However, research suggests that this may be an over-simplification of our experience of sadness in an aesthetic context. This presentation reports on a study in which audience members were surveyed about their experiences of sadness in response to a live performance. The instruments included extended versions of the Geneva Emotional Music Scale and a questionnaire based on Juslin and Västfjäll's BRECVEMA framework. Results suggest that experiences of sadness in response to music can be both positive in valence and high in arousal, contrary to most understandings of sadness, and that the pleasantness or otherwise of the experience may be related to the mechanism (particularly to memories, associations, and visual imagery) by which the emotion is evoked. Results also indicate that the contextual aspects of a live performance such as the ambience of the venue and the response of other audience members also contribute to emotional experience. These results suggest that current models for measuring emotional response to music may not be sufficiently sensitive for measuring the complex ways in which sadness can be experienced and that further investigation of emotion-induction mechanisms outside of laboratory situations is warranted.

A musicology of performance? Complex systems and the non-linearity of expressive variation

Dorottya Fabian
School of the Arts and Media, The University of New South Wales, Australia

Contemporary inter- and transdisciplinary research has increasingly demonstrated the complex nature of music performance. Psychological, historical, ethnographical, computational, neurological, etc. approaches provide rich and diverse insights, at times overemphasizing one or another aspect of this complexity. Taken together they show there is no obvious limit on viable performance options and therefore no best singular-linear approach for its study. The aim of this paper is to argue that music performance is best understood as a complex dynamical system with a multitude of diversely layered interactions, loops and circuits. I analysed over 40 post-1975 recordings of J.S. Bach's Solo Violin Sonatas and Partitas for standard performance features (e.g. tempo, timing, phrasing, bowing, ornamentation, etc.) in relation to perceived effects on aesthetic qualities (expressiveness, style, affect). The recordings were contextualised with historical, biographical and cultural information regarding the violinists and issues of performing baroque music. I compared the results to characteristics of complex dynamical systems and found that eight aspects of these were also typical of the analysed recordings. Through examples the paper demonstrates the importance of analysing the interaction of performance elements because essentially similar uses of a performance feature (e.g. dynamics or bowing or tempo fluctuation, etc.) can contribute to diverse stylistic outcomes depending on differences in the interactions with other features. This supports my claim that approaching music performance as a complex system is the key to unpacking the mechanisms that contribute to ever changing interpretative styles and the individuality of each performance, whether achieved through edited studio recordings or live concerts.

Being on stage: Capturing the experience of music performance

Anemone G. W. Van Zijl
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The performance of music is a very complex human activity. Various aspects of music performance have been studied. Few studies, however, have tried to capture musicians' experiences on stage in their full complexity. The present study aims to capture what performing musicians experience on stage, analyse its various components, and construct a theoretical model of how these components interact. Qualitative in-depth interviews were conducted with nineteen musicians teaching or studying at a European conservatoire. In the interviews, musicians were asked to describe a recent performance experience in as much detail as possible, to make a visual representation of their experiences on stage, and to answer questions about performing music in general. Various strategies of analyses were used to analyse the data and triangulate the findings. Interpretative Phenomenological Analysis (IPA) of the interview transcripts revealed that musicians' experiences on stage are complex composites of cognitive, perceptual, embodied, and affective components – fluctuating over time, and in relation to the music, co-performers, and audience. The findings of this study provide new insights into the various components involved in music performance, and give a comprehensive view of what performing musicians experience on stage.

Performance expertise of DJs in the club-context

Alexander Förstel, Hauke Egermann
Audio Communication Group, Technische Universität Berlin, Germany

Recent theories on musical interaction propose a close, inherent relationship between music and body movements both within the performer and the recipient. This interconnection is especially strong in the club context, where danceable music with pronounced rhythmics is played by DJs. We investigated which movements occur during a DJ performance, and whether these movements differ according to the degree of expertise of the performer. Further, we are interested in which (stereotypical) movements are used by DJs to interact with their audiences. An explorative video content analysis of 8 professional and 6 semi-professional DJ performances was conducted. For both groups, we analysed the amout of time spent with operating the equipment, with dancing and with gestures, by developing descriptive categories. Additionally, we looked for specific individual characteristics within the performances. The video analysis revealed that professional DJs dance much more than the semi-professionals, show largely idiosyncratic behaviour and vary in their gestural expressiveness. Some professional DJs use expansive gestures to address the audience, whereas this does not occur in the semi-professional group. Beyond that, professionals spend more time operating the mixer and less time operating the players than semi-professionals. We conclude that professional DJs have developed a distinct 'performance expertise', allowing them to set the energy level and to lead a crowd through the evening, whereas semi-professional DJs seem to react in a more passive way to the overall situation. Additionally, professional DJs operate their equipment almost continuously, often beyond the mere creation of a smooth transition to the next track.

Friday 21 August 2015 — **FORMAN LECTURE THEATRE**
11.30-13.00 — **SESSION 10C: MUSIC AND THE BRAINChair: Robin Wilkins**

Whole-brain functional connectivity during naturalistic music listening: Effect of musical training

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Musical training has been found to have an effect on both the morphology and functionality of the brain. However, little is known about its effect on functional integration between different parts of the brain while listening to music. We investigated differences in functional connectivity of the brain between musicians and non-musicians during naturalistic music listening conditions. Brain responses of 36 participants (18 musicians and 18 non-musicians) were recorded using functional magnetic resonance imaging (fMRI) during continuous listening of three musical pieces of different genres. Whole-brain functional connectivity analyses were performed using a graph-theoretical approach. Various measures of integration and segregation were determined per subject, including voxel-wise degree and efficiency, as well as community structure. Group-level measures were determined both on the level of the whole participant pool and within the two groups (musicians and non-musicians). Musicians were found to have higher connectivity from sensorimotor and cerebellar networks in terms of both degree and efficiency. Non-musicians, on the other hand, displayed higher connectivity from parts of the default mode network. Community structure analyses suggest that musicians have more consistent network structure over non-musicians within motor areas and enhanced connectivity between sensorimotor areas of cerebellum and temporal poles. The results indicate a cross-modal transfer effect between musical training and music perception, in which auditory-motor training leads to stronger integration of motor areas to other areas during music listening.

Prominent cerebello-hippocampal connectivity in musicians during music listening

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The acquisition of fine motor skills through intensive musical training can modify both function and structure of the brain. Previous research has found that the hippocampus and cerebellum interact during spatio-temporal prediction of motor sequences following preceding visual cues. This phenomenon has however not been studied in the context of music with musically trained and untrained individuals. We hypothesized that differences in functional connectivity of this network may exist between groups during continuous listening to music. In particular, we expected musicians to exhibit stronger cerebello-hippocampal connectivity than nonmusicians as they anticipate musical events. Functional connectivity was measured as the temporal coactivation between the averaged voxel time courses of the hippocampal area and all cerebellar voxel time courses. Preliminary findings showed that the strength of the cerebello-hippocampal network was increased in musicians compared to nonmusicians during music listening. This phenomenon may be explained by musicians' anticipatory imagery in response to the musical flow, aiding in the prediction of subsequent musical events. From an embodied cognition perspective, musicians may be mentally simulating motor sequences needed to produce the music. This simulation is facilitated via strengthened coupling between produced and heard sounds through life-long instrument practice. Thus, our findings may indicate that musicians' spatiotemporal prediction of fine motor actions, as observed in the cerebello-hippocampal connectivity, can also occur during music listening: during perception they perform action simulation. Thus, listening to the sounds triggers the motor program associated to that sound.

intracranial evidence of the modulation of the emotion network by musical structure

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A number of brain areas have been linked to the processing of musical emotions. However, the extent to which musical structure alone, in the absence of perceivable or explicit emotion, modulates these areas remains an important topic for new research. The current study examined the extent to which musical structure modulates areas of the brain commonly associated with emotions in music. Advantage was taken of the spatial and temporal resolution of intracranial electroencephalography (iEEG) recordings, which can be collected from epileptic patients implanted with depth electrodes for presurgical evaluation. Participants were presented with short melodies, whose individual notes had been characterized in terms of Information Content (IC) - a measure of the structural predictability of each note, given its preceding context. iEEG responses to these notes were then examined to determine the extent to which IC predicted activity in and between the different brain structures recorded from in the frontal, parietal and temporal lobes. Modulation of neural activity by the IC of notes was found in, amongst others, the parahippocampal gyrus and anterior cingulate, confirming the role of such structures not just in the processing of valence and basic emotions, but also in the processing of musical structure. Further, Granger causality analysis demonstrated that low and high IC notes differed in the degree of causal flow they induced within and between the medial and lateral areas of the temporal and frontal lobes.

Constructing adaptive tests of musical ability

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The Goldsmiths Musical Sophistication Index is a research tool recently developed to address the multi-faceted nature of musical skill and expertise. It currently comprises a 38-item self-report questionnaire and a battery of listening tests. The present study is concerned with producing adaptive versions of these listening tests, using the powerful framework of Item Response Theory (IRT). Adaptive tests choose successive questions based on the participant's previous responses and therefore tend to be much more efficient than non-adaptive tests. However, within IRT, adaptive tests are typically very expensive to construct, as the difficulty of each test item needs to be estimated empirically by testing hundreds of individuals. This study therefore proposes and implements a much more efficient way of calibrating adaptive tests. Test items are constructed to vary along several controllable dimensions known to influence item difficulty. The exact relationship between these dimensions and item difficulty is then quantified in a calibration study. The resulting information allows the generation of a potentially infinite number of automatically calibrated test items. This methodology was applied to the construction of an adaptive beat perception test, where participants judge how well a beep track aligns to an excerpt of instrumental music. A measure of alignment derived from circular statistics predicted item difficulty very well, $p < 0.001$, Pearson's $r = 0.94$, and the prediction was improved further by including effects of instrumental excerpt and direction of displacement. The resulting model was used to construct an adaptive beat perception test, currently being validating experimentally.

Validation of the Gold-MSI-Questionnaire to measure Musical Sophistication of German students at secondary education schools

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This study introduces an adapted German-language version of the Goldsmiths Musical Sophistication Index (Gold-MSI) inventory to measure musical sophistication in a sample of students in secondary schools. Data of 688 students (mean age = 12.94 [SD = 1.782]; female = 360; male = 326; ns = 2) from four Grammar Schools (n = 420) and three Middle Schools (n = 268) are presented. The questionnaire was distributed on paper copies and gathered musical sophistication as well as music-specific, demographic and socioeconomic background variables from the students. In addition to the students' self-report, the music teachers' assessments of each individual student on various dimensions and the school marks in the school subject 'Music' were assessed. Reliability and confirmatory factor analyses indicate acceptable to good subscale reliabilities (α = .623 to .825) and model fit indices (RMSEA = .053; CMIN/DF = 2.946; TLI = .786; CFI = .818) with the data from this student sample. Correlations between the different Gold-MSI subscales and the grades for the school subject 'Music' ranged from r = .081 to .431. Correlations with the existing self-attribution variables were between r = .176 to .576 and the correlations with the self-assessed motivation were between r = .341 to .576. Correlations were highest for the Perceptual Abilities (F2) and Musical Training (F3) as well as the General Musical Sophistication (F6) subscales and demonstrate their concurrent validity. In addition, a structural equation model indicates (RMSEA = .051, SRMR = .076, TLI = .777 and CFI = .790) significant relationships between the facets of musical sophistication and the assessed background variables, in particular. In summary, the results demonstrate that the German version of the Gold-MSI questionnaire can be used with students at secondary education schools.

Friday 21 August 2015 **CONFERENCE ROOM**
11.30-13.00 **SESSION 10E: WORKSHOP 3**

Introduction to CAMP – Computer-Aided Music Psychology

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In the last decade, significant steps towards more user-friendly and reliable software tools for musicological research have been made. This opens up opportunities for new experimental paradigms and methodologies that have been rarely employed in the past due to the large efforts involved. For example, experiments using a production paradigm are very time-consuming due to the necessary transcription step, which can be now significantly sped up using semi-automatic approaches. Moreover, modern computer-based methods allow characterising and comparing musical stimuli and experimental outcomes in a much more comprehensive, objective and flexible way. Particularly, numerical characterisation of stimuli and results allow for a more detailed modelling of music psychological processes. Likewise, corpus-based methods are a promising approach for incorporating aspects of music cultural background into cognitive models. Hence, these tools and data are likely to boost the development of cognitive and other music psychological models and to improve experimental productivity. Using freely available tools, such as Sonic Visualiser and the MeloSpyGUI, and data, such as the Essen Folk Song Collection or the Weimar Jazz Database, the participants of this workshop will be engaged in a hands-on introduction with carefully crafted samples, exercises and use-cases. A comprehensive overview of available tools, techniques and user-scenarios will be given.

Friday 21 August 2015 **MEZZANINE**
14.00-15.00 **POSTERS 2**

1. The emotional impact of leitmotifs in opera and film music

Henning Albrecht, Clemens Wöllner
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By listening to leitmotifs individuals often recognise certain emotions, given their recurrence to semantic and episodic memory. Since the use of leitmotifs in film music refers to Richard Wagner’s technique of leitmotifs, it seems worthwhile to analyse differences in the emotional impact of leitmotifs between opera and film. This study investigates the influence of relevant factors on the emotional rating of leitmotifs: First, the impact of presentation mode (audio vs. audiovisual), second, the familiarity with the leitmotifs and audiovisual sequences, and third, the influence of listeners’ musical and media expertise were analysed. Twenty-three participants were asked to rate eight leitmotifs from Richard Wagner’s The Ring of the Nibelung and Howard Shore’s film music to The Lord of the Rings regarding six basic emotions. The leitmotifs were first presented in an auditory-only version, and then as an audiovisual sequence. Finally participants reported their familiarity with the stimuli. While most participants neither knew the Wagnerian leitmotifs nor the corresponding scenes, the film leitmotifs and sequences were well-known. A number of significant differences in leitmotif emotion ratings were observed for multimodal presentation modes. Wagner’s leitmotifs showed stronger differences in the emotion ratings regarding the presentation context. Results suggest that if leitmotifs and films are unknown, emotional impressions are increased by the visual layer, since the film and opera images may not correlate with individual associations. If participants are familiar with the topic, leitmotifs may function as a substitution for visual images. Thus the emotional rating of leitmotifs is strongly affected by their familiarity.

2. Dissonance/roughness in Lithuanian traditional Schwebungsdiaphonie

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In contrast to Western art music, the dissonance-like sonorities in Schwebungsdiaphonie-cultures are at the core of the tonal structures. These cultures, although not abundant, are found in different locations all over the world (Cazden, Brandl, Messner, etc.). Sutartinės are a Lithuanian type of Schwebungsdiaphonie (Račiūnaitė-Vyčinienė, Ambrazevičius & Wiśniewska, etc.). On the one hand, the studies on psychoacoustic roughness and sensory dissonance are really big in number. The notions of roughness and sensory dissonance are usually considered as synonyms. On the other hand, it was proposed that ideal sounding of Schwebungsdiaphonie conforms to a maximum dissonance / roughness (Brandl, the diaphony in the Balkans and elsewhere; Ambrazevičius, the Lithuanian Sutartinės). In the present study, we analyse the occurrences of the notions of roughness and sensory dissonance in the psychoacoustic studies and define the case of Sutartinės in this context. The review of the experimental findings on the intervals corresponding to the maximum values of roughness / sensory dissonance reveals certain discrepancies between the concepts of roughness and sensory dissonance. It seems that, at least for a substantial frequency range, roughness is associated with larger interval sizes (Plomp & Levelt, Kameoka & Kuriyagawa, Terhardt, Zwicker & Fastl, Hutchinson & Knopoff, Vassilakis, etc.). Collation of these results and the findings of acoustical measurements of Sutartinė performances leads to the conclusion that the ideal vocal ‘clash’ in Sutartinės most probably corresponds to psychoacoustic roughness, but not to sensory dissonance.

3. The effect of musical culture on pictorial notations of pitch and tempo: How traditional and western-trained Greek musicians represent musical shape

George Athanasopoulos, George Kitsios
School of Music Studies, Aristotle University of Thessaloniki Greece

Previous studies have demonstrated how two-dimensional representations of music are affected by musical training, background culture and even literacy. Taking into consideration the above effects, in order to examine whether training in a specific musical style would affect the relationship between music and its visual representation, research was carried out involving Greek performers from similar cultural but different musical backgrounds (classical-trained musicians; traditional musicians and musicians from a mixed musical background, all familiar with Western Standard Notation). Our goal was to examine whether participants with common cultural but different musical background demonstrated any notable preferences while depicting musical stimuli in two-dimensional fashion. The procedure involved i) a free-drawn design in which participants heard short musical stimuli, varying in pitch and attack rate, and were asked to represent these graphically on paper, and ii) a forced-choice design in which participants had to match auditory stimuli with pre-constructed sets of marks varying in the representation of music articulation and directionality. There were no significant variations between the groups in the forced-choice design. In the free-drawn representation, two major styles of representation emerged: Symbolic Cartesian (SC), where reference to sound events took place through abstract symbols, while pitch contour (y axis) and time (x axis) were represented spatially on orthogonal axes; and Iconic Cartesian (IC), where reference to sound events took place through drawings which attempted to imitate the events as icons represented loosely in time (x axis). Musicians with western and mixed musical training opted for SC models of representation, while traditional musicians equally opted for SC and IC. Regarding the directionality of responses, there were no variations between the groups (all were horizontal and left-to-right). The results indicate that the association between music and shape could be affected by not only cultural parameters, but also by the musical performance background of performers. This could suggest that while western and mixed trained participants appear to take strongly into account the temporal aspect of music and produce structured SC representations linking music and its visualisation, traditional musicians adopt a more open approach to the task.

4. How does Progressive Rock sound? Perceptual facets of a complex genre identified using musical similarities

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Progressive rock was popular in the 70s and is defined by structural complexity, long instrumental parts and sound experimentation. Having lost its popularity, it is considered today as an 'expert's' genre. We attempt (1) a definition of the genre 'progressive rock' from a listener's perspective, and (2) test whether musical expertise and knowledge of the genre are required. We used triadic comparisons, in which 50 subjects chose the most similar pair of stimuli out of a triple. The stimuli consisted of 13 short progressive rock excerpts matched with 13 control stimuli, by rock bands from the same period and achieving similar commercial success. All possible triads were presented across participants using a balancing algorithm. The Goldsmiths Musical Sophistication Index was used to measure subjects' musical abilities, while a questionnaire assessed familiarity with the genre. Similarity judgments were analysed using multidimensional scaling. Participants performed poorly in the familiarity questionnaire (M = 30% correct answers), while they were able to perform the similarity task. A MDS model with three dimensions was sufficient to decompose the similarity matrix. These three dimensions were identified musically as corresponding to (a) Intense vs. Relaxed, (b) Keyboards vs. Guitars and (c) Clean consonant vs. Dirty dissonant. We found no significant difference between participants' similarity judgments, and no influence of familiarity with the genre. Despite the usual view of progressive rock as an expert's genre, it may not require (1) knowledge of progressive rock nor (2) musical training, to be identifiable by listeners.

5. Affect self-regulation through music: Which concepts do we use and how?

Margarida Baltazar, Suvi Saarikallio
Department of Music, University of Jyväskylä, Finland

Music engagement is often used for affect self-regulation, i.e. inducement, maintenance or change in affect by the individual. Research on the involved processes has been blooming over the last two decades; however, this is still an emergent field composed by a heterogeneous variety of traditions, approaches, and concepts. This research aims to identify the current frameworks used by researchers in the field, assess the overall state of conceptual clarity, and propose useful suggestions for future studies. The data was collected and analysed through an integrative literature review. From a systematic online search of databases, 34 publications were selected, analysed and interpreted. It was found that a wide variety of terms related to affective states – such as emotion, mood, feelings, and affect – and to regulatory processes – such as emotion regulation, mood management, and coping – is used in the field. As for conceptual clarity, this was hampered by the low rate of use of definitions (e.g., nearly half of the publications did not provide a definition for their targeted phenomena) and by the inconsistent use of terms (e.g., 12 of 34 publications used affective terms interchangeably). The review did not find a comprehensive model for music-based affect regulation. The amount of research on this topic is fairly small and the knowledge produced is not, yet, solid, clear, and cohesive across studies. Recommendations for future research are presented.

6. Intelligence and mode preference

Leonardo Bonetti, Marco Costa
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The relationship between fluid intelligence and the preference for major-minor mode was investigated in a sample of 96 university students. Intelligence was assessed by a subset of the Raven's Advanced Progressive Matrices (items 25-36). Mode preference was assessed presenting 20 pairs of musical stimuli, either melodies or chords, that varied for mode only. Mood and personality were assessed by, respectively, the Brief Mood Introspection Scale (BMIS), and the Ten-Item Personality Inventory (TIPI). Considering chord stimuli the preference for minor stimuli was significantly related to fluid intelligence; inversely related to Conscientiousness score in personality assessment, and positively related to Gloomy scale in mood assessment.

7. Predicting stimulus tempo and experiment instructions from music-induced movement

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#*Carleton College, USA*

Full-body movements reveal complex patterns of sensorimotor coordination to music, in particular rhythmic structures. However, the ways humans move differently related to systematic changes in musical tempo have not been extensively studied. Thirty participants took part in this motion capture study investigating whether movement characteristics were altered when 1) moving to the same music at different tempos and 2) asked to give a fast or a slow interpretation to music of the same tempo is examined. Six Motown songs reoccurred in two time-stretched versions at ±5 BPM of the original tempo, to which participants were asked to dance freely/spontaneously. Following this, the same songs were presented two times at the original tempo, with the participants being instructed to provide a 'fast/vigorous' and a 'slow/relaxed' interpretation. Two logistic regressions were conducted, one predicting the time-stretched trials, the other predicting the instructed trials, with 16 movement features as predictors. In the time-stretched case, Foot Acceleration and Body Rotation were found to be significant predictors with a rather low strength of association, but an adequate fit and a correct classification of 63.3%. In the instructed condition, nine movement features, including Amount, Complexity and Area of Movement, and Hand and Foot Acceleration, were found significant predictors. The model indicated a strong association with an adequate fit and a correct classification of 93.6%. This study suggests that participants embodied different tempos and different instructions for the same song with somewhat specific and coherent movement features. The effect of tempo was simpler than of instruction.

8. Intra-judge reliability of music performance assessment

Malgorzata Chmurzynska
Unit of Psychology of Music, Fryderyk Chopin University of Music, Poland

Polish experimental research into music performance assessment (Manturzewska, 1970; Jordan-Szymanska, 1981) showed that adjudicators (a) do not recognize the same performance (b) while listening to the same performance twice, assess them in a different way. Two groups of participants assessed a set of eight recorded compositions for piano by Chopin (including one repeated). It was suggested to the first group (n = 20) that "performances are ordered from the best to the poorest", while the second group (n = 20) assessed without any biased information. The repeated performance was assessed with intra-judge reliability if no biased information was introduced.

9. Music performance anxiety – Where next?

Hugh T. Cowell, Alexandra Lamont
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Music Performance Anxiety (MPA) has blighted the careers of some professional musicians. Since 2000 around 150 studies have examined MPA or trialled interventions. Most of the studies have been quantitative, some experiencing difficulties in separating the variables. Few have been qualitative. The paucity of idiographic research in the aetiology of MPA is being addressed in a pilot qualitative study to determine the typology and epidemiology of MPA. Results to date with amateur folk club musicians have uncovered themes of: short MPA duration; boost "When it works it's amazing"; and the positive effect of friends' support. However, there are perceptions that others perform better; fear of negative evaluation (FNE) and wanting to please "the moment you are performing you are doing it for other people." Memories of failures persist over those when things go well: "Details blur together into one … it turns into a roller coaster." There was a coping strategy of closing off: "I am so in my bubble", "I find it difficult to look at people." Perception of audience feedback is an issue "I have no idea what the audience are thinking … that is very unnerving." A putative gender difference is that men sought positive affirmation from an audience, whilst women were concerned with the audience benefit. This study is a precursor to a larger study (i) within a more tightly defined population and (ii) involving wider investigation methods, including bio-feedback.

10. Influence of the home musical environment on phonological competencies in preschool children

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In the early years of child development, music and language seem to share the same basic learning mechanisms for sound categories. Intervention studies with preschool children have shown that phonological competencies can be influenced by specially-designed short-time music training. It is well established that preschoolers benefit from a supportive Home Literacy Environment for the development of their linguistic competencies as well as from a favourable Home Musical Environment for the development of their musical competencies. However, findings regarding the influence of the Home Musical Environment on the development of phonological competencies are lacking. Therefore we focused on different components of the Home Musical Environment and investigated their specific relations with the development of phonological and musical competencies in preschoolers. We examined 342 children (mean age = 54.82 months, SD = 4.37 months; 52 % girls) at the beginning and end of the second year in German kindergarten and assessed their phonological awareness and music perception abilities using standardized inventories. To explore children's Home Learning Environments, parents completed a questionnaire including items regarding demographic data, the literacy, and music stimulation in the child's immediate surroundings. Statistical analyses revealed positive significant effects of different components of the Home Musical Environment on the phonological awareness. Significant findings were found specifically for the child's formal participation in music-related hobbies, availability of and access to audio equipment, and parents' music-related activities. Thus, a diverse Home Musical Environment does not only positively influence the development of preschoolers' musical competencies but it also stimulates their phonological competencies.

11. Hearing aids for music: Exploring initial findings from questionnaire and interview studies

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Music is an important part of people's lives which can have significant health and wellbeing benefits, including those with mild, moderate, severe or even profound deafness. However little is known about the music listening experiences of this subset of the population because existing studies have focused on 'normally' hearing participants. A new AHRC-funded project aims to explore how music listening behaviour is shaped by deafness, hearing impairments and the use of hearing aid (HA) technology. Initial findings from two studies will be reported. First, a questionnaire study distributed to Sheffield Teaching Hospitals Hearing Service and a private audiology clinic in London asked participants whether they experience any problems with music listening, the extent to which this affects their quality of life, and whether they have discussed music listening with their audiologist. Second, an interview study explored the music listening experiences of users of HA technology in greater depth. The sample includes people who have been i) deaf since birth or childhood and ii) those with presbycusis in proportions that are representative of the population. It also includes both musicians and non-musicians to allow for an exploration of differences according to age, specific HA technology used, and levels of musical training. Results will inform the design of a large-scale, national survey which will identify trends in the music listening behaviour of HA users. Data will also be used to create a website, online discussion forum and advice leaflet for HA users of all ages to improve their access to music.

12. Music and autism in everyday life

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Today, autism diagnoses are on the rise with about one in 68 children being diagnosed. Although research has shown that people with autism display unique musical abilities and talents, little is known about the role music plays in their day-to-day lives. Here we present data from a group diagnosed with autism spectrum conditions (ASC) (N = 152) and a control group of typically developing adults (N = 146) who completed test batteries that assessed their daily musical activity. Results showed that adults with autism rated music-listening (along with reading non-fiction books) as the most important and frequently engaged with activity in daily life, and on average they indicated they listened to nearly six hours of music per day (M = 5.8 hours, SD = 5.20). Based on their scores on the 23-item Musical Engagement Test (MET), results showed that the ASC group scored significantly higher on Cognitive engagement (defined by intellectual processes and detailed attention to the sonic and structural elements in music), but lower on Physical engagement dimension (defined by physiological processes related to dance and movement). These results were reflected in correlations between AQ scores and MET scores in both the ASC and control groups.

13. Music learning and the developing brain – Report from an ongoing longitudinal study

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Playing music is a complex task that requires the concurrent recruitment of distinct sensory systems, as well as the interplay of these sensory systems with the motor and executive systems. Mastering of this rich and demanding process requires regular and intense practice and is likely to influence the development of the underlying brain structures and their function. The aim of this longitudinal study is to investigate the effects of music training on brain, cognitive, musical and social development. Seventy 6-7-year-olds were recruited from elementary schools and community music and sports programs. The musical group consists of children training within the Youth Orchestra of Los Angeles, an El Sistema-inspired sociomusical program. As comparison groups, we included a group of children involved in sports training and a third group with no systematic, organized post-school activity. To date, all children have been tested twice, once at the start of the study (prior to training) and again one year later with a series of behavioural assessments including melody and rhythm discrimination, beat perception and production, and singing. The data analysed so far confirm our prediction that after one year, children involved with music training would show significant improvements in auditory skills including pitch perception and production. Results from the performance on musical measures will be presented, along with a discussion on the variable development of different musical skills, and on how such skills may relate to the development of synaptic connections in the auditory cortex as expressed by auditory evoked potentials.

14. Working memory updating executive function and music training

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The main aim of our study was to examine whether musical training is associated with improvements in updating information in WM both in children and adolescents, as well as to analyse which updating sub-processes – inhibition or maintenance – are more affected by musical experience. 69 musicians (37 children aged between 10-11 years and 32 adolescents between 15-16 years) and 69 non-musicians (37 children aged between 10-11 years and 32 adolescents between 15-16 years) participated in the study, matched in academic level and in fluid intelligence. Updating function was measured by the updating task developed by De Beni and Palladino (2004), which allowed differentiating scores for maintenance and inhibition processes: maintenance, suppression of information in WM, and proactive interference. Results showed that musicians outperformed non-musicians both in maintenance and in inhibitory processes, specifically in resistance to proactive interference.

15. Trombone players seem to use different tongue positions while playing sustained notes, depending on their native languages

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We used ultrasound imaging of the tongue to record midsagittal tongue contours of eight trombone players with different native languages while producing sustained notes on an identical 'pBone' plastic trombone and during speech production in their First Language. While speakers of New Zealand English seem to have the option of using a tongue shape close the central unstressed schwa vowel /ə/ or in the vicinity of the cardinal vowel /o/, players whose native languages do not include centralized vowel positions seem to be constrained to using the higher and more retracted position close to /o/. Furthermore, while both highly proficient and less experienced players seem to change the height of the back of their tongue when ascending throughout the trombone's register, the directions of these changes are the opposite. This paper discusses possible reasons for these differences and relates them to earlier empirical research on the function of the tongue in brass instrument playing.

16. Self-other judgements of sonified movements: Investigating Truslit´s musical gestures

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Institute of Systematic Musicology, University of Hamburg, Germany

Alexander Truslit´s theory of musical gestures and his assumption that there are ideal movements inherent in musical interpretations, which in turn can be experienced by listeners, have been discussed in music psychology and beyond. The present study investigates this assumption by examining finger movements that were analysed using a motion capture system. 26 right-handed participants (13 musicians) were asked to follow melodies of original Truslit pieces with their index finger first intuitively and then after verbal instruction. While there were large inter-individual differences in the movements' trajectories, repeated-measures ANOVAs showed no differences in global measured velocity, acceleration, and cumulative distance of index finger movements between the free and after-instruction conditions, suggesting that individuals performed comparable movements across trials. A second experimental part contains a self-others judgement paradigm with multimodal presentation conditions, investigating the stability of inner movement and sound representations in terms of the success of self-other distinctions. We discuss how people perceive the gestural quality inherent in different musical interpretations. In particular, we attempt to highlight a common perceptual basis that is grounded in human movements and may lie beyond individual percepts of music.

17. When words and music meet in the brain: Reviewing effects of music and second language education on executive functions

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Executive function (EF) refers to a general broad cognitive concept that includes working memory, inhibitory control and attention shifting. Previous studies have shown that both language and music training have similar effects on EF. The present study aims at further investigating these effects in children aged between 9 and 12 years, who either participated in musical training since age 5 or attended second language immersion school programs since the age of 5. Thirty-one monolingual musicians were compared to 31 monolingual children without musical training (control 1). In addition, 44 non-musically trained children being in immersion education were compared to 48 monolingual non-musicians (control 2). Socio-economic status, verbal and non-verbal intelligence were taken into account. All children underwent the Simon task, a neuropsychological test that measures inhibitory control by measuring reaction times (RTs) and error rates on congruent and incongruent trials. The musically trained children showed significantly faster RTs on the incongruent trials only, compared to the monolingual non-musicians, suggesting an inhibitory control advantage. In contrast, the immersion learners showed faster RTs on both congruent and incongruent trials compared to monolingual children, suggesting another aspect of EF might be enhanced. To the best of our knowledge, this may be the first study comparing the cognitive effects of music versus second language education methods. Both training types, musical training and language immersion, seem to enhance EF. However, the precise aspect of EF might be different between both training types, which will be discussed.

18. Manipulation of mechanisms underlying emotional reactions to music

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A common approach to study emotional reactions to music is to attempt to obtain direct links between musical surface features such as tempo and a listener's responses. However, such an analysis ultimately fails to explain why emotions are aroused in the listener. In the present study, we explore an alternative approach, which aims to account for musical emotions in terms of a set of psychological mechanisms that are activated by different types of information in a musical event. The novel approach was tested in four experiments that manipulated four mechanisms (Brain stem reflex, Contagion, Episodic memory, Musical expectancy) by selecting existing musical pieces that featured information relevant for each mechanism. The excerpts were played to 60 listeners, who were asked to rate their felt emotions on 15 scales. Skin conductance levels and facial expressions were measured and listeners reported subjective impressions of relevance to specific mechanisms. Results indicated that the target-mechanism conditions evoked emotions largely as predicted by a multi-mechanism framework and that mostly similar listener effects occurred across the experiments that included different pieces of music. We conclude that a satisfactory account of music and emotion requires consideration of how musical features and responses are mediated by a range of underlying mechanisms.

19. Idiographic modelling of aesthetic judgments of music

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Music is commonly regarded as one of the fine arts, but aesthetic responses to music are still poorly understood. The aim of the study was to model aesthetic judgments of music based on subjective criteria, featuring a representative sample of musical pieces and using the tools of Judgment Analysis. A Stratified Random Sampling procedure was used to select 72 pieces from 12 genres. The pieces were divided across two groups of participants (N = 44), who judged each piece with regard to aesthetic criteria (e.g., beauty, originality, expressivity) as well as overall aesthetic value. Both idiographic (individual) and nomothetic (averaged) multiple regression analyses were conducted on the listeners' judgments. The results showed that linear models provided a good fit to listeners' aesthetic judgments (mean variance accounted for = 76%), suggesting that the process is systematic and mainly additive. Some criteria (e.g., originality, skill) made a larger contribution to prediction than others overall, but there were large individual differences between listeners regarding what criteria they used. A nomothetic regression model did not adequately describe the different judgment strategies of individual listeners. The results imply that aesthetic judgments are systematic, and that individual differences can be explained in terms of different weighting schemes for subjective criteria of aesthetic value. Implications for future research on aesthetic responses are discussed.

20. Effectiveness of special musical training (workshops) organized for children at the age between 4 and 7 by Lodz Philharmonic

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Surveys of the public's satisfaction with concerts for children do not, unfortunately, have a long tradition. Only a few of those kind of projects have been completed (Gembris, 2005; Kaczmarek, 2009). My project presents and discusses the results of surveys made on public concerts for children called 'Odkrywcy Muzyki' ('Explorers of Music') conducted jointly by the Lodz Philharmonic and the Music Education Faculty at the Music Academy in Lodz. Those concerts are organized on Saturday's morning by the Lodz Philharmonic and are provided for children at preschool age (4-7 years). 'Explorers of Music' is a unique art project based on the method of a German composer and educator Carl Orff. In order to examine the effectiveness of children's concerts a questionnaire was created for parents. The study involved 100 parents. The questionnaire included questions about children's comfort at workshops and concerts, an overall assessment of the workshop, their potential effects, benefits, and results. The answers show immense satisfaction of both children and adults with concerts. Parents believe that the atmosphere at the concert was enjoyable, children had a lot of fun with the concerts, felt well on it, and more importantly, the show was adapted to the intellectual and emotional level of participants, and it was a fantastic mutual experience for the whole family. Finally, 80% of the surveyed audience is willing to take part in the following concerts and workshops. Almost 90% of parents see positive effects of concerts for their children, which mean that those concerts have a high acceptance and high level of satisfaction.

21. Testing Vogel's Theory of Tonal Space

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Martin Vogel presented an extension of Euler's Tonnetz, which includes three dimensions for fifths, thirds, and sevenths in its graphical representation, and four dimensions (including octaves) in its mathematical representation. Vogel suggested a formula that should predict the consonance of such chords. The present contribution compares the predictions of Vogel's theory and of a psychoacoustical theory (Plomp) with consonance ratings given by musical experts. Twenty students of music theory rated 60 different chords on three scales (consonance – dissonance, familiarity, emotional valence [happy – sad]). In a second study ten very experienced keyboard players rated similar chords before and after a training session where they were trained to identify the presented chords. In accordance with Vogel's theory, and in contrast to the predictions following from Plomp's theory, consonance ratings depended little on register but strongly on intonation. However, minor chords set along Vogel's composition rules are rated as less consonant. This is paralleled by them being rated as unfamiliar. They are, however, rated as having a higher emotional valence than classical set minor chords. A correlational analysis revealed that the prime weights used by Vogel are not optimal to represent today's listeners' consonance perception. The second study failed to demonstrate an effect of training. It revealed, however, an effect of expertise: The ratings of the experienced listeners were more in accordance with Vogel's composition rules. Vogel's theory of tonal space can elucidate some aspects of consonance ratings not covered by a psychoacoustical theory of consonance.

22. Associations between social skills and ensemble performance in music majors

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Social behaviours in ensemble have been observed to contribute to performance quality. However, it remains unclear whether behaviours for musical interactions can be regarded as identical to daily social skills? The present study investigated associations among daily social skills, social behaviours during practice, and evaluation of ensemble music performance. A total of 68 female music majors responded to performance questionnaires, as well as to two scales for social skills, and one each for styles of handling interpersonal conflict, for nonverbal behaviour, and for leadership. Using structural equation modelling, the author assessed the causal model among social skills, social behaviours during practice, and evaluation of ensemble performance. In the holistic social skills, positive correlations existed between the rating of the scale and social behaviours during ensemble practice. Significant positive correlations existed between the items on social behaviours during ensemble practice and Integrating style (i.e., win-win style) of handling interpersonal conflict. An analysis of the causal model suggested that a performer's daily social skills, an Integrating style of handling interpersonal conflict, and leadership in daily communication influences the evaluation of ensemble performance via social behaviours during practice. The main findings are as follows: (1) daily social skills correlate with behaviours during ensemble practice; (2) performers with a high evaluation in their ensemble performance might employ the following strategies during ensemble practice: democracy-oriented behaviours and leadership-oriented behaviours; (3) the causal sequence, in which daily social skills influence evaluation of ensemble performance via social behaviours during practice, is likely to be valid.

23. Chasing an effect of background music on foreign vocabulary learning: A futile undertaking?

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There is currently no consistent evidence for beneficial effects of background music on cognitive task performance. Background music has even been shown to have detrimental effects, posing issues for educational contexts. Some studies have suggested that the variation in the findings might be explained by inter-individual differences in extraversion. Here we investigate whether background music affects vocabulary learning. We tested Eysenck's theory of personality which predicts that introverts – reported to possess a lower optimal level of cortical arousal than extraverts – perform poorer when learning with background music compared to silence. Extraverts, on the other hand, should be unaffected by background music or benefit from it. Intro- and extraverts (N = 31) were tested in a paired-associate learning paradigm and cortical arousal was assessed with spontaneous EEG. Results revealed no interaction between extraversion/cortical arousal and learning condition. Instead, we found an unexpected main effect of cortical arousal on recall, suggesting that individuals with high beta activity perform better than those with low beta activity. To substantiate this finding we conducted an exact replication (N = 38). Whereas the main effect of cortical arousal vanished, a beneficial main effect of background music appeared. The combined analysis of both experiments suggests, however, that there is no effect of background music on vocabulary learning. Given these findings, we discuss whether searching for such an effect might be a futile undertaking. Importantly, our findings emphasize the need for more exact replications of theory-driven experiments when studying the effects of condition and personality on task performance.

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24. The special role of music in wellbeing

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While much is known about the positive effects of engaging in music, existing work has not yet explored in depth how or why music might work to bolster wellbeing, and very little research has compared music with other activities. The current paper explores two different theoretical perspectives on wellbeing: Seligman's PERMA approach positing wellbeing results from a combination of positive emotions, engagement, relationships, meaning, and accomplishment). The second models the mechanisms by which music evokes emotion (Juslin's BRECVEMA framework proposes that emotions are evoked in music experiences through the mechanisms of brain stem response, rhythmic entrainment, evaluative conditioning, emotional contagion, visual imagery, episodic memory, musical expectancy and aesthetic judgement). Data are reported from adult participants who engage in music and comparisons drawn with those who take part in knitting and crafting activities. Participants have been surveyed on the nature of the activities, motivations, rationales, and feelings about their leisure activities, with a focus on understanding precisely why music might be special drawing on the concepts outlined from positive psychology and from music and emotion.

25. Effect of music and language expertise on the implicit learning of musical and linguistic structures

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The cognitive consequences of music and language expertise are rarely compared. The present study examines the ability of music and/or language experts to implicitly learn musical and linguistic structures. We asked 14 music experts, 14 bi- or multi-linguals (i.e., language experts with informal training), 14 speech therapists (i.e., language experts with formal training) and 8 dual experts (bi- or multi-linguals also experts in music) to listen attentively to 7.30 min of a continuous stream made out of trisyllabic nonsense "words" sung on three-tone melodies. Melodic and linguistic transitional probabilities were congruent. A two-alternative forced-choice required choosing between "words" and "partwords", either spoken (in the linguistic test) or instrumental (in the music test) was used to test participants' learning of the linguistic or melodic structure, respectively. Expertise modulated performance in the linguistic test ($F(3, 49) = 5.92$, $p = .002$, $\eta 2 = 0.28$): contrary to the three other groups, from which they differed significantly, the speech therapists performed at the chance level. In the musical test, there was no significant group effect ($p = .25$), but one-sample t-tests showed that only the dual experts performed above chance, with 62.5% correct ($p < .01$). Thus, whereas informal language training and music expertise lead to similar abilities to implicitly learn linguistic - but not musical - structure, this was not the case of formal language expertise. The combination of music and informal language expertise led to a particular profile, namely the ability to learn simultaneously the musical and linguistic structures of sung material.

26. “Limits are relative” – Hearing-impaired children improve their musical potential

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This empirical study strives to increase awareness regarding the unused potential of hearing-impaired children. Even severe hearing losses do not obviate musical activities. Although music instruction in England and the US has been equally offered to children with and without hearing impairment for many years, there remains much more work to do in Germany. It is important to attend to the multi-sensual quality of auditory perception of the Hearing Impaired – the so-called ‘Listening with all senses’, because their perception of sounds always includes vibro-tactile and visual excitations. Thus, the motivation and aim of this study is to offer music and instrumental practice in equal quality for both groups: the hearing-impaired and hearing capable children. A group of 31 children participated in this study. The test battery was comprised of a music attitude test for young children including time and pitch performances, measures of intelligence (K-ABC) and measures of emotional aspects in spoken language. Moreover audio recordings of spontaneous singing were analysed. The results of the study showed an improvement concerning musical and cognitive skills, as well as an enhancement in difference frequencies of the investigated voices. In summary those findings suggest that hearing-impaired children have musical abilities above their language level. They are able to produce or reproduce melodies and perform with several instruments. The musicality of hearing-impaired children is obvious and should no longer be neglected in music education programs.

27. The psychosocial profile of young musicians on the example of Polish music school students

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This topic was inspired by numerous researches realized by music psychologists, which showed that there are significant differences between musicians and non-musicians, not only in the level of their musical abilities but also in the range of their psychosocial functioning. The main aim of the research is to understand the psychosocial profiles of musically talented youth studying in professional music schools in Poland. Understanding their particular functioning style will be possible by comparing their results with the results of several control groups. The first control group are art schools students. The second control group are students attending general education schools, who do not have experience with artistic education. The specific objectives of the research will help to find answers to the questions of whether and to what extent musically gifted youth are different from their artistically gifted peers or peers without artistic talents, in the field of (1) temperament traits, (2) locus of control, (3) strategies for coping with stress (4) emotional intelligence level and (5) social competence. The results confirmed the hypothesis that youth learners in Polish music schools differ from their art talented and non-art talented peers in the level of prevalence of the psychosocial selected characteristics. They made it possible to observe that students with different profiles of abilities also differ in the specifics of their psychosocial functioning, which causes that they require different interactions in difficult situations.

28. Health and wellness education for musicians: Investigating music teachers' perspectives

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Musicians are vulnerable to the development of performance-related problems (PRPs). Most PRPs are preventable if appropriate resources are available. Instrumental/vocal teachers provide training and support and may be ideally placed to act as health promotion advocates. There is a lack of research investigating teachers' experiences, beliefs and current practices regarding health promotion. An online survey study was distributed via purposive and snowball sampling. A mixture of 50 single choice and open-ended questions were presented. Results were analysed using descriptive statistics and thematic analysis. Respondents included 502 teachers from various musical genres and instrumental groups (female 69%, male 30%, age range 18-90, mean age = 46.24). A history of physical PRPs was reported by 69% of respondents, symptoms of MPA by 55%, and hearing problems by 31%. Most respondents feel responsible for pupil well-being and help pupils to make appropriate adaptations. The primary source of respondents' knowledge of PRPs is personal experience. Most respondents offer advice about PRPs but refer pupils to medical specialists if symptoms persist. Respondents would like to know more about health promotion – preferably via the internet, books, and lectures. Instrumental/vocal teachers are ideally placed to act as health promotion advocates and to a large extent are already fulfilling this role. In order to protect the health of pupils and teachers alike it is imperative that further research is conducted with instrumental and vocal teachers to facilitate development of resources and advice that is accurate, practical and appropriate to the context.

29. The competence of performance: Mental aspects of succeeding and failing in musicians

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Being good when it counts is crucial for the professionalism of musicians. Music performance anxiety (MPA) is prevalent even among experienced professional musicians. It may impair cognitive and motor aspects of performance. Research in sports psychology suggests a specific competition-related expertise: a set of cognitive skills that foster the ability to perform under challenging conditions significantly. Due to identified similarities of the development of excellence in sports and music, a competition-related expertise – or performance competence (PCO) – can also be assumed for musicians as having extensive potential for influencing MPA and the capacity to perform at one's personal best. The present study investigates PCO and its correlation with MPA in challenging situations in musicians. A questionnaire for PCO was constructed. MPA was evaluated with a German translation of the K-MPAI. The sample (N = 130) consists of professionals, students, and amateurs from different musical styles. CPO and K-MPAI-d were tested with exploratory factor, scale and item analyses. The correlation between PCO and MPA was tested by correlation analysis. Six clearly interpretable factors of PCO were found: conviction of performance competence, progress focussing, deficit orientation (as an impairment factor), relation to teacher, concentration, and practice strategy. The hypothesised correlation between MPA and PCO was confirmed. Findings indicate that a specific PCO could improve the ability to perform at one's personal best, even under potential anxiety triggering conditions.

30. The origin of music and the Baldwin Effect

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The origin of music has been explained as either the result of natural selection or as a cultural invention. On one hand the cross-cultural diversity of music supports the claim that music was created thanks to cultural flexibility. On the other, the fact that music is easily recognizable, and that no culture exists without music suggests that it could be an adaptive phenomenon. The aim of this paper is to suggest that the most probable scenario of music origin is the result of Baldwinian evolution in which some culturally invented behaviour was transformed into an instinctive behaviour by the means of natural selection. Similar explanations have been proposed for the development of language and birdsong evolution. Music is a phenomenon in which structures are transmitted by imitation. This indicates that music is a good example of a ritual culture. In this respect, music resembles animal songs (e.g. birdsongs) which are characterized by instinctive and inventive components. This is exactly what can be expected as a result of the Baldwinian mode of evolution. It is proposed that the evolution of music started as the invention of sound sequences which was used for ritual purpose, and as the ritual was an important part of social life its performance gained a consolidating function. Cultures that encompassed such a ritual therefore began to act as a selective environment. After many generations an individual was born better predisposed to memorize sound sequences thanks to the regularity present in the ritual.

31. Links between musical and linguistic abilities in preschoolers: The role of the family's musical environment

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Links between music and language have been extensively examined in adults and school aged children, with many studies relating linguistic advantages to years of musical training. Relevant research in preschoolers is either limited to children ≥ 4 years or typically explores links between single linguistic and musical aptitudes rather than evaluating a broad range of linguistic and musical skills. This research explores associations between a broad range of musical and linguistic abilities in 3- and 4-year-old children with the aims of a) examining these links more extensively and at a younger age than previously studied, b) evaluating the possible mediating effect of cognitive factors such as general ability and memory on these links and c) evaluating the effect of the family's musical environment on these skills. A comprehensive battery of age-appropriate musical tasks was designed for this experiment and standardized measures are used to evaluate language development, memory and general ability. Parents/guardians complete questionnaires providing information about their own musical experience and the child's exposure to music within the family. This investigation sheds light on the early development of the music-language association contributing to the debate of whether or not language and music rely on shared cognitive mechanisms for sound category learning (see Patel, 2008). It also aims to provide novel insights on how environmental factors might contribute to musical and linguistic skills at a young age.

32. Assessment and modelling of latent and overt absolute pitch

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Absolute pitch (AP) research typically focuses on one manifestation of the ability; for instance, overt pitch labelling is a demonstrably dichotomous ability, but such tests preclude investigation of individuals without musical training. Additionally, a latent form of AP involving veridical pitch memory for music exists in a substantial proportion of the general population suggesting that such abilities may lie on a continuum. Therefore, a comprehensive approach is needed to investigate the structure and nature of both AP abilities in musicians and non-musicians. This study constitutes the first step in creating a standardised test battery for AP. We aimed to discover whether overt AP (oAP) and latent AP (lAP) are continuous or discrete abilities and to identify which tests discriminate maximally between possessors and non-possessors. Sixty-three participants including 22 self-reported oAP possessors completed eight pitch perception and production tasks adapted from existing literature. Test design was intended to capture both overt and latent abilities in musicians and non-musicians by including tasks with and without explicit pitch-naming. Cluster analysis showed oAP and lAP to be bimodally distributed with two-component models as the best fit on all tests. Variable selection algorithms reveal production of named pitches and song recognition as providing the greatest discrimination between clusters for oAP and lAP respectively. Results support previous findings that oAP is an all-or-none ability but, interestingly, suggest that lAP is also dichotomous. On-going testing will provide deeper analysis of the structure and association of these abilities and enable further optimisation of the test battery.

33. "TV's Got Talent". On reception and economic aspects of German music talent shows

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The music industry has been in crisis for at least a decade. Although music consumption is higher than ever, sales figures are at an all-time low. Music talent shows have proven to be a salvation for the music industry. Debuting in the 1990s, music talent shows have become one of the most successful television formats in recent years. This has been especially true in relation to the high demand for reality TV shows. While there has been considerable research on talent shows, it is not comprehensive. Most empirical studies investigate the reasons why people - especially children and young adults - watch talent shows and how they perceive the jury and the stars-to-be. Consequently, we focus on the reception of music talent shows and the perceived differences between the show formats. Additionally, we examine the economic aspects of these formats and compare which dispositions lead to better purchasing behaviour of talent show products. Therefore an experimental online survey (N = 230, M = 25.48, 75.7% female) was launched comparing the reception of two different formats. The questionnaire aims on user behaviour, consumer acceptance, parasocial relationship, received authenticity and musicality of the jury and the show participants as outcome variables. The results indicate that the most important factor for buying products of music talent shows is the parasocial relationship between the recipients and the participants.

34. Neurodynamics of the human brain during listening to rock music with modified frequency range

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Experienced musicians and sound engineers know and consider the fact that depending on signals level of certain frequencies music can elicit different emotions and affect its strength. We decided to investigate the influence of low-frequency components in rock music on music perception features. 20 healthy volunteers with no prior musical education participated in this study. We estimated spectral power density (SP) of all subbands from 4 to 35 Hz. To estimate spectral power EEG changes we compared every listening to audio sample with preceding rest state. During listening to the sounds and music the most significant EEG changes were observed mainly in theta- and beta-bands, which related to emotional and cognitive processes. Listening to white noise caused frontal activation in theta1-, theta2-, alpha3-, beta1- and beta2-subbands basically in right hemisphere (negative emotional activation, sensory attention). We detected decrease of SP in theta2-, alpha1-, alpha3- and beta1-subbands during listening to the song of birds (relaxation, positive emotional response, activation of external attention). During listening to the rock composition in two variants different lateralization in beta2-subband was observed: left in temporal, parietal and occipital lobes (rock composition with native frequency range, positive emotional response), and right in frontal, temporal and parietal lobes (rock composition with reduced frequency range, processing of music components). Thus, both growth of cognitive processes, related to processing of music components, and enhancement of emotion intensity level, related to music perception, take place during listening to music and depend on spectral structure of music composition.

35. Writings by internationally renowned flutists on breathing control in the orchestral excerpt from Debussy´s Prélude à l´après-midi d´un faune

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The Prélude à l´après midi d'un faune by Claude Debussy is an important orchestral work from late 19th century. In addition to being very significant for the literature of the flute, this orchestral excerpt has become a standard audition piece worldwide. The performance of the opening four measures has been consistently considered one of the most demanding passages for the instrument. Renowned flutists such as Peter Lloyd, Michel Debost, Elizabeth Buck, Georges Barrère, Jeanne Baxtresser and Marcel Moyse have pointed out to breathing, intonation, sound colour, vibrato, dynamics, articulation, timing phrasing, expressivity and style as the main technical and interpretative aspects requiring skillful resolutions on the part of the instrumentalist. This article brings out discussions, suggestions, commentaries and solutions presented by internationally renowned musicians in order to shed light on their learning processes and strategies as well as on their experiences with this work. The methodology is based on writings compiled among internationally renowned flutists through the bibliographical investigation written by McCutchan (1994), Lord (1998), Debost (2002), Buck (2003), Toff (2005), Baxtresser (2008) and Toff (2012). As result, breathing appears as the number one aspect in the performance of this excerpt due to the fact that these initial four measures should be played in a single breath especially in audition situations. All other aspects seem to become subsumed under breath control.

36. The effect of repetition and expertise on liking and complexity in contemporary music

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Aesthetic perception of music has been extensively researched in the last decades. Numerous studies suggest that listeners find a piece of music more or less pleasant according to its complexity. Experimental results show that complexity and liking have different relationship according to the musical genre examined, and that these two variables are also affected by other factors such as familiarity to the music and expertise of the listener. Although previous experiments have examined several genres such as jazz, pop, rock and bluegrass, surprisingly, no study has focused on contemporary music. In this paper, we fill this gap by studying the relationships between complexity, liking, musical training and familiarity in the case of contemporary music. By analysing this genre – which is usually underrepresented in music cognition – it is possible to shed some light on the correlation between liking and complexity in the case of highly complex music. To obtain data, a multifactor experiment was designed in which both music experts and novices had to provide scores of subjective complexity and liking for four 30-second long excerpts of contemporary music with different degrees of complexity. Empirical results suggest that liking and complexity are negatively correlated in the case of contemporary music and that listeners' expertise does not influence the perceived complexity of musical pieces, but it can significantly affect liking. This possibly indicates that experts have the musical knowledge needed to appreciate extremely complex music, while novices do not.

37. Perceived sadness, beauty, and liking: Exploring the interconnections

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#Department of Music, Durham University, UK

Juslin (2013) proposes that the paradoxical enjoyment of music-induced sadness could be explained simply in terms of pleasure drawn from aesthetic beauty, or 'mixed emotions'. Indeed, previous work has shown that perceived sadness and beauty tend to be highly correlated (at least in the Western music tradition), but we wanted to investigate this proposition further. By selecting music examples where levels of beauty and sadness would vary somewhat independently, we aimed to elucidate the interconnections of perceived sadness, beauty, and liking in the context of music listening. Nineteen musically trained participants heard 27 short film music examples (approx. 15-20 s each), where perceived sadness and beauty were varied as independently as possible (high, moderate, and low levels of both; 3 x 3 x 3 examples). Participants rated liking, perceived beauty, and perceived emotion (tenderness, peacefulness, sadness, movingness, scariness, happiness, and positive and negative valence) using visual analogue sliders. Although care was taken to select music excerpts were levels of sadness and beauty would vary as independently as possible, the two concepts were still somewhat correlated; $r = .26$. Liking and sadness were not significantly correlated; $r = .18$. Liking ratings for the 9 highly sad excerpts were best predicted by ratings of beauty and movingness ($R2 = .74$; $p < .001$). However, it remains unclear to what extent 'liking' and 'perceived beauty' are conceptually distinct, or whether the conclusion "people like sad music because they find it beautiful" is an example of circular reasoning.

38. A lexicon of audio quality

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While many listeners can determine varying levels of audio quality what is not always clear is what criteria has been used in the decision-making process. A subjective listening test has been undertaken in which participants rated the audio quality of 62 samples of commercially available popular music, from 1982 to 2013. In addition to providing a five-level quality rating for each audition the participant was asked to choose two words to describe sound attributes on which quality was assessed. This paper details an analysis of these words gathered. Over all samples and participants, 255 unique words were used. By representing the data as a network graph, the relationships between words, ratings, songs and participants can be examined. A number of metrics are introduced to score each word according to quality, expertise and objective signal features of the audio samples. We find evidence to suggest that the words used to describe high-quality and low-quality audio samples are significantly different and that experts and non-experts draw from different sets of words. We find that the words used vary across objectively defined dimensions and multidimensional scaling indicates pairings of words which were used to describe similar conceptual attributes.

39. Congruity and diversity in conceptualizing improvisational expertise: The case of adaptors versus innovators

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#Faculty of Health, Medicine and Life Sciences, Maastricht University, The Netherlands

This study explores the conceptualization of improvisational expertise and specifically addresses the differences and similarities between more adaptive and more innovative jazz experts. The aim is to reveal conceptions of improvisational expertise within and between the two groups. Twenty-four renowned jazz musicians, teachers, and critics participated in this study. They were categorized by creativity style (i.e. adaptor or innovator) using Kirton's Adaption-Innovation Inventory. Both the adaptors and innovators completed Trochim's Group Concept Mapping (GCM) procedure to generate, categorize, and rate constituents of improvisational expertise. Multivariate data analyses including multidimensional scaling and a hierarchical cluster analysis resulted in a concept map for each group. The two concept maps show that both adaptors and innovators acknowledge the importance of basic musical skills and regulation skills for jazz improvisation. Interestingly the innovators underline the significance of artistic boundary crossing, risk-taking, and the creation of a personal voice, while the adaptors emphasize building and strengthening (a variety of) existing musical idioms. More adaptive and more innovative musical experts seem to have different views on improvisational expertise.

Friday 21 August 2015 | **RNCM THEATRE**
15.00-16.00 | **KEYNOTE 3** | **Chair: Michelle Phillips**

A model of music-related emotional competence

Suvi Saarikallio
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This paper presents a theoretical model of music-related emotional competence. Music is a language of emotion that conveys performer's emotions, induces strong emotions in listeners, activates evolutionarily adaptive neuroaffective mechanisms, and is actively used for the self-regulation and communication of emotions in daily life. Yet, music and emotion is an emerging field with a lack of comprehensive theoretical models. Emotional competence is a useful concept for understanding the emotion-related aspects of musical behaviour and the connections of music to general emotionality and wellbeing. This paper presents a theoretical model of the core elements that constitute the concept of music-related emotional competence. General emotion research and theories of emotional intelligence are used as a foundation for constructing the model. The model consists of four fundamental components: (1) Emotion recognition and awareness, (2) Emotional self-regulation and induction, (3) Emotional expression and communication, and (4) Emotional self-agency and self-control of thought and behaviour. The paper will elaborate on how these specific aspects of music-related emotional competence have their distinctive relationships with various aspects of general emotional competence and how they play their distinctive roles also in connecting musical behaviour to emotional health and wellbeing. The proposed model does not only serve as a groundwork for scientific and empirical investigation of the connections of music to general emotional competence and wellbeing, but also provides a framework for practitioners in music education and music therapy who wish to embrace musical practice as a forum for training, recovering, and excelling in aspects of emotional competence.

Suvi Saarikallio works as an Academy of Finland Research Fellow at the Finnish Centre of Excellence in Interdisciplinary Music Research at the Department of Music, University of Jyväskylä, Finland. Her research interests focus on the psychological aspects of musical behaviour, including mood and emotion, personality, development, and wellbeing.

Friday 21 August 2015	**RNCM THEATRE**	
16.30-18.00	**SESSION 11A: EMOTION 2**	**Chair: John Sloboda**

The effect of social feedback and listening context on affective responses to music

Katelyn Koehler, Mary C. Broughton
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Music plays an important role in our social worlds. It is integral to culturally significant social events, and is commonly used for social validation and bonding. Previous research suggests that music can influence individual affective responses. However there is scant research examining how social factors might influence affective responses to music. This study investigates the effects of social feedback and listening context on affective responses to music. In a between-subjects experiment, participants listened to unfamiliar music from various genres either alone or with another participant. For each music piece, participants received positive and negative social feedback derived from a pilot study or factual album information. After listening to each music piece and reading the provided social feedback or album information, participants reported their subjective valence, arousal, music liking, familiarity and task concentration. Positive/negative social feedback influenced subjective arousal ratings positively/negatively. There was no effect of social feedback on subjective valence ratings. Social listening context did not influence affective responses. Greater familiarity was reported when social feedback was provided. Lower concentration was reported in social listening conditions compared to solitary conditions. Social feedback can influence particular affective responses to, and familiarity with, music. However, social listening might reduce concentration. In social gatherings where music is in focus, social feedback can influence individual affective responses. This warrants consideration for the use of music in everyday life, and the social influences on emotion.

My life as a playlist: Investigating emotional experience in music in rituals across time

Jane W. Davidson, Sandra M. Garrido
ARC Centre of Excellence for the History of Emotions, Faculty of Victorian College of the Arts and Melbourne Conservatorium of Music, The University of Melbourne, Australia

The current paper explores how music is used in key rituals, building on contemporary psychological theories of music and emotion and work on personality and group behaviours. It also draws on recent theoretical work in cultural history. The study investigates the following questions: how has music played a key role in the rituals that mark peak emotional events in human lives, such as the birth of our children, falling in love and the passing of a loved one? How do modern day music choices compare with historical ones and how do they reflect the changes in societal meanings and emotional experience? Data collection has been two-fold: a major on-line survey promoted by the Australian Broadcasting Corporation; and a survey of historical documents on musical practices and interpretations of them. Using refined survey analyses and close readings of historical documents, results have revealed that contemporary associations with specific socio-emotional life-markers have common musical attributes within a specific cultural group, e.g., music for funerals employing similar musical structures. Also, when historical music or music from a different culture is adopted into a contemporary setting tend its attributions are perceived and used according to the dominant cultural explanation. However, when historical musics are examined in context, it is possible to reveal the remarkably different structures, emotional experiences and meanings attributed to these musics. This research offers a theoretical model for how music functions in everyday life and how psycho-cultural context plays into the meanings ascribed.

Describing music-mediated emotion with motion: PDA-measured acceleration data predict perception of GEMS-9 to different degrees

Melanie Irrgang, Hauke Egermann
Audio Communication Group, Technische Universität Berlin, Germany

Music is often discussed to be perceived as emotional because it renders expressive movements into audible musical structures. Different theoretical accounts of embodied music cognition state that listeners internally mimic movements during music listening experiences. That is why this study tested if mobile-device generated acceleration data produced by free movement during music listening experience can be used to predict different degrees of the Geneva Emotion Music Scales (GEMS-9). The study has been conducted in both lab ($n = 22$) and field ($n = 11$). Participants were instructed to move a mobile device (smartphone or tablet) continuously while listening to music in order to describe their experience. After each embodied description they rated the perceived emotional qualities of the musical excerpts according to the GEMS-9 on a 100-point, unipolar intensity scale initialized to '0'. For this study 10 musical excerpts of ~ 40s duration were selected in advance by the field participants covering various genres and GEMS states. The variance of the perceived GEMS-states could be explained by the fitted models as follows: (1) power ($r^2 = .37$), sadness ($r^2 = .17$), tenderness ($r^2 = .16$), joy ($r^2 = .15$), tension ($r^2 = .11$), peacefulness ($r^2 = .08$), nostalgia ($r^2 = .07$), wonder ($r^2 = .066$) and transcendence ($r^2 = .01$). Since GEMS states that are more related to rhythm could be predicted better, observations suggest that there might still be a lot of hidden potential in additional movement features capturing direction and position, and also describe the gestalt of the movement (gestural data).

Empathy polarises search for meaning in life after hearing mood-incongruent music

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#*School of Psychology, University of Kent, UK*

According to the Meaning Maintenance Model ‘meaning threats’ should increase the pursuit of meaning. A meaning threat occurs when people’s expectations, goals or values are violated. But research has yet to examine if meaning threats elicit heightened search for meaning in life while measuring meaning search directly. It was examined if meaning threats elicit heightened search for meaning in life while measuring meaning search directly. Three different experimental studies (N = 59-142) in which mood-incongruent music and empathy were operationalized in different ways confirmed this hypothesis. In these studies, we measured trait or state empathy and then made it easy or difficult for people to empathize with music by either placing them in a mood congruent or incongruent state to the music. Empathy expectancy violations increased meaning search when search for meaning was directly measured. For people with empathy expectations, mood-incongruence heightened meaning search relative to people without empathy expectations. As mood-congruence hinders empathy, it appears that meaning threats increase search for meaning, consistent with the Meaning Maintenance Model. Both neutral and positive mood inductions and sad, neutral and happy music elicited meaning search in different contexts. Both empathizing with people and not empathizing with people elicited meaning search depending on a person’s expectations. Findings will be integrated with current literature on meaning, empathy and music psychology.

The adaptive functions of music listening: Theory and measurement

Jenny Groarke, Michael Hogan
School of Psychology, National University of Ireland, Galway, Ireland

The current study aims to develop a scale to measure functions of music listening (FML) that is suitable for analysing theoretically-driven research questions in relation to the affective, social, and cognitive consequences of different music listening strategies. Item generation was on the basis of an exhaustive literature review and four focus group sessions with younger (18-30 years) and older adults (60-85 years). 150 items were administered to a sample of 673 undergraduate students for exploratory factor analysis, 34 items were retained and a 7-factor solution (Anger Regulation, Anxiety Regulation, Stress Reduction, Cognitive Regulation, Rumination, Strong Emotional Experience, and Reminiscence) accounted for 57% of the variance in FML. This revised AFML scale was administered to a separate sample of 641 university students along with a battery of well-being (WB) and personality measures. The factor structure was confirmed, and the validity of the AFML theoretical model evaluated using Structural Equation Modelling. Listening to music for anxiety regulation predicted higher positive affect (PA) and lower negative affect (NA) suggesting it may act as an effective affect regulation strategy. However, stress reduction by music listening predicted higher NA and lower PA. Perhaps music is better suited for mood regulation than coping with stressors. Another explanation is that a more diverse set of regulation strategies were enacted to regulate anxiety by music listening, or that those strategies were more adaptive. As hypothesized, rumination in music listening predicted increased NA, and decreased Emotional WB. Using music to activate Strong Emotional Experiences predicted increased PA and Psychological WB. These findings provide initial support for the validity of the AFML scale and theoretical model.

Is music listening able to evoke affiliation?

Jonna K. Vuoskoski*, Eric F. Clarke*, Tia DeNora#
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#Department of Sociology, Philosophy and Anthropology, University of Exeter, UK

Recent empirical evidence suggests that – like other synchronized, collective actions – making music together with others fosters affiliation and prosocial behaviour. However, it is not yet known whether these effects are limited to active, interpersonal musical participation, or whether solitary music listening can also produce similar effects. This study investigated whether listening to music from a specific culture could evoke affiliation towards members of that culture more generally. We hypothesized that music listening could evoke empathy and affiliation through motor and affective resonance with the rhythmic and emotional elements in the music, and that listeners with high dispositional empathy would be more susceptible to the effects. Sixty-one participants listened to either Indian or West African popular music, and subsequently completed an Implicit Association Test (IAT) measuring implicit preference for Indian vs. West African people. Dispositional empathy was measured using the Interpersonal Reactivity Index. A significant interaction effect revealed that listeners with high dispositional empathy were more likely to display an unconscious preference for the ethnic group to whose music they were exposed. The effect was not related to differences in liking for the musical stimuli. The finding that high dispositional empathy made participants more susceptible to the musical manipulations suggests that the outcome cannot be explained simply in terms of priming or knowledge activation effects.

Friday 21 August 2015 | **FORMAN LECTURE THEATRE**
16.30-18.00 | **SESSION 11C: MEMORY** | **Chair: Lauren Stewart**

Conductors at cocktail parties: Attention and memory in musicians

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**Institute of Systematic Musicology, University of Hamburg, Germany*
#Psychology Department, Bucknell University, USA

Individuals with high working memory capacity are more flexible in attending to detail; for example, they excel at both divided and selective attention tasks such as verbal shadowing (‘cocktail party phenomenon’). Research has shown that musicians are more successful in spatial selective attention, depending on their domains of expertise. Less is known about the relationship between attention and working memory (WM) for auditory and visual stimuli among different types of highly trained musicians. Orchestral conductors need to focus their attention both on individual instruments and on larger sections of various instruments. We investigated their attentional flexibility by comparing them to equivalently trained pianists. Following a series of musical WM span tests, they were asked to detect small pitch and timing deviations in three dichotic attention tasks presenting two melodic streams (a) separately: baseline, (b) together, while concentrating on only one stream: selective attention, or (c) together, while concentrating on deviations in both streams simultaneously: divided attention. Using signal detection analysis, conductors showed higher d-prime scores than pianists for timing deviations across attention conditions. Professionals detected more targets than students. We found no group differences for working memory capacity or for pitch deviations in the attention tasks. Musicians’ WM span across multimodal conditions was positively related to selective and divided attention. High WM participants also had shorter reaction times in selective attention. Taken together, conductors showed higher attentional flexibility in successfully switching between different foci of attention – a process also described as ‘zooming in and out’.

Common serial order processes in musical and verbal short-term memory: Evidence from a novel serial order probe recognition paradigm

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Fund for Scientific Research, F.R.S.-FNRS, Brussels, Belgium

Several models in the verbal domain of short-term memory (STM) consider a dissociation between item and order processing. This view is supported by data demonstrating that memory for order is significantly more impaired than is memory for item. This study investigated the domain-generality of serial order processing in STM by comparing the influence of an interfering rhythm task on item and order processing in verbal and musical STM. Twenty-six non-musicians performed a novel serial order probe recognition task. They had to retain sequences of four tones or syllables played at a regular beat. After a short delay, participants heard the beat and had to repeat the sequence in their head synchronously with the beat. In the item condition, participants had to decide if the item played was present in the target sequence independently of its position; in the order condition, they had to decide whether the item was presented in the same serial order position as in the memory list. For half of trials, participants had to perform a rhythmic interfering task during the maintenance period. The results showed similar deleterious effect of the rhythm interfering task on order retention in both verbal and musical conditions, while item processing was insensitive to interference. This experiment is the first to demonstrate a dissociation between serial order and item processing in musical STM. These results provide evidence for the existence of common serial order processes in verbal STM and musical STM.

Melody recall and recognition: The effect of musical features on memory

Joe Mooney*, Margherita Nulli*, Andrea Halpern#, Daniel Müllensiefen*
**Psychology, Goldsmiths College, University of London, UK*
#Psychology, Bucknell University, USA

This project comprises separate recall and recognition experiments. The recognition experiment tested the predictive power of Müllensiefen and Halpern's (2014) computational model for implicit and explicit memorability of real melodies. This method predicts memorable features from a post hoc analysis of previous results as opposed to the traditional method of theoretical predictions and artificial manipulations. The recall experiment used computational analysis techniques to annotate participants' singing and compare them to their target melodies. The recall experiment utilised a novel semi- automated system for converting recordings of participants' sung recalls into usable quantitative data. 'Tony' software tool for melodic annotation was used to convert audio recordings to MIDI, these files were compared to the target melodies using 'Simile' similarity algorithm. This process vastly reduces the time necessary to process the data and allows for larger studies without necessitating large budgets. Recognition experiment results confirmed predictive ability of the feature-based model for explicit recognition memorability. Recall results demonstrated that memory of a novel melody improves over repeated exposures but do not support the hypothesis that simple global features such as mode and meter can predict the memorability of a melody; further feature analysis of stimuli is necessary to develop future hypotheses. The lack of a significant correlation between recall and recognition experiments suggest independent mechanisms for recall and recognition memory, but recall results may be influenced by singing ability. We propose that the tools presented in this study can be used to investigate music recall and recognition with both efficiency and accuracy.

Friday 21 August 2015 **CAROLE NASH RECITAL ROOM**
16.30-18.00 **SESSION 11D: PIANO 2** **Chair: Vaike Kiik-Salupere**

An examination of value judgements in criticism of Beethoven's Piano Sonata recordings

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Critical review of recorded performance is a common form of evaluative response to music, relevant to musicians' careers but about which we still know little. The aim of this study was to offer a systematic investigation of value judgements in the written criticism of recorded performance. We adopted an explorative, inductive approach and a novel combination of data reduction and thematic analysis techniques. Reviews of Beethoven's piano sonata recordings published in the Gramophone (1923-2010) were collected (N = 845) and word-stem patterns were analysed to produce a representative selection (n = 100) of reviews suitable for subsequent thematic analysis. Inductive thematic analyses were then used to identify performance features critics discuss, the valence of critics' statements, and the criteria underpinning their judgements. The outcome of the study is an initial model of basic performance evaluation criteria used by critics. The model captures seven criteria that focus on aesthetic (intensity, coherence, complexity) and achievement-related (sureness, comprehension, endeavour) properties, the suitability of these properties to the musical and cultural context of the performance, and the ability to balance the performance between these different poles. Findings inform current discourses on the role of evaluation in music criticism and the generalizability of aesthetic principles. They emphasize the importance of the construct of performer's achievement for our appreciation of the performance. Foremost, they further our understanding of the nature of music performance criticism as a form of reasoned evaluation that is complex and contextual.

Inter-disciplinary integration in piano studies and music theory in one Estonian music school

Kadri Steinbach, Tuulike Kivestu
Music, Tartu University Viljandi Culture Academy, Estonia

Inter-disciplinary integration has been used in Estonia for a long time and it is in the state curricula for general schools. Still, awareness about the necessity of integration in Estonian music schools and the content connections between subjects are lacking. The aim of the study is to analyse inter-disciplinary integration in Estonian music schools using the example of one school's piano studies and solfeggio, and to offer advice for further and more effective integration of piano studies and music theory. Which themes are common in the curricula for music theory and piano studies? To what extent are these subjects integrated in practical course work? The study uses the case study model. For analysing the integration of piano and music theory studies, first the curricula were compared. Second, the piano lessons of five teachers with five students were observed. The qualitative content analysis method was used for the database. Based on the study, it can be claimed that in music school curricula, there is a plethora of ways to integrate music theory with piano studies. Yet, the lessons observed showed that these ways are not utilized and the teachers are focused on their own subject, leaving the broader context aside (including supporting students' studies by integrating music theory and piano studies).

The relationship between immanent emotion and musical structure in classical piano scores

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#Faculty of Music, University of Montréal, Canada

By focusing on notated music and separating immanent emotion (latent in the score) from performed emotion (contributed by the individual performer), we model immanent emotion as a linear combination of simple predictors for valence and arousal. We calculated a series of relevant measures – such as strength of tonal center, dissonance, average pitch variation, and overall tempo

– from a set of musical scores partly selected from the piano repertoire and partly rearranged by one of the author, in order to reproduce different musical structures by varying each aspect one at a time. Performances corresponding to 4 different structures (recorded on a MIDI grand piano Disklavier at 2 different tempi (slow, fast) and in 3 different performing styles - deadpan, moderately expressive and exaggeratedly expressive or 'emotional', for a total of 24 performances) are randomly presented to musicians and non-musicians, who are asked to rate them according to both dimensional and categorical models of emotions. Preliminary results are consistent with hypotheses that positive immanent valence is associated with major or clear tonality, and immanent arousal with tempo and melodic pitch range. We will test the hypothesis that low tonal clarity and high degree of dissonance are correlated with emotions such as uncertainty, anxiety and fear, and associations such as darkness, insecurity and death.

Friday 21 August 2015 CONFERENCE ROOM
16.30-17.30 SESSION 11E: AUDIATION Chair: Laura Bishop

Edwin Gordon's Advanced Measures of Music Audiation (AMMA): A critical evaluation

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Edwin Gordon's music learning theory is a widely accepted model of music aptitude. It is closely related to his concept of 'music audiation' which is an innate capacity for acquiring musical skills. Following from this, only a learning environment adapted to an individual's level of audiation can maximize a person's final musical achievement. In order to design such an optimal learning environment in the context of music education, it is important to first measure music audition in a manner consistent with state-of-the-art psychometric standards. For this, Gordon developed a number of tests: among them the Advanced Measures of Music Audiation (AMMA). Until today, the AMMA has not been validated either by means of classical test theory or the use of item response theory (IRT). Conclusively, our aims were first, to analyse the item and person parameters as well as the internal test validity by means of IRT methods and goodness-of-fit tests; second to optimize the AMMA by removing those items that would not meet the criteria of the Rasch model. IRT analyses of internal test validity based on N = 364 participants' response data revealing that the AMMA only met psychometric standards if the majority of the items was removed. Based on the remaining items, however, the optimized version of the AMMA is no longer suitable for a selective discrimination between different levels of music audiation. Our results suggest that the AMMA is largely an inappropriate measurement for the quantification of both music audiation and – by proxy – of music aptitude.

The development of a new assessment of notational audiation by professional musicians

Luis A. Estrada*, Reinhard Kopiez#, Anna Wolf+, Friedrich Platz$
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According to Gordon's music learning theory, notational audiation is based on the skill of generating a mental representation of unfamiliar music from only reading the score without the presence of physical sounds. The aim of this study is the development of a standardized measurement of professional musicians' ability to generate a mental representation from written notation. In line with previous studies by Brodsky et al. (1999, 2003, 2008), an embedded melody paradigm was used. In contrast to

Brodsky et al., only new examples were constructed to prevent the confounding effects of familiarity. First, N = 70 triple combinations were generated by a group of composers: a theme of eight bars length; a melodic-outline variation of the theme; a 'lure' variation. In a second step, six music theory teachers evaluated the material according to the criteria of musical plausibility. As an outcome, N = 27 triple combinations were selected. In a third step, 40 students of music theory, composition and conducting participated in the experimental testing: first, they silently read either the notated variation or lure variation followed by the original theme. Secondly, participants had to decide whether the visually presented notation contained those invariant notes represented by the original theme. Finally, items were analysed by means of item-response theory and were excluded if they did not meet all model-fit-criteria. The final results are expected in Summer 2015. We will address differences in notational audiation between groups of musicians and the consequences for music education.

Saturday 22 August 2015 **RNCM THEATRE**
09.00-11.00 **SESSION 12A: EMOTION 3** **Chair: Hauke Egermann**

The icebreaker effect: Singing together creates faster social bonds

Eiluned Pearce, Jacques Launay, Robin I. M. Dunbar
Department of Experimental Psychology, University of Oxford, UK

Mounting evidence from music psychology and the health sciences demonstrates that singing together benefits individuals' wellbeing. Research also shows that having a larger social network and meaningful social interaction likewise improves mental and physical health. In this longitudinal study we bring together these two bodies of literature by focusing specifically on the social bonding aspects of singing. We collaborated with a charity, the Workers' Educational Association, to explore whether weekly singing classes create stronger social bonds between class-mates than other activities, such as creative writing and crafts (N = 84 singers and 51 non-singers). We followed newly-formed classes over seven months, collecting questionnaire data during three sessions: Month 1, Month 3 and Month 7. Both singers and non-singers felt closer to their class-mates at the end of seven months compared to baseline. However, at time-point 1, singers showed a significantly greater increase in how close they felt to their fellow singers before and after their class, compared to non-singers. In contrast, for the two subsequent time-points there was no significant difference in the change in closeness score between the two conditions. A similar pattern was found for positive affect. Additionally, singers showed a steeper increase in the proportion of their classmates they could name over time. We conclude that although both singing and non-singing activities increase group connectedness to a similar level over time, singing seems to have a greater immediate effect on both social closeness and positive mood. Consequently, singing may provide a quicker boost to wellbeing than other activities.

Temporal dynamics and modelling of musical emotions using a multi-component approach

Konstantinos Trochidis, Simon Lui
Department of Information Systems Technology and Design, Singapore University of Technology and Design, Singapore

Music by its nature unfolds in time and therefore, musical emotions are time varying. In addition, the change of musical structure over time affects different emotional components including self-reported, behavioural and physiological responses. The dynamic relationship between musical structure, felt emotions and physiological responses is fundamental to deeper understanding and modelling of musical emotions. However, how the time course of emotions are affected by musical features as they develop in time still remains unclear. The aim of this study is to understand the dynamic relationships between acoustic features, physiology and affective states. To model these relationships we used a multivariate approach including continuous measures of emotions from behavioural, subjective and physiological responses. Classical music excerpts taken from opera overtures were used as stimuli to induce emotional variations across time between neutral and

intense emotional states. Continuous ratings of arousal and valence along with cardiovascular, respiratory, skin conductance and facial expressive activity were recorded simultaneously. Results show that parts of the music with higher energy and pulse clarity induced higher ratings of arousal, sympathetic activation and increased cardiorespiratory synchronization. In contrast, parts with major mode and prominent key strength induced higher ratings of valence, parasympathetic activation and increased facial activity.

Genres do matter – The influence of contextual knowledge to expressed emotions in music

Tuomas Eerola, Pasi Saari
Department of Music, Durham University, UK

In the past, music and emotion studies have attempted to keep familiarity, expertise, music genres in control when collecting self-report ratings of expressed emotions. Yet it has been occasionally reported that these may influence the ratings. In order to tap into larger datasets harvested from crowdsourcing, it would be vital to know to what extend these factors do contribute to the self-reports of emotions. We contrast the self-reports with projections of these emotion dimensions obtained from analysis of social tags crowd-sourced from web communities. A set of 600 music tracks was sampled in a balanced manner from last.fm to systematically cover the affective circumplex space as well as six genres. 59 participants rated short clips of the tracks using three core affect dimensions (valence, arousal, tension) and seven mood terms. Half of the participants rated the clips within blocks specified by the genres (genre-based) and half without this information (mixed). Novel semantic analysis technique that capitalises tags and affective circumplex emotion term positions was used in comparing the self-reports with a larger, crowd-sourced dataset. Agreement among the participants differed across the rating context and emotions. Analysis of variance revealed that the context of the ratings (genre-based or mixed) had a relative minor main effect on ratings reflecting adaption in scale usage but there were strong interactions between genre and context in several emotions. Regression analyses suggested issues of relevancy, that is, certain emotions such as happiness are not really appropriate for all genres whereas others may capture large part of the variance by themselves.

The role of embodied simulation in emotional contagion with music

Julian Céspedes-Guevara, Nicola Dibben
Department of Music, University of Sheffield, UK

According to theories in music psychology, one of the mechanisms that leads to the induction of musical emotions is ‘emotional contagion’ with the emotion expressed by the music. Although these theories coincide in that contagion happens via implicit embodied simulation, two competing hypothesis have been suggested about the type of simulation involved: either internal mimicry of the sonic aspects of music; or internal mimicry of the performers’ motor expressions and gestures. This experiment aims to examine these hypotheses. Participants were divided into three groups and asked to listen to three instrumental pieces (expressing sadness, fear, and joy, correspondingly). The first group was instructed to engage in vocal simulation (i.e. humming along with the music), the second was instructed to engage in motor simulation (i.e. pretending to play the instruments they hear), and the third group was instructed to perform a motor and vocal task that prevented them from making any musically-relevant behaviours. The participants’ affective state was measured using an indirect perceptual technique, and by asking them to report the emotions they perceived and experienced. Twenty-five participants have taken part in the experiment so far. Preliminary results indicate that the non-simulation group experienced less intense and less clear emotions than the two simulation groups. These results suggest that the phenomenon of emotional contagion with music is moderated by the extent to which the listener engages in embodied simulation of the melodic aspect of the music and of the movements performed by the musicians.

Saturday 22 August 2015 CONCERT HALL
09.00-11.00 SESSION 12B: JAZZ AND POPULAR MUSIC
Chair: Elena Alessandri

Mid-level analysis of monophonic jazz solos: A new approach to the study of improvisation

Klaus Frieler*, Martin Schütz#, Martin Pfleiderer*
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#*Institute for Systematic Musicology, University of Hamburg, Germany*

We present a novel approach to the analysis of jazz solos based on the annotation distinctive musical units. We presume that these units are shaped semi-automatically by overlearned motor processes according to underlying mid-level plans ('ideas'). To this end, a system of categories was devised, which comprises nine main categories (line, lick, theme, quote, melody, rhythm, expressive, fragment, void) with 19 sub- and 38 sub-subcategories, enhanced with syntactical rules for expressing relationships between ideas in order to capture motivic improvisation. A set of 77 monophonic jazz solos from different styles (swing, bebop, hard bop, cool, postbop) were manually annotated, resulting in 3040 annotated ideas. Expectedly, the most common main categories were licks (42.7%) and lines (32.8%), with the most frequent subcategory of wavy lines (18.5%). Distributions of categories did not differ significantly between styles. Mean duration of ideas was 2.23 s, in accordance with the duration of subjective present. About 20-30% (AM = 28%, range 0-60%) of ideas were based on motivic improvisation, i.e., derived from some other idea, with an average relationship distance of 0.55 ideas. Mean length of motivic chains was 2.8 (SD = 0.96). Finally, the amount of motivic improvisation differed considerably between performers, but not between styles.

The development of improvisational expertise in jazz musicians

Iwan Wopereis, Saskia Brand-Gruwel, Els Boshuizen
Faculty of Psychology and Educational Sciences, Open University of the Netherlands

Improvisation is a complex musical skill that takes many years of practice to master. An interesting question is what it takes to start and maintain such long period of practice and which environmental factors influence commitment to practice. This study aims to reveal factors that affect successful and less successful improvisational skill development. The study compared improvisational skill development of a group of six elite musical improvisers to a group of five semi-elite musical improvisers by means of a multiple site, structured case study design. A biographical research method was used to collect data for cross case analyses. Data were analysed using a combination of a theory-based categorization system and open coding searching for actors and factors that affected vicious and virtuous cycles of learning. Findings on learning during pre-conservatory, conservatory, and post-conservatory phases revealed group differences in intensity and quality of individual practice, group practice (e.g., participation in jam sessions), network activities that create further opportunities for development and work, as well as individual, self-directed efforts and strategies after developing a personal voice. Theoretically the study provides insight into differences in trajectories of identity development, as well as the development of skills that include timing, interactivity, and risk-taking. Educationally, the study helps to understand learning processes that can hardly be planned and entail hazardous transitions.

Spectral distribution and dynamic range in best-selling popular music recordings

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The loudness, dynamic range and energy distribution in low-frequency bands of popular music are analysed. One objective was to operationalize popular music and construct a robust, balanced sample that covers a specific but relevant music market regarding annual revenues. The sample consists of the German Top 40 year-end charts from 1965 to 2013. Furthermore, different methods of measurement, such as LKFS or dBFS RMS, are used and compared. It could be shown that there was a significant increase of loudness, a decrease of the dynamic range and an increasing importance of the low-frequency bands over time. While our results correspond to most previous research, there is a major difference regarding the recent data. It is frequently mentioned in studies that the process of decreasing dynamic range peaked in 2004, and after that the opposite trend occurred, namely, an increase in dynamic range. In the German music market, however, this seems to be true only for the time span from 2004 to 2010. From 2011 to 2013 a significant decrease of the dynamic range and an increase in loudness were found.

The effectiveness of TV ads and the impact of music on ad perception: An electrodermal activity study

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Music can be a highly arousing stimulus influencing the emotional experience of visual media. The measurement of electrodermal activity (EDA, otherwise known as galvanic skin response) is a non-invasive way of quantifying emotional arousal. Previous research has suggested that music can influence the reactivity to TV ads but the direct relationship between emotional arousal, music and commercial effectiveness of ads in the market remains unclear. This study aims to validate the suitability of a portable EDA system and to compare arousal responses to a set of commercially effective and ineffective ads. Experiment 1 presented high- and low-arousal visual, auditory, and musical stimuli taken from IAPS/IADS provided by University of Florida and Mas-Herrero et al. (2014) while recoding the EDA of 20 participants. In Experiment 2, 20 ads (10 effective and 10 ineffective ads in business terms) were presented to 33 participants while EDA was recorded. A subset of 10 ads was presented with and without music to participants in a between-groups design. Event-related EDA as well as spontaneous EDA activity was analysed using linear mixed effects models. EDA responses were significantly stronger for high arousal sounds and images compared to low arousal stimuli. Effective ads generated significantly more spontaneous EDA responses than ineffective ads as did the music versions of the ads compared to the non-music versions. The results indicate how the commercial effectiveness of ads can be directly linked to their potential to arouse emotions, and that music is significant in driving the emotional experience of watching TV ads.

Alpha EEG/EMG ratio during finger movement as an index of musical performance ability

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#Sholokhov Moscow State University for Humanities, Russia
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Previous investigations had demonstrated that measurable indices of sensorimotor organization (SMO) could be EEG power in individual adjusted upper alpha frequency range as an index of cortical 'top-down' control with simultaneous decreasing redundant muscles tension. With the aim to study the interrelationship between the musical performance ability, motor fluency and alpha EEG/EMG during the FMPT and its mental imagery in 18 non-musicians (NM), musically trained participants (MS) and experts (PM) fluency of actual and imagined FMPT were assessed. EEG and forehead muscles EMG were recorded during the rest, FMPT and mental imagery of FMPT in all subjects. To determine whether ratio of EEG alpha/EMG power changed across motor task performance and mental imagery conditions, a series of repeated measures ANOVAs and multiple regression analysis were run. Fluency of FMPT was highest in PM vs MS and NM ($F[2, 176] = 12.23$, $p = 0.001$). There were no significant group differences of alpha EEG amplitude and EMG power in rest conditions. In contrast, alpha EEG/EMG during FMPT and mental imagery were significantly greater in PM compared to MS and NM ($F[2, 176) = 8.23$, $p < 0.001$). In the current study significant correlation between the fluency of actual FMPT and alpha EEG/EMG ratio was found in all groups ($r \geq 0.54$; $p \leq 0.009$). It was concluded that upper alpha EEG /forehead muscles EMG ratio while finger motor performance task (FMPT) and its mental imagery could predict the musical performing ability. This research was supported by Russian Foundation for Humanities (RFH) 14-06-00951a and 15-04-00565a grants.

Chunking by intermittent motor control in music

Rolf Inge Godøy
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Various theories in music perception and cognition, from classical gestalt theory to more recent experimental work and data-driven modelling, have contributed to our understanding of chunking in musical experience. But our own research on music-related body motion has singled out intermittency in motor control, i.e. a basically discontinuous and point-by-point control scheme, as an essential factor in chunking. Classical motor control theories with claims of so-called closed loop continuous feedback have in recent years been challenged by models suggesting intermittent control manifest in so-called open loop and pre-programmed motor commands, because continuous feedback loops are thought to be too slow for many highly demanding tasks. Various findings in human motor control, i.e. the so-called psychological refractory period, principles of posture-based motion control, of action hierarchies, of goal-directed behaviour, and our own research on music-related body motion, seem to converge in suggesting the existence of intermittent motor control for chunking at the short-term timescale of very approximately 0.5 seconds duration. Following a so-called motor theory approach, the basic tenet here is that schemas of sound-producing body motion are projected onto whatever musical sound it is that we are hearing. This in turn means understanding chunking by recognizing a number of constraints of body motion and motor control, something that suggest an unequal distribution of attention and effort in musical experience, hence, the idea of chunking by intermittent motor control in music.

A multidimensional model of arousal and its relevance for music-health research

Joel S. Swaine
School of Drama, Music and Screen, University of Hull, UK

To address the reduced specificity of unidimensional models of arousal, some music psychologists have employed Thayer's two-dimensional model of 'energetic' and 'tense' arousal. However, energy and tension may themselves comprise empirically dissociable components. This paper introduces a novel, multidimensional model of felt energy and tension, and indicates how this model is consistent with existing psychological constructs and knowledge of biological systems. Variations in self-reportable feelings of arousal are represented on two sets of dimensions. One, relating to variations in the deployment of attention, comprises 'alertness' (high-low), 'selectiveness' (distributed-focused), and 'direction of focus' (sensations-thoughts). The other, relating to variations in interoceptive stimulation, comprises two components: 'motivational energy' and 'motor tension'. Levels of motivational energy (energy mobilised to support the metabolic demands of instrumental actions) are represented on dimensions of 'locomotive action preparation', 'vocal action preparation', 'actual demand', and 'anticipated demand'. Motor tension (competition between preparatory and inhibitory influences on motor output), includes levels of preparatory influence represented on the dimensions of motivational energy, and levels of inhibitory influence represented on dimensions of 'freeze responding', 'behavioural inhibition' (associated with approach-avoidance conflict), and 'effortful restraint'. This framework provides the basis for a development of the proposal that, through musical activity, individuals who habitually dysregulate emotions, with strategies of avoidance, suppression, rumination or worry, can learn to experience positively and negatively valenced changes in motivational energy more 'openly', i.e., with more distributed attention, more alertness, and less motor tension. This approach contrasts with hedonic models of emotion regulation, and accords with mindfulness-based approaches.

Controlling the clarinet: Tongue and finger actions

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Institute of Music Acoustics, University of Music and Performing Arts Vienna, Austria

When clarinettists perform, they coordinate their finger movements on the tone holes with their tongue articulations on the reed. In this study, the finger forces and the tongue actions of N = 23 clarinettists were investigated under controlled performance conditions. In order to carry out an expressive performance task, eight excerpts from Weber's first Clarinet Concerto were selected to fit a 2 x 2 x 2 design (register: low-high; tempo: slow-fast, dynamics: soft-loud). During the experiment, the experimenter introduced additional instructions that altered the clarinettists' expression levels (low-high). Furthermore, the participants played a technical exercise task, in which different combinations of tongue actions and finger actions in three different tempi were required. All participants played on the same sensor-equipped Viennese clarinet, which measured the finger forces applied to the six main tone holes as well as the reed oscillation signal. From the force sensors, the average finger forces (Fmean) and the peak finger forces (Fmax) were calculated for each player and each recorded excerpt. Overall, the measured finger forces were low (Fmean = 1.17 N, Fmax = 3.05 N) in comparison to those on string instruments. From the reed signal, timing and articulation information were extracted. The analysis of the timing information showed that in fast tempi, finger actions have dominance over the tongue's timing.

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Transformations of musical scales in traditional unaccompanied singing

Rytis Ambrazevičius
Department of Audiovisual Arts, Kaunas University of Technology, Lithuania
Department of Ethnomusicology, Lithuanian Academy of Music and Theatre, Lithuania

Because of an absence of a fixed referential tonality, musical scales can experience certain gradual changes in the course of a cappella vocal performance. For example, the phenomenon of floating tonality or gradual transposition (usually a gradual rise of pitch up to several semitones) common in traditional, unaccompanied singing has been discussed (Niemi & Jouste, Greene, Ambrazevičius). Alexeyev studied some peculiar instances of so-called 'evolving' scales in Yakut singing, i.e. the intervals between adjacent scale degrees tend to widen in the course of performance. In the present study, we aim to identify types of gradual changes of musical scales in traditional singing without accompaniment and to discuss possible causes for the changes. Praat-aided acoustical measurements of pitches in traditional unaccompanied vocal performances were carried out. The sample was composed of 20 song records exemplifying the Lithuanian vocal tradition, both monophony and homophony. Several phenomena were revealed. First, the gradual transposition (rise) from the beginning to the end of the song performances can be identified as typical case. Second, the phenomenon of evolving scales was found to range from negligible to striking, for different vocal performances. Third, sometimes an opposite phenomenon of gradual shrinking of the musical scales, i.e. microtonal narrowing of intervals, takes place. The rise and widening might be attributed to warming-up, timbral brightening, and mastering of range, whereas the gradual shrinking manifests as the upper scale degrees reach gradually the upper part of a vocal range not comfortable for voice production.

Classical singing students and professional classical singers' performance preparation

Vaike Kiik-Salupere
Department of Music, Institute of Fine Arts, Tallinn University, Estonia

In recent years, changes in society have led to a corresponding increase in competitiveness, and professional musicians have not been exempt from this. Performance anxiety usually manifests itself in negative changes in mental and physical sense of self before the performance. The aims of the study was to find out (1) how professional singers and singing students achieve and maintain psychological and physical optimal state needed for their performance, and (2) what pre-performance activities and exercises singers consider the most efficient before their performance on stage. The study method employed semi-structured interviews with professional classical singers (N = 12). To allow organization, categorization and analysis of the received information, the texts were processed with the qualitative research software NVivo 9. For the study with students (N = 60), an original questionnaire including 25 statements was used. A five point balanced Likert scale was used and results were analysed making use of the SPSS software. According to the results, all vocalists had developed their strategies and personal routine of daily activities in order to maintain physical and psychological readiness for performing and ensure coping with performance anxiety. Breathing exercises, suitable diet, sufficient sleep and optimal use of voice were considered beneficial before a performance. The singing students' voice and singing were negatively affected by a bad mood, unfavourable conditions and rush. Students claimed that they try to find out on their own what gives them confidence before a performance. All singing students considered the pre-performance psychological attunement to be important.

Saturday 22 August 2015 **RNCM THEATRE**
11.30-12.00 **ESCOM EARLY CAREER RESEARCHER AWARD**
Chair: Jukka Louhivuori

Rules of engagement: The structure of musical engagement and its personality underpinnings

David M. Greenberg, Peter J. Rentfrow
Department of Psychology, University of Cambridge, England

Music has been present in human societies for tens of thousands of years. Although music remains a prominent feature in everyday life, people engage with it in a variety of ways. Why is music like a religion for some, but only sonic wallpaper for others? To address this issue we introduce a new self-report instrument, the Musical Engagement Test (MET), which measures individual differences in music listening behaviour. Results across three samples (Ns = 1,012, 1,070, and 146) converged to reveal a robust, replicable, and generalizable five-factor structure underlying musical engagement: These engagement factors are interpreted as: Cognitive, defined by intellectual processes related to perceiving sonic and surficial features in music; Affective, defined by emotional processes involved with cathartic and expressive engagement; Physical, defined by physiological processes related to movement, dance, and energetic responses to music; Narrative, defined by a perceptual focus on the symbolism, lyrical, and story-like features in music; and Social, defined by group bonding and identification processes with the musician(s) and fellow music listeners. Results indicated that the MET had strong test-retest reliability and convergent validity. We then examined the links between musical engagement and musical preferences across self-report and behavioural measures of preferences, and also examined the links between musical engagement and personality across four different measurements of the Big Five.

David studied psychology, philosophy and aesthetics as an undergraduate and holds an MPhil in Social and Developmental Psychology from the University of Cambridge. He is a PhD candidate at the University of Cambridge where he explores music at the intersection of personality, social, and clinical science. His work has thus far focused on the mechanisms and processes underlying music perception, preferences, and engagement, and the role of musicality in autism.
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Saturday 22 August 2015 **RNCM THEATRE**
12.00-13.00 **KEYNOTE 4** **Chair: Jane Ginsborg**

How to get somewhere in Music – 25 years of research on expert performance and deliberate practice

Andreas C. Lehmann
Hochschule für Musik Würzburg, Germany

Although skill acquisition is a central topic in music education, it has also attracted much attention in cognitive psychology. Fuelled by a much-cited publication by Ericsson, Krampe & Tesch-Römer (1993) and a lesser-known preceding publication by Ericsson, Tesch-Römer & Krampe (1990), critics and supporters of the expertise view on expert and exceptional performance have since been engaged in controversies. The central concept of Ericsson, Krampe & Tesch-Römer, namely ‘deliberate practice’ (DP), has been widely accepted as a potent predictor of performance in different domains of expertise, ranging from sports to games and music performance. DP denotes the task-specific structured training activity that plays a key role in skill acquisition and helps us explain individual differences in expert performance. In my presentation I will offer an overview of recent research related to DP and address some common misconceptions. Furthermore, I will advocate future research in this important area, which is at the intersection of music psychology and music education. Researching task-specific practice in music and its context offers great potential for

basic research in psychology/ musicology as well as for practical research with applications in music education. While the concept of DP was first developed in the domain of classical music, it can and should be adapted to other music-related activities. Unfortunately, the current lack of longitudinal studies regarding practice among novices hampers advances in our understanding of DP. In sum, research on training-related activities has provided, and will hopefully continue to provide, benefits for all involved in skill acquisition and expert performance.

Andreas C. Lehmann has been Professor for Systematic Musicology and Music Psychology at the Hochschule für Musik Würzburg (School of Music), Germany, since 2000. He received his PhD in musicology after completing a degree in music education (both from the School of Music and Drama in Hanover, Germany). Andreas Lehmann is associate editor of the music cognition journal Musicae Scientiae, president of the German Music Psychology Society, and (co-)author of a number of chapters, journal articles and books. His latest book, written together with John A. Sloboda and Robert H. Woody, is entitled Psychology for Musicians: Understanding and acquiring the skills (2007), published by Oxford University Press.

Practical information

The conference venue is the Royal Northern College of Music, 124 Oxford Road, Manchester M13 9RD. The RNCM telephone number (office hours only) is 0161 907 5200. If you need to speak to a member of the organising committee during the conference you may contact

- Chrissy Brand 07913 213246
- Alexandra Lamont 07548 124165
- Michelle Phillips 07811 971869.

There is a registration/information desk in the RNCM reception area between the entrances on Booth Street and Rosamund Street staffed by student volunteers between 12.30 and 18.30 on Monday, 08.30 and 18.30 on Tuesday, Wednesday and Friday, and 08.30 and 14.00 on Thursday and Saturday. An information board nearby can be used by anyone wishing to exchange information, make travel or dinner plans, or connect with other delegates. Last-minute changes to the programme will be indicated here.

Please note that all presentations will take place at the times advertised in the programme, so in cases of absence there may be a break in a session. You are free to change rooms between presentations, although we ask you do so quickly and quietly so as not to disturb presenters or the other members of the audience.

Buffet lunches, coffee and tea will be served on the Lower and Upper Concourses. There are seating areas in the Concert Bar and Café, and Brodsky Restaurant/Bar. Please ensure you show your conference badge to catering staff as proof of eligibility. The Café will be open for cash sales from 8.30 and the Concert Bar will be open in the early evenings, other than on Tuesday and Thursday.

Internet access at RNCM

Eduroam – free wifi available at educational establishments in 74 territories worldwide: see www.eduroam.org
The Cloud – free public wifi available to anyone by setting up a Cloud account.

Social media

We would encourage delegates to share aspects of the conference via social media as widely as possible. Please use the hashtag #musicsciences2015. The conference team will be tweeting and retweeting from the account @ESCOM2015.

Social programme and live music

A programme of social events has been designed to help foster interactions between delegates and enrich your experience of attending the conference, and there are opportunities to hear current, award-winning students at RNCM in performance.

Tuesday: The Abelia Saxophone Quartet (Emma McPhilemy, Hannah Corcoran, Isobel Williams and Catherine Hanson) – winners of the 2015 Christopher Rowland Prize for Chamber Music – will give a short concert from 18.00 to 18.30 in the Concert Hall, followed by a welcome reception free of charge to all delegates starting at 19.30 in the Tempus Bar at the Palace Hotel, a short walk north from the RNCM along Oxford Road.

Wednesday: After the ESCOM General Assembly there will be live jazz from Ali Roocroft (keys), Alasdair Simpson (bass) and Joe Luckin (drums) – Popular Music student of 2013 – in the Concert Bar and Café from 19.00 to 19.45.

Thursday: Three excursions have been arranged to locations that may be a little hard for you to visit independently. These must be booked and paid for in advance, either via the conference website (www.escom2015.org) or by 18.00 on Tuesday 18 August at the very latest at the conference registration desk. Places will be limited to the number of seats on the coaches. If there is not sufficient take-up of places on an excursion, we reserve the right to cancel it. Coaches will leave at 13.30 from RNCM and will return at 17.30 (exact times of departure from destinations will be confirmed).

1. Tatton Park in Cheshire (£19): one of the UK's most complete historic estates, situated in Cheshire just to the north of the town of Knutsford. It contains a mansion, Tatton Hall, a manor house dating from medieval times, Tatton Old Hall, 50 acres of landscaped gardens, a farm and a deer park of 2,000 acres.
2. Imperial War Museum North at Salford Quays (£10): Based in Salford Quays, this museum explores the impact of modern conflicts on people and society, showing how war continues to shape and change lives. The main exhibition space takes you through a timeline of wars from the First World War to the present day. Six walled-off spaces called 'silos' within the space look at themes common to all conflict – from the role of women to science and technology.
3. Old Trafford Football Stadium (£26): The tour takes approximately 80 minutes to complete. Go behind the scenes at Old Trafford and see the stadium through the eyes of Manchester United greats themselves. From the heights of the Sir Alex Ferguson Stand, to the atmosphere-soaked players' dressing room, every moment will seem to carry the roar of 76,000 fans in your ears – none more so than the ultimate honour of emerging from the players' tunnel and following in the footsteps of so many legendary reds.

Friday: The Conference Dinner will take place at the beautiful Gorton Monastery (89 Gorton Lane, Manchester M12 5WF telephone 0161 223 3211). Tickets (£45) must be booked and paid for in advance, either via the conference website (www.escom2015.org) or by 18.00 on Tuesday 18 August at the very latest at the conference registration desk. Places will be limited to the number of seats on the coaches, which will leave RNCM at 19.00 on Friday 21 August and return from the Monastery at 22.00.

Exploring Manchester

If you do not wish to join one of the excursions, you might like to explore city centre attractions within easy walking distance of RNCM, including the Victorian buildings of and around the Town Hall, shopping at the Arndale Centre, the impressive Central Library and John Rylands Libraries, bars in the Spinningfields area, and the quirky cafés and bars of the Northern Quarter.

Cultural and leisure activities at or within very close walking distance of RNCM include:

RNCM Collection of Historic Musical Instruments (opening hours during the conference will be advertised) www.rncm.ac.uk/research/resources/collection
UK Museum of the Year 2015: Whitworth Gallery, University of Manchester, Oxford Road, Manchester, M15 6ER (stunning architecture: free, open till 21.30 on Thursdays – historic fine art, modern and contemporary art, textiles, prints, wallpaper and sculpture) www.whitworth.manchester.ac.uk/visit/
The Manchester Museum, University of Manchester, Oxford Road, Manchester M13 9PL (free, open daily 10.00-17.00pm – dinosaurs, mummies and stuffed animals) www.museum.manchester.ac.uk/
The Holden Gallery, Manchester School of Art, Grosvenor Building, Cavendish Street, Manchester M15 6BR (free, open until 19.00 on Thursdays – contemporary art) www.holdengallery.mmu.ac.uk/about/
The Manchester Aquatics Centre swimming pools, Oxford Road, directly opposite RNCM www.manchestersportandleisure.org/memberships/pay-you-go-memberships

In the city centre, still within walking distance or a short bus ride away, you will find the following:

- Manchester Art Gallery, Mosley Street, Manchester, M2 3JL (open till 21.00 on Thursdays) www.manchestergalleries.org
- Central Library, St. Peters Square, M2 5PD. Exhibitions and also the Henry Watson Music Library www.manchester.gov.uk/centrallibrary
- Centre for Chinese Contemporary Art, Market Buildings, Thomas St, Northern Quarter, M4 1EU, www.cfcca.org.uk
- Elizabeth Gaskell's House, restored home of novelist Elizabeth Gaskell, 84 Plymouth Grove, M13 9LW, (Wednesdays, Thursdays and Sundays, 11.00-16.30) www.elizabethgaskellhouse.co.uk
- Museum of Science and Industry (MOSI) Liverpool Rd, M3 4FP www.mosi.org.uk
- National Football Museum, Urbis Building, Corporation St, M4 3BG www.nationalfootballmuseum.com
- The Pankhurst Centre, 60-62 Nelson St, M13 9WP (open Thursdays 10.00-16.00) www.thepankhurstcentre.org.uk
- People's History Museum, Left Bank, Spinningfields, M3 3ER www.phm.org.uk/

More information is available at www.visitmanchester.com/what-to-do/

Taxi phone numbers

Lynch Taxis 0161 661 7777
Mantax 0161 230 3333
Radio Cars 0161 236 8033
Street Cars 0161 228 7878
Union Cars (offers student discounts) 0161 833 4141

Food and drink

Lunches and refreshments during the tea and coffee breaks are included in the conference registration fee.

For breakfast and evening meals there are many options for budget eating close to RNCM, since Oxford Road is also home to two universities and Manchester School of Art. Of these we would particularly recommend the closest:

- Aardvark Cafe (south along Oxford Road, opposite Blackwell University Bookshop) www.aardvarkcafe.co.uk/aardvark.html (every day 7.30-18.30)
- Christie's Bistro (south along Oxford Road, The Old Quadrangle, University of Manchester) www.chancellorscollection.co.uk/christies-bistro/ (Monday to Friday 09.00-17.00) main courses range from £11 to £13
- Eighth Day café (north along Oxford Road) http://8thday.coop/ (Monday-Friday 09.00-17.00, Saturday 10.00-17.00) sandwiches start at £3
- Sandbar (north along Oxford Road and right into Grosvenor Street) www.sandbarmanchester.co.uk/ (Sunday-Wednesday 12.00-00.00, Thursday 12.00-01.00am, Friday-Saturday 12.00-02.00) main courses range from £3 to £9
- Umami (virtually opposite RNCM on Oxford Road) www.umami.cc/ (Monday-Saturday 12noon-11pm) sushi dishes from £3 to £13, main courses between £6 and £8.

We can also recommend other local restaurants along, and off Oxford Road:

- Don Giovanni's (Italian) 1-2 Peter House, Oxford Street, M1 5AN, 0161 228 2482 www.dongiovannis.co.uk/ Main courses range from £7 to £27
- Gio's (Italian) 5-7 Lower Mosley Street, M2 3WS, 0161 228 2030 http://giosmanchester.com/ Main courses range from £7 to £23
- Mr Cooper's House & Garden and The French, both in Midland Hotel, Peter Street, M60 2DS, 0161 932 4198 www.mrcoopershouseandgarden.co.uk/ www.the-french.co.uk/ Main courses range from £14 to £23 in Mr Cooper's House & Garden; Tasting menus from £65 per person in The French
- Opus One in the Radisson Edwardian Hotel (the former Free Trade Hall), Peter Street, M2 5GP, 0161 835 8904 www.radissonblu-edwardian.com/manchester-hotel-gb-m2-5gp/gbmanche/hotel/dining/opus Main courses range from £14 to £23
- Red Chilli Chinese Restaurant, 1 Oxford Road, M13 9WL, 0161 273 1288 http://redchillirestaurant.co.uk/manchester-oxford-road/ Main courses range from £9 to £16
- San Carlo Fumo (Italian), 1 St Peters Square, *Oxford Road*, M1 5AN, 0161 236 7344 www.sancarlofumo.co.uk/fumo-manchester/ Main courses start at £7)
- Zouk (Indian & Pakistani), The Quadrangle, Chester Street, M1 5QS, 0161 233 1090 www.zoukteabar.co.uk/~zoukteab/manchester.php Main courses range from £8 to £17.

Just south of Whitworth Park where Oxford Road becomes Wilmslow Road (a 20-minute walk from RNCM) is the start of the "curry mile" in Rusholme, with dozens of Indian, Pakistani and other south Asian restaurants.

Selected restaurants in the city centre include:

Albert Square area

- 1847 (gourmet vegetarian) 58 Mosley Street, M2 3LQ, 0161 326 1811 http://by1847.com/ 2 courses £19; 3 courses £25; 5 course tasting menu £32; 7 course tasting menu £42
- Albert Square Chop House, 14 Albert Square, M2 5PF, 0161 834 1866 http://albertsquarechophouse.com/ Main courses range from £12 to £29
- Armenian Tavern, 5 Princess St, (off Albert Square), M2 4DF, 0161 834 9025 www.armeniantaverna.co.uk/ Main courses range from £9 to £17
- Baltic Cellar (Russian, Polish, Baltic) 20 Lloyd Street (off Albert Square), M2 5WA, 0161 971 6047 www.balticcellar.com/ Main courses range from £10 to £17
- Bill's (Contemporary European, breakfasts to dinner) 8-12 John Dalton St, M2 6JP, 0161 834 2756 http://bills-website.co.uk/restaurants/manchester/ Main courses range from £9 to £17
- Duttons, 2-10 Albert Square, M2 6LW, 0161 241 6839 www.duttonsmanchester.co.uk/ Main courses range from £7 to £16
- Tampopo (East Asian street food) 16 Albert Square, M2 5PF, 0161 819 1966 www.tampopo.co.uk/ Main courses range from £8 to £15
- Rozafa (Greek) 63 Princess Street, M2 4EQ, 0161 236 6389 www.rozafa.co.uk/home.html Main courses range from £9 to £18

Castlefield

- Akbars (Indian) 73-83 Liverpool Road, M3 4NQ, 0161 834 8444 www.akbars.co.uk/manchester Main courses range from £7 to £12
- Albert's Shed (modern) 18-20 Castle Street, Castlefield, M3 4LZ, 0161 839 9818 http://albertsshed.com/ Main courses range from £8 to £23
- Don Marco (Italian) Campfield Avenue Arcade, Deansgate, M3 4FN, 0161 831 9130 www.donmarcomanchester.co.uk/ Main courses range from £8 to £25
- Dimitri's (Greek tapas) Campfield Arcade, Deansgate, M3 4FN, 0161 839 3319 www.dimitris.co.uk/ Tapas dishes range from £4 to £8
- Evuna (Spanish tapas) 277-279 Deansgate, M3 4EW, 0161 819 2752 http://evuna.com/evuna-deansgate/ Tapas dishes range from £2 to £16
- Lal Qila (South Asian) 310 Deansgate, M3 4HE, 0161 839 6730 http://lalqilarestaurants.co.uk/ Main courses range from £7 to £15
- Per Tutti (Italian) 3-11 Liverpool Road, M3 4NW, 0161 834 9741 www.pertutti.co.uk/ Main courses range from £8 to £19
- Sapporo Teppanyaki (Japanese) 91-93 Liverpool Road, M3 4JN, 0161 831 9888 www.sapporo.co.uk/restaurant-manchester/ Sushi dishes range from £3 to £28; Main courses range from £10 to £40.

Chinatown: head for George St, M1 4HE for Chinese, Thai and fusion food www.visitmanchester.com/articles/attractions/china-town/.

Northern Quarter

- Blue Pig (French bistro) 69 High Street, M4 1FS, 0161 832 0630 www.thebluepigmcr.co.uk/ Main courses range from £6 to £30
- Dough (Italian) 75-77 High Street, M4 1FS, 0161 834 9411 www.doughpizzakitchen.co.uk/ Main courses range from £7 to £11
- Evuna (Spanish tapas) 79 Thomas Street, *M4* 1LQ, 0161 833 1130 http://evuna.com/evuna-northern-quarter/ Tapas dishes range from £2 to £13
- Ning (Malaysian) Burton Building, 92-94 Oldham St, M4 1LJ, 0161 238 9088 www.ningcatering.com/manchester/index.php (Main courses range from £9 to £16
- Walrus Canteen and Bar (sharing plates, cocktails), 78-88 High St, M4 1ES, 0161 828 8700 www.walrusmanchester.com/ Main courses available from £5 to £24.

Full information about restaurants and other retail outlets in Manchester, several offering online discounts, can be found at www.manchesterconfidential.co.uk/offers.

Emergencies

Hospital (Accident and Emergency Department)

Manchester Royal Infirmary
Oxford Road
Manchester
Greater Manchester
M13 9WL
Tel: 0161 276 1234
Distance from RNCM (postcode M13 9RD): 0.5 miles (0.8km)

Doctors

Boundary Medical Practice
63 Booth Street West
Hulme
Manchester M15 6PR

Tel: 0161 227 9785
Distance from RNCM: 0.1 miles (0.1km)

Brunswick Health Centre
Hartfield Close,
Manchester M13 9YA

Tel: 0161 273 4901
Distance from RNCM: 0.4 miles (0.7 km)

Dentist

Dental Hospital Access Centre
Higher Cambridge Street
Manchester M15 6FH

Tel: 0161 393 7730 www.cmft.nhs.uk/dental/contact-us
Distance from RNCM: 0.2miles (0.3km)
Further information should you have a medical emergency is available at www.nhs.uk/ServiceDirectories/

Environmental statement

One of our responsibilities in organising an international event is to minimise its environmental impact, and we have made some careful decisions with sustainability in mind that we should like to share with delegates.

Where possible we have sourced merchandise that can be reused at future events, for example lanyards without conference-specific branding. The roll-out banners have reusable stands and after ESCOM2015 will be rebranded to promote future RNCM research events. Rather than encourage the production of more plastic pens on the planet, we are using up stock from a previous RNCM project.

The RNCM in-house caterers endeavour to keep food miles to a minimum by using local suppliers wherever possible.

Those of us who work in institutions of higher education, including researchers, typically use enormous quantities of paper, which has a particularly large impact on the environment. Although we decided to print this book containing the programme and conference abstracts the full-length proceedings are available only in electronic form. We have employed a locally-based firm of printers, Chapel Press, which is committed to producing print using recycled paper, or paper supplied from sustainable forests, wherever possible. The firm is a member of the FSC (Forest Stewardship Council) and PEFC (Programme for the Endorsement of Forest Certification) schemes and has a state-of-the-art printing press that has been designed specifically to use as little power as possible, vegetable-based inks and to reduce waste.

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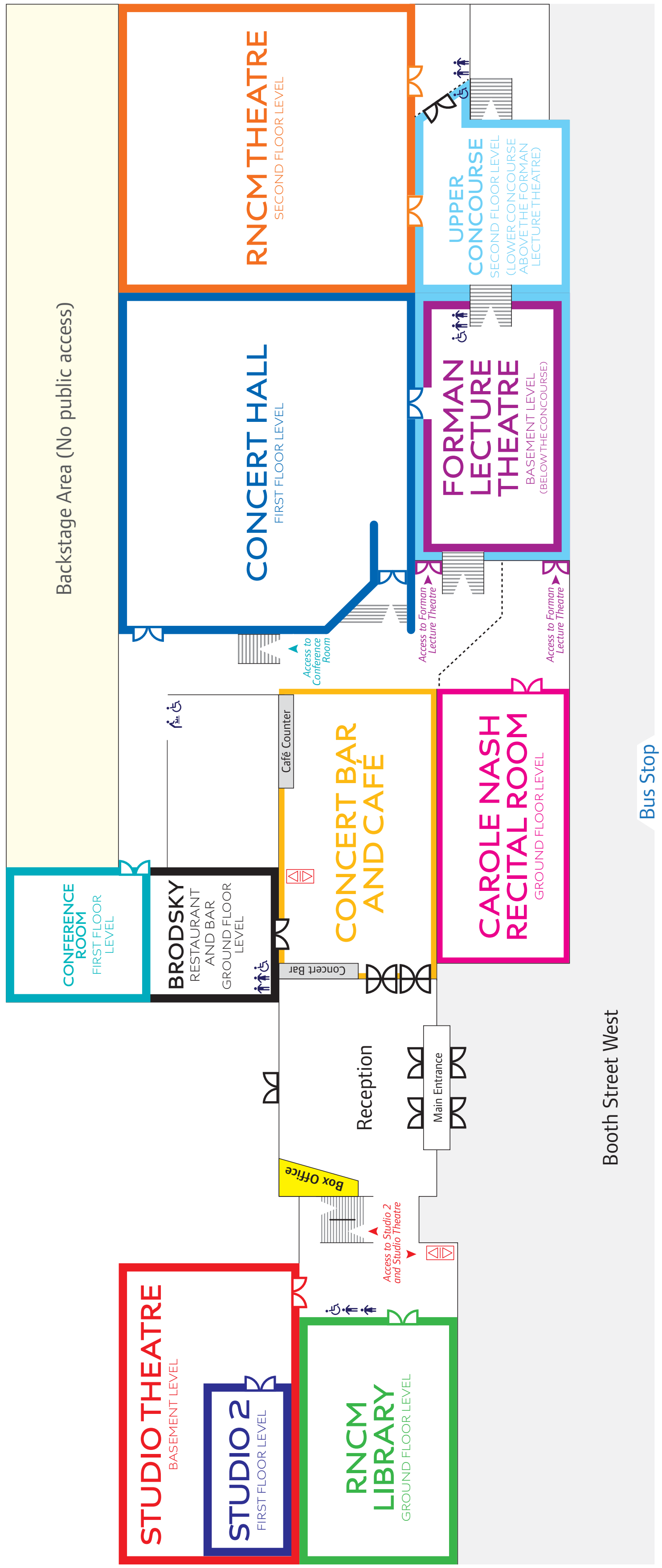
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UPPER CONCOURSE
SECOND FLOOR LEVEL
(LOWER CONCOURSE ABOVE THE FORMAN LECTURE THEATRE)
CONCERT HALL
FIRST FLOOR LEVEL
FORMAN LECTURE THEATRE
BASEMENT LEVEL
(BELOW THE CONCOURSE)
Access to Forman Lecture Theatre
Access to Forman Lecture Theatre
Access to Conference Room
Café Counter
CONCERT BAR AND CAFÉ
CAROLE NASH RECITAL ROOM
GROUND FLOOR LEVEL
Bus Stop
CONFERENCE ROOM
FIRST FLOOR LEVEL
BRODSKY
RESTAURANT AND BAR
GROUND FLOOR LEVEL
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Reception
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Parental motivations to enrol their children in music early learning programs

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ABSTRACT

Background

Research suggests that families engage in music activities in everyday life for a range of reasons including: as a means of establishing family rituals, changing moods and, modifying behaviours (Barrett 2009, 2011, 2012). Families value music as an early childhood resource within the family unit (Custodero and Johnson-Green, 2003). Beyond this realm, there has been an evident rise in the proliferation of, and enrolment in, formal music education programs for young children (Adachi & Trehub, 2012).

This growth of Music Early Learning Programs (MELPs) indicates an additional formalisation in the ways in which families engage in music with their children. Through enrolment in a MELP, a young child's formal engagement with music commences at a very early age (in some instances as young as 3 months). Further, their participation in the MELP is guided by a music "professional" through a program of planned activities that purport to support a range of learning and development goals. However, there is little extant research that identifies the motivations of parents to enroll their children in such formal music programs from a very young age. Further, little is known of the ways in which such program participation shapes the child's engagement in music in the home or in the role of parenting. Barrett (2009) suggested that attendance at a MELP for some families was likely to accrue a range of benefits in and beyond music for both parent and child. These benefits included the development of parenting skills and techniques that employed music as a means to shape family engagement, unity, and interaction. The research reported in this paper was designed to build and expand on these findings.

Aims

This research aims to identify and making meaning of the ways in which Australian parents invest in and utilise music through participation in Music Early Learning Programs (MELPs). It investigates family music participation through the lenses of young children's culturally situated everyday engagement in one of four formal music programs, and how participation contributes to, influences, or shapes the way music is used in the family home and in the role of parenting.

Method

Data were generated for a total of 29 families. Of these, 26 families' generated data over a one year period with their children aged from 12 months to five years. Data generation techniques included a baseline self-report survey to gauge musical history and engagement levels; 3 semi-structured interviews undertaken at 4-6 monthly intervals; two observations of families participating in MELP sessions; and, video observations recorded as a video diary by the parents in the home. Written weekly diaries accompanied these video diaries.

This paper focuses on an analysis of interview data specifically and investigates the reported reasons for why parents enroll their children in formal music programs.

Results

Findings indicate that reasons include: having a high value for music, following their own childhood experiences with music; having a high value for music despite having little childhood experience with music; belief that early music exposure will support their young child's cognitive and/or psycho-motor development; as a social outlet for the parent; and as a means to bond and engage with their child. Program participation shaped the way parents used music in the home and in the role of parenting, as evidenced in the use of specific techniques from the music classes in the home to manage child behaviour (e.g., tidy up songs), regulate emotion (transition songs), share play time (nurturing songs, repeating activities) and build family traditions (bedtime routines).

Conclusions

These findings contribute to a better understanding of the ways in which participation in MELPs contributes to the development of parenting skills and family cohesion, as well as the development of music and extra-music skills for the child from a younger age, what parents perceive the benefit of participation to be, and how this influences the way that they parent.

This research is funded by an ARC Discovery Grant led by Barrett and Welch (Being and becoming musical: towards a cultural ecological model of early musical development).

Keywords

Music Early Learning Program; music in early childhood; music in the home; parents and music.

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The emotional impact of leitmotifs in Opera and Film Music

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Background

By listening to musical leitmotifs individuals often recognise certain emotions, given their recurrence to semantic and sometimes episodic memory. Since the use of leitmotifs in film music fundamentally refers to Richard Wagner's technique of leitmotifs, it seems worthwhile to investigate differences in the emotional impact of leitmotifs between opera and film. Film music fulfils several functions such as inducing moods or emotions, directing the spectators' attention to important features on the screen, and shaping meaning (Vitouch, 2001, p. 71; Cohen, 2010, p. 891). Because the musical expression affects the entire emotional impression of a film (Bolivar, Cohen & Fentress, 1994; Vitouch, 2001), it is interesting to analyze the transfer of these findings to musical leitmotifs.

Aims

The present study investigates the influence of relevant factors on the emotional rating of leitmotifs: First, the impact of presentation mode (audio vs. audiovisual), second, the familiarity with the leitmotifs and audiovisual sequences, and third, the influence of listeners' musical and media expertise are analyzed.

Method

Twenty-three participants (students of musicology and other humanities) were asked to rate four leitmotifs from Richard Wagner's *The Ring of the Nibelung* (e.g. "Riesen-Motif") and four leitmotifs of Howard Shore's film music to *The Lord of the Rings* (e.g. "The History of the Ring-Motif") regarding six basic emotions.

The leitmotifs were first presented in an auditory-only version, and then as an audiovisual sequence. Compared to the auditory-only motifs, six of the eight leitmotifs in the audiovisual film sequences differed in length, tempo, gestalt, melodic contour and instrumentation. Finally participants reported their familiarity with the leitmotifs and the audiovisual sequences.

Results

While most participants neither knew the Wagnerian (*Ring of the Nibelung*) leitmotifs nor the corresponding scenes, the film (*Lord of the Rings*) leitmotifs and sequences were well-known. A number of significant differences in leitmotif emotion ratings were observed for multimodal presentation contexts. For instance, the film leitmotif "The History of the Ring-Motif" was more often assigned to sadness (χ^2=9.86, p<.05) in the auditory-only condition than in the audiovisual condition. In general, Wagner's leitmotifs showed stronger differences in the emotion ratings regarding the presentation mode, which may depend on participants' lack of familiarity with the motifs. For instance, significant differences between the presentation modes were found for Wagner's "Riesen-Motif" (χ^2=9.14, p<.05) that was more often attributed to "anger" in the auditory-only condition than in the audiovisual condition.

Conclusions

If leitmotifs and film sequences are unknown, emotional impressions are clearly increased by the visual layer, since the film and opera images may not correlate with individual associations. On the other hand, if participants are familiar with the topic, leitmotifs may function as a substitution for visual images. Thus the emotional rating of leitmotifs is strongly affected by their familiarity.

Keywords

leitmotif; emotion; Richard Wagner; Howard Shore; audiovisual

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An examination of value judgements in criticism of Beethoven's Piano Sonata recordings

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ABSTRACT

Background

The question of what sets a great performance apart from a mediocre one has engaged philosophers, artists and scientists for centuries, back to the eighteenth century debate on taste in aesthetics (Hume, 1757) and Helmholtz's (1877) first empirical work on physiological response to music.

In the present study this question has been addressed through an investigation of value judgements in the written criticism of recorded performance. Music performance criticism is a common form of evaluative response to music, relevant to musicians' careers but about which we still know little. Research on performance evaluation in recent decades has focused on holistic and segmented assessment in the educational environment, furthering our understanding of the phenomena underpinning the evaluation process (for an overview see Alessandri, 2014).

However, there is still no consensus on the nature of performance judgements and on the existence, or not, of criteria that may reliably drive critical evaluation (McDermott, 2012; Wrigley & Emmerson, 2013). Gabrielsson (2003) and more recently McDermott (2012) and Wrigley and Emmerson (2013) all made calls for further research to explore value judgements by experts in different musical settings in order to obtain new perspectives on this debate.

Aims

Employing an inductive, qualitative/quantitative approach, the aim of this study was to offer a systematic investigation of the evaluation criteria used in recorded performance critical review, as reasons given to support value judgements.

Method

First, reviews of Beethoven's piano sonata recordings published in the monthly British magazine *Gramophone* between 1923 and 2010 were collated ($N = 845$) and metadata analyzed to obtain an overview of review structure, repertoire, as well as pianists and critics involved (Alessandri, Eiholzer, & Williamon, 2014).

Next, a series of quantitative/qualitative data reduction procedures was applied to the dataset to produce a representative selection of reviews suitable for in-depth qualitative investigation. This included an analysis of vocabulary and word patterns, which were compared between critics and different periods. The resulting selection of reviews (n = 100, written by 10 critics, published between 1934 and 2010) was subjected to thematic analysis using a double-coder protocol in order to develop a visual descriptive model of critical text content. This content was summarized in terms of musical sound properties, energy level and delivery mechanics (primary descriptors, n = 719), higher-order characterizations of the performance (supervenient descriptors, n = 1,404), and the value of these properties (evaluative judgements n = 1,502) (Alessandri, Williamson, Eiholzer, & Williamon, 2015).

Finally, based on this model, the relationship between the emergent descriptors (primary and supervenient) and the valence of critics' evaluative judgements was examined through a three-step, double-coder qualitative analysis. The valence of critics' statements (n = 943) was analyzed independently by two researchers. Then, lists of valence loaded statements were retrieved for each performance primary and supervenient descriptor (n = 30 quote lists) and qualitatively analyzed by the first author to identify descriptor qualities praised by critics. This led to the development of a set of value adding descriptor qualities used in reviews to support value judgements. The emergent qualities were then compared and organized into areas of evaluation that represent an initial model of the basic performance evaluation criteria used by critics in our sample (Alessandri, 2014).

Results

The majority of critical review statements (87.57%) emerged as valence loaded (positive, negative, or mixed – that is, partly positive and partly negative), with a bias towards positive loaded statements (49.73% positive, 23.49% negative, 14.35% mixed, 7.33% neutral, 5.10% unclear). Reviews were characterized by a juxtaposition of positive and negative statements: on average, each review entailed 50.08% (SD = 0.26) of positive, 23.61% (SD = 0.23) of negative and 16.71% (SD = 0.19) of valence mixed statements. Evaluations were expressed explicitly through purely evaluative terms (e.g., good, poor, excellent, unduly) and implicitly through the use of value-laden terms (e.g., 'dainty' vs. 'emasculated' playing).

Across all primary and supervenient descriptors thirty-five value adding descriptor qualities were identified. These were grouped into seven areas of evaluation, linked to the aesthetic value of the performance (**intensity** (n = 300), **coherence** (n = 248), and **complexity** (n = 221)), to its achievement-related value (**sureness** (n = 129), **understanding** (n = 118), and **endeavor** (n = 94)), and to the appropriateness of each quality to the given musical context (**suitability** (n = 286)). Evaluation criteria were reliably used across all critics (Cronbach's α = .928). A tension characterized the relationship between evaluation criteria. Performance properties emerged as interdependent, so that an increase in one of them may neutralise, decrease or increase the value assigned to other qualities. The ability to balance two or more evaluation areas in a performance (e.g., an 'impetuous' (**intensity**) but 'disciplined' (**sureness**) performance) was discussed as added value by critics.

Conclusions

This study offers the first empirically developed model of performance evaluation criteria in critical review. The findings have both pedagogical and conceptual implications.

Judgements on the aesthetic value of a musical performance were grounded in three criteria: **intensity**, **coherence**, and **complexity**. This finding overlaps with Beardsley's proposed triadic theory of aesthetic value (Beardsley, 1962, 1968) and resonates with Kaplan and Kaplan's (1989) model of aesthetic appreciation of nature. In addition to aesthetic value, three achievement-related criteria emerged as comprising a substantial portion of critics' value judgements (**sureness**, **understanding**, and **endeavor**). Taken together the findings from the present analysis emphasise the importance of the construct 'performer's achievement' when it comes to our appreciation of a recorded piano performance, supporting Carroll's 'success value' theory (Carroll, 2009).

The emerging themes and criteria from the present analysis were reliably used in review by critics born generations apart. However, the relative weight in the present sample given to the seventh criterion, **suitability**, and the existence of tension between criteria are factors that emphasise the context dependency of value judgements, supporting Carroll's (2009) and Sibley's (Dickie, 1987) context-aware generalism. The interdependency between criteria suggested by the findings is in line with the widely discussed 'uniformity-in-variety' theory of experimental aesthetics (Berlyne, 1971; McDermott, 2012) and with interactionist perspectives on the aesthetic experience, such as the processing fluency framework proposed by Reber, Schwarz, and Winkielman (2004).

Finally, our emergent model of recorded music performance evaluation offers a new perspective and insights on the nature of professional review that may be used to promote discussion in music schools, not least in the context of the continuous development of assessment schemes and procedures. The model also furthers our understanding of music performance criticism as a form of written response to music that is both complex and contextual.

Keywords

Music criticism, Beethoven, recorded performance, aesthetic judgement, success value.

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Expectations and tensions induced by primitive rhythms

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ABSTRACT

Studies of tension while perceiving music are currently focused on the tonal structure of compositions. The complexity of a composition as a unique acoustic event limits the exploration of mechanisms of acoustic perception, particularly that of the temporal aspect. The new method that is based on the construction of abstract primitive rhythms is proposed in the paper. Signals of fixed intensity, form and spectrum with the duration of 50, 150 and 300 ms were succeeded by pauses of different length ranging from 100 to 2000 ms. Each sequence looped forming primitive rhythm. A total of 45 stimuli were evaluated by 33 subjects on the 11 Lickert-type scales. Most of the subjective scales represented the dimension of expectation-tension and highly correlated with themselves and with the period (tempo). Correlations with the fill factor are mostly insignificant. Dependencies of the subjective scales on period are nonlinear. Irrespective of the duration of the signal (i.e. in all of the three series) there was one turning point at about 950-1050 ms at which a constant decrease of tension with the growth of pause stopped and a multi-directed trend with the more or less significant rise and fall began. Whether this turning point is constant independently of the intensity of the tones is the subject of further exploration.

BACKGROUND

Stating the problem

As it is widely accepted in the psychology of music and musicology since E. Kurth (1947), emotions are induced as a result of tensions and subsequent relieves. Subsequent studies mostly concentrated on the tonal characteristics of tension (Lehrdahl, Krumhansl, 2007, Lerdahl, 1996). The works that are based mainly on this approach but develop it are Farbood & Price K. (2014), Farbood & Upham (2013), Lehne, Rohrmeier, Gollmann, & Koelsch, (2013). Generally, systematic studies ignore the temporal parameters of expectation and tension. Meanwhile, expectations are supposed to play a significant role in the expression of a certain musical idea. What is more important for this process: relation of signals to pauses (fill factor) or some specific parameters (constants)? What is the temporal structure of expectations? Do they have several levels? At what duration of a stimulus do these levels come into action? What are the relations between the tempo and expectations? These questions are important for the construction of a theory that would be suitable for the explanation of psychic states induction (emotions as well as other) by music, prosody, etc. Although the prospect of such a theory was first sketched about fifteen years ago (Almayev, 2000), empirical investigations using the proper methodology started and brought first results relatively recently (Almayev, Sadov, Tarkhov, 2014).

Methodology

Scientists studying psychological effects of music or any other acoustic event face interaction of several constantly changing parameters: frequencies, their durations, energies, spectrums (cepstrums). All of them in their turn interact with the human system of sound experiencing in some rather complicated manner. For example, physically minor and major chords for the same tonality are almost identical; nevertheless, their psychological meanings differ obviously and dramatically. Moreover, any real sound of a real pitch has its form with the attack, decay, sustain and release phases, and a great performance differs from a MIDI playback only relatively slightly as far as these phases are concerned. Also any real musical piece can have plenty of associations and reminiscences, making the experience highly individualized. Facing this complexity of the subject, it looks preferable to study each variable in controlled conditions. Abstract noises with a change to the limited number (one, two) of the variables appear to be promising for the study of the parameters of the psychic state induction by sound.

AIMS AND METHOD

A. Aims

Construct and test a method for an exploration of the timing parameters of expectations and tensions that is based on primitive abstract rhythms. Preliminarily identify the character of dependency of tensions on the duration of pauses and signals. Find nonlinearities if any. Make a preliminary estimate of the influence of the tempo on expectations. Estimate the possible impact of the individual differences.

B. Method

Subjects were exposed to white noise, width of spectrum: one octave, center A5 (880Hz), duration: 50, 150 and 300 ms, 70dB. Form of the signal – rectangular. Each tone succeeded with pauses ranging from 50 ms to 2000 msec. Tones and pauses looped forming primitive rhythms. Some of the stimuli with relatively long pauses (i.e. long in relation to the duration of stimuli) were excluded. Each subject evaluated the total of 45 stimuli, administered quasi-randomly. The total of 38 subjects participated. First 5 persons had to describe the stimuli freely, then on the basis of content analyses the most frequent definitions were transformed to the Lickert-type scales. The subsequent 33 subjects had to evaluate the stimuli according to these scales. The scales were: "relaxation-tension", "anxiety–calmness", "serenity – irritation", "approach – withdrawal ", "slowing – acceleration ", "indifference – desire

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to act", "distraction – concentration ", "tranquility – anxiety", "boredom – interest", "something will happen – nothing will happen", and "industrial – natural ". Stimuli were generated in Cool Edit Pro 2.0 sound editor, and administered in laboratory setting. Data were analyzed using R environment.

RESULTS AND DISCUSSION

A. Period vs. Fill factor

Most of the subjective scales strongly intercorrelate (Spearman r from 0,32 to 0,72), except that of the "industrial – natural". It can be said that these scales represent the dimension of temporality and tension, while the last that of the objects to which the sounds could refer. Period (duration of tone + duration of pause) turned out to be a much more important predictor than the fill factor (relation of stimulus to pause).

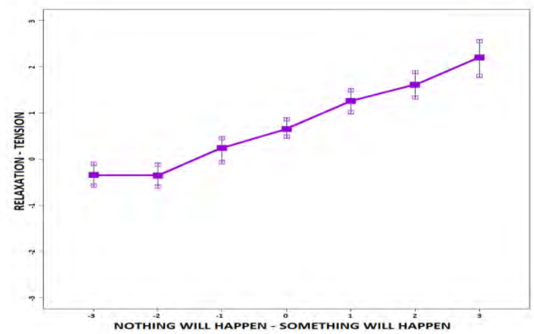
Table 1. Influence of Period vs. Fill factor on the Subjective Estimations of the Stimuli (N=1485)

	Fill Factor	Period
Relaxation-Tension	-0,07	**-0,35**
Tranquility-Irritation	-0,02	**-0,25**
Withdrawl-Approach	-0,09	**-0,24**
Slowing-Acceleration	-0,17	**-0,55**
Distraction-Concentration	0,00	**-0,30**
Indifference DesireToDo	-0,08	**-0,34**
Calmness-Anxiety	-0,07	**-0,26**
Boredom-Interest	-0,07	**-0,32**
NothingWillHappen-SomethingWillHappen	-0,10	**-0,26**
Industrial-Natural	0,06	0,11
Corporal Sensations	0,03	-0,07

B. Expectations and Tensions

Semantically expectations are best of all expressed by "Nothing Will Happen – Something Will Happen" (further on – the "Expectation") scale, while tension by the "Relaxation-Tension" one. Their Spearmen r correlation is 0,54 for the total sample (N=1485) with almost the same meanings within each of the series.

Figure 1 "Relaxation-Tension" and "Nothing will happen Something will Happen" ("Expectation") scales. (Means with 95% confidential intervals).



C. Essential nonlinearities. Important parameter?

Essential nonlinearities were observed regarding the dependency of the subjective scales on the Period. In all of the three series for both Expectation and Tension scales one crucial turning point area may be distinguished that is located at 950-1050 ms. Up to this turning point expectations and tensions clearly decrease with the lengthening of period (although with some distortions) while subsequently a multi-directed trend is observed.

Figure 2 "Nothing will happen Something will Happen" ("Expectation") scale and the Period within 50 ms series.

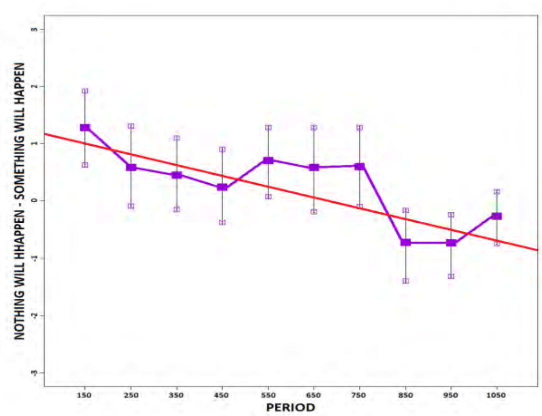


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Figure 3 "Relaxation-tension" scale and the Period within 150 ms series.

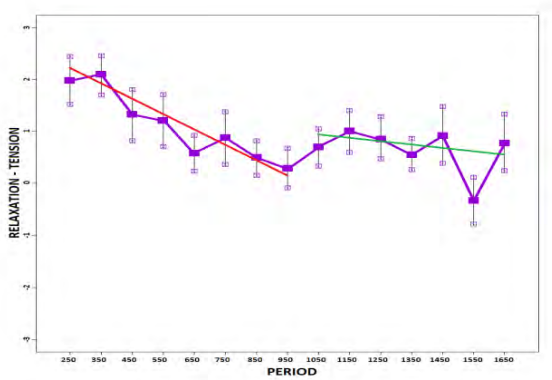
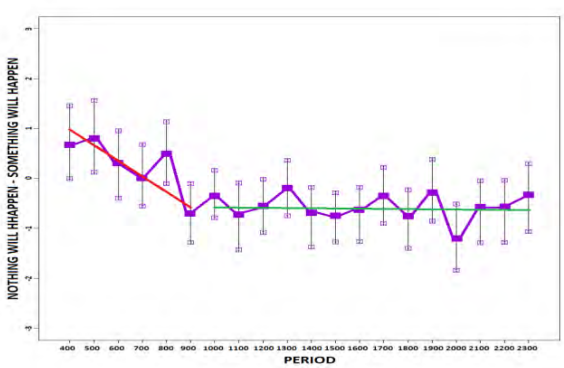


Figure 4 "Nothing will happen - Something will Happen" ("Expectation") scale and the Period within 300 ms series.



Regarding the difference between the tension's decrement for the region "before the turning point" at the 50 ms and 150 ms series (see table 3), it has to be noted that the average tempo of the series sufficiently differed. For the 50 ms series it was 141,7 BPM that corresponds to Allegro; 150 ms – 85,2 BPM – Moderato; 300 ms – 57,02 BPM – Lento. Although the stimuli from all of the series were mixed into one set and administered quasi-randomly, the tempo - not as such but as a quality for the whole corresponding family of the stimuli - could affect the estimation of tension on account of the duration of the signal.

Table 2. Linear regression Betas for the Expectation scale

Series	up to 900-950 ms	since 950 ms	Total
50 ms	-0,26	n.a.	-0,26
150 ms	-0,32	-0,03	-0,203
300 ms	-0,21	-0,01	-0,196

Table 3. Linear regression Betas for the Tension scale

Series	up to 900-950 ms	since 950 ms	Total
50 ms	-0,16	n.a.	-0,13
150 ms	-0,40	-0,15	-0,29
300 ms	-0,26	-0,08	-0,26

D. Interpretation

Based on the obtained results, it can be stated that the duration of the stimuli generally had little influence on the subjective estimations in this experiment. Whether it is due to the signal's form (rectangular) or intensity (70 dB) is the subject of further investigation. It might be noted that subjectively intensity grew within 150 and 300 ms stimuli (due to the summation of neural impulses) making the sound somehow "shuffling". Nevertheless, the role of the period turned out to be decisive. The dependency of expectations on tempo is essentially nonlinear with at least one turning point that is located between 950 and 1050 ms. What happens at this point looks like some qualitative shift. How can it be interpreted? In terms of the theory that was proposed in Almayev 2000, relations between expectation, tension and the tempo might be described as an intensification of the search for resources for the management of the upcoming stimulus. The higher is the tempo (i.e. the shorter is the period) the more intensive is the search and correspondingly the higher is the tension. Before ca. 950 ms the signal is protended, its reappearance looks certain, and finding sufficient resources for its management is more or less problematic. But after ca. 950 ms the protention of the pause starts, while the probability of signals reappearance is estimated. This is the process of the upper levels of consciousness that in its turn can be consuming resources and also producing tension, of the sort "why does the signal not appear"? The growth of dispersion with the lengthening of period indicates impacts of possible individual differences, such as the state of anxiety.

The proposed method could be developed in several directions – first it is important to acquire data about the role of intensity of the signals, how it affects expectations and tensions. The method may include such physiological measurements as heart rate and galvanic skin reaction; those results being compared to subjectively perceived tension may reveal important latencies and perhaps individual differences. Further on it may be used for the localization of the brain structures connected to expectations and tensions with the help of EEG (especially 3D methods) and fMRI.

The interaction of the tonal structure with the temporal parameters is the subject of special concern. An investigation of its mechanisms that takes into consideration the new knowledge about the subjective corporal localization of acoustic stimuli in the human body (Almayev, Sadov, Tarkhov, 2014) looks as an important but rather challenging task.

E. Implications

The popularity of music as the object of study seems to grow constantly in Psychology and Psychophysiology. Scientists see its potential. Nevertheless, almost exclusively whole compositions are used as the stimuli in psychological and psychophysiological studies. Each of such stimuli being a very complicated, constantly changing acoustic event may provoke different, often contradicting and competing emotions. A transition from complex acoustic events such as whole musical pieces to more primitive "transparent" stimuli looks promising for the investigation of the psychophysiological mechanisms underlying emotions and psychic states. These entities, being themselves the characteristics of psychic processes, are now almost exclusively perceived as discreet qualities (e.g. "basic" emotions, psychic states, personality traits) without any explicit study of the parameters of duration which are crucial for their constitution. The psychology of music seems to be one of the most appropriate fields of investigation in order to reveal the interplay of quality and quantity, adequate integration of discreet and dimensional theories.

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Dissonance/roughness in Lithuanian traditional *Schwebungsdiaphonie*

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ABSTRACT

In contrast to Western art music, the dissonance-like sonorities in *Schwebungsdiaphonie*-cultures are at the core of the tonal structures. These cultures, although not abundant, are found in different locations all over the world (Cazden, Brandl, Messner, etc.). *Sutartinės* are a Lithuanian type of Schwebungsdiaphonie (Račiūnaitė-Vyčinienė, Ambrazevičius & Wiśniewska, etc.). On the one hand, the studies on psychoacoustic roughness and sensory dissonance are really big in number. The notions of roughness and sensory dissonance are usually considered as synonyms. On the other hand, it was proposed that ideal sounding of *Schwebungsdiaphonie* conforms to a maximum dissonance / roughness (Brandl, the diaphony in the Balkans and elsewhere; Ambrazevičius, the Lithuanian *Sutartinės*). In the present study, we analyze the occurrences of the notions of roughness and sensory dissonance in the psychoacoustic studies and define the case of *Sutartinės* in this context. The review of the experimental findings on the intervals corresponding to the maximum values of roughness / sensory dissonance reveals certain discrepancies between the concepts of roughness and sensory dissonance. It seems that, at least for a substantial frequency range, roughness is associated with larger interval sizes (Plomp & Levelt, Kameoka & Kuriyagawa, Terhardt, Zwicker & Fastl, Hutchinson & Knopoff, Vassilakis, etc.). Collation of these results and the findings of acoustical measurements of Sutartinė performances leads to the conclusion that the ideal vocal "clash" in *Sutartinės* most probably corresponds to psychoacoustic roughness, but not to sensory dissonance.

I. INTRODUCTION

Quite a few musical cultures favour dissonances (in terms of physiological acoustics) rather than consonances in their polyphonies. This is described as various types of psychoacoustically based "diaphony of beats" (*Schwebungsdiaphonie*) in some places (although not abundant) throughout the world (Cazden, 1945; Brandl, 1989; Messner, 1989; etc.).

Thus it is important that sonorities in the *Schwebungsdiaphonie*-cultures are governed by the phenomena opposite to those that are characteristic of the Western tonal music: there is a striving for (maximum?) dissonance (or roughness; see below) rather than consonance. In certain cases it could be stated that aesthetic standards and notions are somehow reversed. For instance, strong (in terms of roughness) "clashes" of seconds obtain positive connotations. Thus generally striving for the "native" consonance could be envisaged instead.

II. DISSONANCE AND ROUGHNESS

Sensory dissonance and roughness are two concepts used in psychoacoustic studies almost always as synonyms. The classical study of Plomp & Levelt (1965) could serve as a typical example of the presumed interchangeability of the two concepts. While the authors asked the subjects to judge intervals on the scale "consonant-dissonant" (or, in the case of incomprehension, they substituted the "consonant" with "beautiful" or "euphonious" instead; p. 553), they exploited both notions of dissonance and roughness unambiguously in their discourse. Incidentally, in many other studies, the questions presented to the participants are not revealed and the procedures of the experiments are not (or only faintly) detailed. Therefore the subjective sonic qualities meant and evaluated in the experiments remain obscure.

However, it is also argued that, even though roughness is one of the main constituents of sensory dissonance, it is not the only one. Moreover, several types of roughness are distinguished or in some cases the multidimensionality of roughness is suggested.[1]

Now we will take glance at the results of several studies on sensory dissonance / roughness. For instance, Ernst Terhardt (1968, p. 219) states that "the modulation frequency of maximum roughness increases with increasing carrier frequency initially and reaches a constant value f^*_{mod} = 75 Hz at carrier frequencies above approximately 2 kHz"[2] and presents the corresponding graph (see Figure 1). In his later study (1974), Terhardt claims the approximate identity of dissonance and roughness. However, there is some discrepancy between this claim and the factual results (Figure 2): it is clear that at least in the relevant spectral range the sense of roughness slightly differs from the sense of dissonance. Briefly, roughness is stronger for wider seconds and dissonance is stronger for narrower seconds.

[1] See forthcoming paper Ambrazevičius, 2015, for details.

[2] A number of studies employ AM (amplitude modulated) sine tones, while others use sine tone pairs. However, it is stated that the results do not differ significantly for the two cases (e.g. Terhardt, 1968, p. 219).

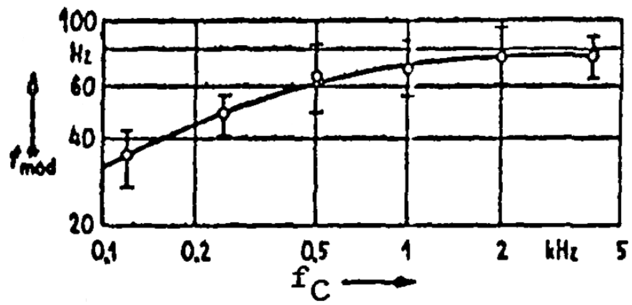

Figure 1. Modulation frequency for maximum roughness f^*_{mod} as function of carrier frequency f_c. Modulation factor is 1, *SPL* = 60 dB (Terhardt, 1968, p. 219).

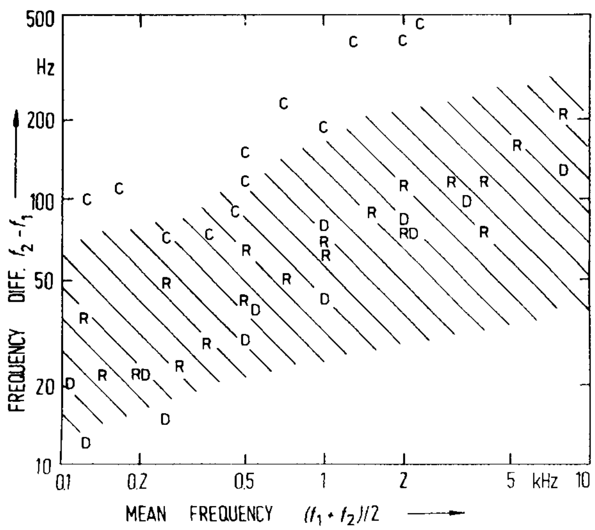

Figure 2. Dissonance, consonance, and roughness; according Terhardt, 1974, p. 1062. Hatching marks the area of pronounced roughness, "R", "D", and "C" mark, correspondingly, the maxima of roughness and dissonance, and the limit of appearance of consonance.

Findings of Andrzej Rakowski (1982) lead to the approximation for the frequency interval for maximum roughness as $2\sqrt{f}$. William Hutchinson and Leon Knopoff (1978) proposed noticeably different evaluation of dissonance. They designed their own approximation for the critical bandwidth as $1.72\ f^{0.65}$ and employed the Plomp's and Levelt's 1/4 CBW-criterion for the maximum dissonance.

The results of Marc Leman's model for roughness (2000) are presented in Figure 3. Pantelis N. Vassilakis (2001, p. 197–198) applied the model proposed earlier by William A. Sethares (1998; see the illustration from the second edition of his book on Figure 4). Finally, consider the evaluations by Fastl & Zwicker (Figure 5).

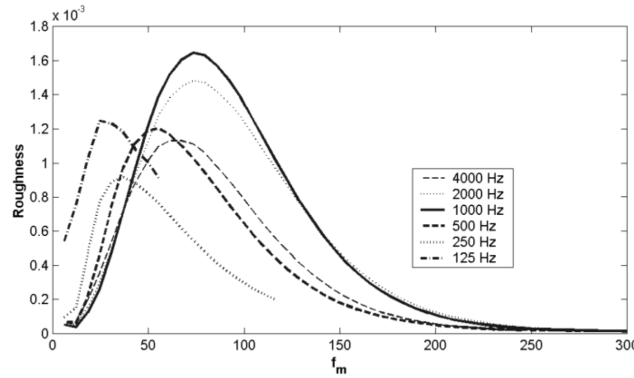

Figure 3. Roughness in function of modulation frequency of different carrier frequencies (modulation factor is 1; Leman, 2000, p. DAFX-5).

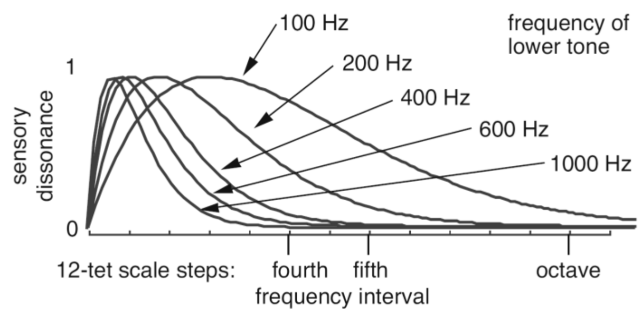

Figure 4. Sensory dissonance in function of frequency interval between two sine tones sounding simultaneously (Sethares, 2005, p. 47). Curves for different frequencies of the lower tone are presented.

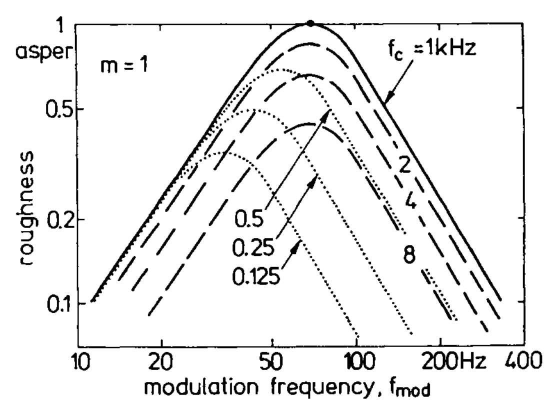

Figure 5. Roughness of 100% amplitude-modulated tones; according Fastl & Zwicker, 2007, p. 259. Curves for different centre frequencies are presented.

Now let's compare the findings of the psychoacoustic studies. The curves in the Figure 6 were composed based on the formulas and interpolations of graphically presented results from the discussed sources. Probably, the confusion between the dissonance, roughness, and its possible types explains why the results of the experiments show significant discrepancies. A

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closer examination of Figure 6 reveals that roughness is typically associated with larger interval sizes, and that sensory dissonance is associated with narrower interval sizes. For instance, Terhardt in his experiment asked the subjects specifically to evaluate roughness (1968, p. 216), and the corresponding curve lies higher. On the contrary, as already mentioned, the well-known relating of the maximum dissonance to 1/4 of critical bandwidth (Plomp & Levelt, 1965) refers specifically to dissonance but not to roughness.

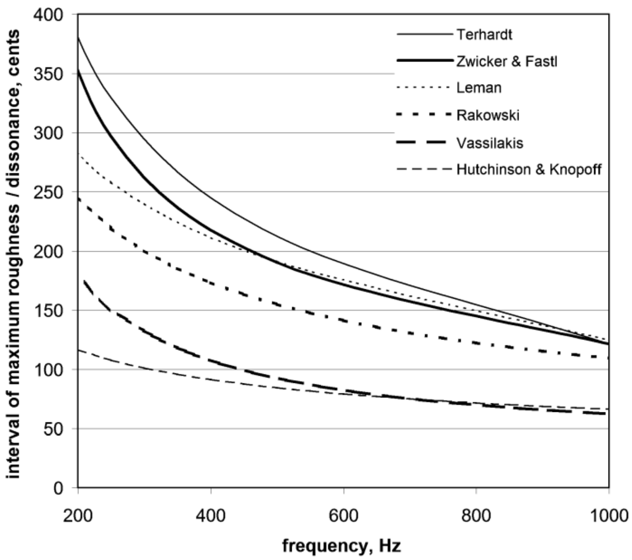


Figure 6. Dependence of maximum roughness / dissonance on the central frequency. See the body text for details.

On the one hand, roughness is typically associated with the perceptual result of rapid fluctuation of envelope of sound pressure amplitude, i.e., with the subjective rate of amplitude change (expressed as product of the subjective modulation depth and f_{beats}; e.g. Fastl & Zwicker, 2007, p. 262), or, briefly, with the "bumpiness of the [subjective] acoustic surface of a sound" (Parncutt, 2006, p. 202). On the other hand, sensory dissonance could be probably connected to the features of critical bandwidth. Certain doubts remain whether the "bumpiness" and critical bandwidth are tightly related. From my purely subjective observations, the (sensory) "dissonance", "unpleasantness", or "annoyance" could be rather equalized to "harshness" and not so much to "roughness". One may therefore speculate that, for instance, a semitone in the middle of a piano keyboard sounds harsher, whereas the whole tone seems to be rougher. Incidentally, the terms such as "harsh" or "turbid" occur episodically when describing non-euphonious, unpleasant, or dissonant sonorities (e.g. Plomp & Levelt, 1965, p. 554; Mashinter, 2006, p. 65, 66).

III. *SUTARTINĖS*: GENERAL REMARKS

Now from the "cosmopolitic" experiments on psychoacoustic roughness and sensory dissonance we move to the Lithuanian ethnic *Sutartinės*. The most distinctive kind of Lithuanian *Sutartinės* present a peculiar type of *Schwebungsdiaphonie*, i.e. diaphony of the *Sutartinės* is based mostly on intervals of the second occurring between the vocal parts which intertwine polyphonically and polyrhythmically.

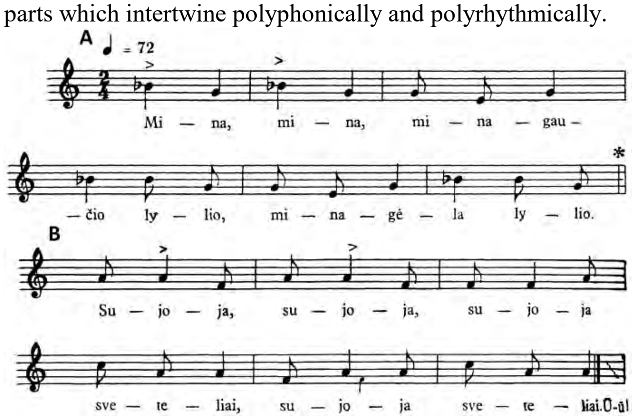
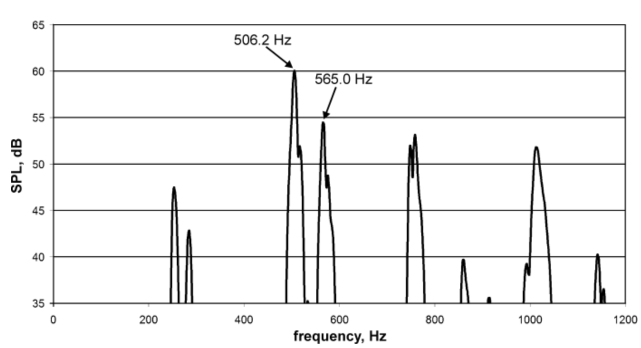


Figure 7. *Sutartinė "Mina, mina, minagaučio lylio"*: original transcription of one part (Slaviūnas, 1958, p. 657 [Nr. 428a]). Entrance of the canonically succeeding voice is asterisked.

Figure 7 shows a typical example of a *Sutartinė*. This *Sutartinė* was performed canonically by three singers in such a way that the two parts A and B (separated by an asterisk in the figure) sound simultaneously, except in the beginning when only one voice (part A) sounds. The lyrics change. Thus mostly intervals of the second occur continuously between the two voices.

When listening to the original recording of this *Sutartinė* (Račiūnaitė-Vyčinienė, 1998)[3], even unsophisticated ear could suggest an idea that the transcription in Figure 7 is actually crude or, at least, quite approximate: the real recording sounds "non-tempered" enough. To reveal the actual scale, the recording was analyzed acoustically: the pitches of dyads were measured and the intervals were calculated (Ambrazevičius, 2005). The pitches were determined from the spectra of the dyads: certain partials were identified as belonging to one or the other of two voices, their frequencies were measured (see the example in Figure 8), and the pitches were calculated. Relatively stable portions of the dyads were considered in terms of spectrum (fortunately, the intrasonic intonation of *Sutartinės* features quite stable segments).



[3] The digitized version of the old recording (from 1930s).

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Figure 8. Excerpt from typical spectrum of *Sutartinė "Mina, mina, minagaučio lylio"*.

The statistical distribution of pitches is depicted in Figure 9. It shows approximately 1.8 of tempered semitone between the most frequent intonations. Thus the corresponding most frequent thirds in vocal parts (G3–B3 and A3–C4[4]) equal approximately 3.6 semitones, i.e. they are neutral. Fourth G3–C4 equals 5.4 semitones. D4 occurs very seldom, thus categorical conclusions about its position in the tuning system could not be drawn. Nevertheless C4–D4 equals 1.5–2.2 semitone, i.e. also roughly 1.8 semitones on the average. A3 and H3 are the most stable tones according to the corresponding sharp peaks in Figure 9. This bichord could be treated as certain bitonal nucleus and anchor of the tuning system. G3 and C4 are less stable, whereas F3 and D4 are the least stable. The zones of intonation are quite wide, even for the most stable anchors. Hence, to generalize, the two central steps are intoned relatively steadily in the course of the entire performance thus forming the nucleus of the scale. The marginal steps show greater freedom in intonation.

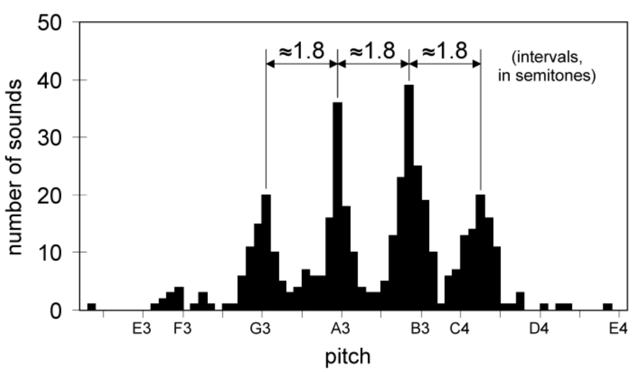

Figure 9. Histogram of pitches in *Sutartinė "Mina, mina, minagaučio lylio"* (Figure 7); all pitches in all parts.

The analysis leads to a conclusion that we have to be very cautious when treating and denominating the scale and tuning system aurally. Western major-minor system and equal temperament work as elements of apperception, which results in "aural ghosts". They lead to misinterpretation that design of the scale is diatonic. Actually the tuning system has nothing in common with diatonics: there is no semitone/whole tone contrast in the sequence of intervals. The scale could be considered as "squeezed anhemitonics", since the intervals between the adjacent pitches are a bit narrower than the tempered whole tone.

One could try to visualize the revealed regularities of the scale in transcription (Figure 10) where a peculiar staff is intentionally applied to avoid associations with the diatonic scale.

Figure 10. Transcription of characteristic patterns of *Sutartinė "Mina, mina, minagaučio lylio"* on an alternative staff. The petit notes show the most characteristic variants.

In the subsequent study (Ambrazevičius, 2008), a total distribution of dyad-intervals in 25 *Sutartinės* has been also composed. The distribution showed that the majority of the intervals are seconds. The category of the interval is quite wide and does not split into the individual categories of minor and major seconds. As in the case of the separate *Sutartinė "Mina, mina, minagaučio lylio"*, the seconds slightly narrower than the tempered whole tone (around 1.7 semitones) are most preferred.

So, again, we come to a simple conclusion: the intervals of second between the voices in the dyads of *Sutartinės* comprise relatively wide category centred at, approximately, 170–180 cents. What accounts for such a peculiar interval? Let's return to the psychoacoustic studies on sensory dissonance / roughness and collate their results to the findings of the study on intervals in *Sutartinės*.

IV. DISSONANCE OR ROUGHNESS IN *SUTARTINĖS*?

For female voices, frequency of the first formant ranges roughly from 400 to 1000 Hz. So this frequency range is expected to be the most intense range in the spectra of singing voices. This corresponds to the second or third (or sometimes fourth) harmonics. Application of these frequency values to the graphs in Figure 6 leads to an insight that the singers were aiming for maximum roughness: the most intense frequency range corresponds to the wide range of pitch intervals centered at slightly "squeezed" whole tone. Importantly, the aiming for maximum dissonance would lead to significantly narrower intervals, around 70–100 cents, what is not the case of *Sutartinės*. It seems that specifically roughness was meant by the singers of *Sutartinės* when describing the sonorities as "clashing" (clanging, warbling; but not "cutting" which would point to the sensory dissonance and narrower intervals). The "perfect clash" was considered by the singers as an essential quality and marker of a congenial performance. Earlier Brandl already concluded that the psychoacoustic correlate of the ideal ring in *Schwebungsdiaphonie* (found in the Balkans and elsewhere) is of maximum roughness (1989). It is actually dubious whether this statement really works for all traditions in Balkans, as there quite different intervals in the dyads could be registered for different cases (cf. Miljković, 1998; Rihtman, 1969). At any rate, the measurements in our studies support this statement when applied to Lithuanian *Sutartinės*. Therefore it can be credibly stated that the scales of *Sutartinės* are actually determined by psychoacoustic, i.e. by extramusical phenomenon.

Importantly, the noun *Sutartinė* derives from the verb *sutarti* which means "to agree", "to be in concord" ("to live in

[4] Here and hereafter a simplified marking for pitch class is used. For instance, C4 actually could be as high as C#4 or even higher.

concord", "to sing in concord", and so on); in other words, "to sing in consonance". Nowadays the word *Sutartinė* is sometimes even applied to signify a perfect, harmonious performance in general, no matter the kind of the performance. Thus, in the case of the Lithuanian *Schwebungsdiaphonie*, roughness obtains a positive connotation: aesthetically and semantically, the sonorities in seconds are considered as consonances.

However, it should be pointed out that the requirement of maximum roughness is not categorical in the Lithuanian case for the following reasons: the intonational zone of a second is too wide, durations of the sounds are too short to produce exact intervals (initial glides are characteristic), and the partials are, on the average, too different in SPL.[5] All these factors diminish the role of maximum roughness. It could be stated that maximum roughness is a desirable quality, but the zone of the suitable roughness is quite wide; the factor of roughness is possibly reduced by other important factors of articulation.

V. CONCLUSIONS

The close inspection of psychoacoustic studies on roughness / sensory dissonance show significant divergences in their findings. Most probably, this results from different experimental conditions and confusion of notions of roughness and sensory dissonance. Attempts to separate these two notions reveal that, at least for a substantial frequency range, maximum roughness tends to be associated with larger interval sizes, compared to the case of maximum sensory dissonance.

Brandl's insight on aiming for maximum psychoacoustic roughness in performance of *Schwebungsdiaphonie* (exemplified mostly by the examples of Balkan music traditions), most probably, is valid for the case of Lithuanian *Sutartinės* as well. Here specifically roughness and not sensory dissonance is meant; this results from the collation of the findings of psychoacoustic studies on roughness / sensory dissonance and the findings of acoustical measurements of *Sutartinė* performances. The rough quality of the sonorities in *Sutartinės* obtains positive connotations, i.e., in a broad sense, these sonorities are considered as "consonances". The maximum roughness is obtained for the intervals slightly narrower than the tempered whole tone, for the characteristic spectra of the female voices of *Sutartinės* singers. This results in the peculiar scale structures deviating considerably from the twelve-tone equal temperament. As a side product, problem of transcription occurs, making the conventional five-lined staff unsatisfactory for adequate presentation of the scale structures in the roughness-based *Sutartinės*.

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[5] Roughness shows substantial dependence on the ratio of amplitudes of the "clashing" harmonics. The strongest roughness occurs for equal amplitudes. The more different in SPL are the harmonics, the weaker is the sense of roughness (Terhardt, 1968; Vogel, 1975; Guirao & Garavilla, 1976).

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Transformations of musical scales in traditional unaccompanied singing

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ABSTRACT

Because of an absence of a fixed referential tonality, musical scales can experience certain gradual changes in the course of *a capella* vocal performance. For example, the phenomenon of floating tonality or gradual transposition (usually a gradual rise of pitch up to several semitones) common in traditional, unaccompanied singing has been discussed (Niemi & Jouste, Greene, Ambrazevičius). Alexeyev studied some peculiar instances of so-called "evolving" scales in Yakut singing, i.e. the intervals between adjacent scale degrees tend to widen in the course of performance. In the present study, we aim to identify types of gradual changes of musical scales in traditional singing without accompaniment and to discuss possible causes for the changes. Praat-aided acoustical measurements of pitches in traditional unaccompanied vocal performances were carried out. The sample was composed of 20 song records exemplifying the Lithuanian vocal tradition, both monophony and homophony. Several phenomena were revealed. First, the gradual transposition (rise) from the beginning to the end of the song performances can be identified as typical case. Second, the phenomenon of "evolving" scales was found to range from negligible to striking, for different vocal performances. Third, sometimes an opposite phenomenon of gradual shrinking of the musical scales, i.e. microtonal narrowing of intervals, takes place. The rise and widening might be attributed to warming-up, timbral brightening, and mastering of range, whereas the gradual shrinking manifests as the upper scale degrees reach gradually the upper part of a vocal range not comfortable for voice production.

I. INTRODUCTION

Gradual transposition of tonality, mostly rise, seems to be quite common for unaccompanied vocal performances in various musical traditions worldwide. For instance, the gradual transposition found in Yakut, Russian, and some other traditions was mentioned by Eduard Alexeyev (1976; 1986). Paul D. Greene in his study on Tamil religious incantation found that, in the final part of the ecstatic recitation (during some 20 recited lines), tonality could rise even in the interval of twelfth (!) (Greene, 1999, p. 482). Also Jarkko Niemi and Marko Jouste noticed that tonality in the North Eurasian songs changes in the course of performances. "There are two types of changes in the tonal structures that are common in northern songs. First, the overall pitch level often rises during the performance. There are examples of Sámi yoiks in which a singer has ended the piece as much as an octave higher to the initial level. Second, the distance between various intervals can change during a single performance or between different variations of the same melody" (Niemi & Jouste, 2002, p. 257).

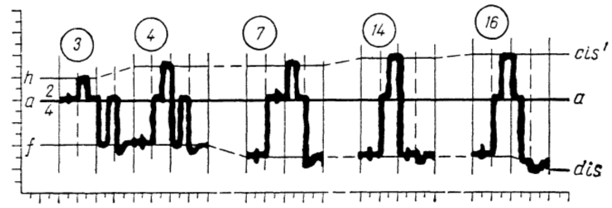

Figure 1. Example of an "evolving scale" (Alexeyev, 1976, p. 49).

We find the second type especially intriguing. Here one encounters not a simple transposition of the whole scale, but a different transposition of the different scale steps. This results in what Alexeyev has named "outspreading" or "evolving" scales (1976, pp. 48-58), an archaic phenomenon connected with the physiological and cognitive matters of singing[1] inter alia. Alekseev visualizes this schematically by outspreading the lines in a staff (Figure 1).

In the present paper, the dynamic transformations of scales in a set of typical Lithuanian traditional vocal performances are examined.

II. SAMPLES

Briefly, monophony (heterophony), polyphony, and homophony are/were characteristic of various Lithuanian singing dialects. Monophony in ensemble performance is traditionally attributed almost exclusively to Dzūkija and Suvalkija (Southeastern and Southwestern Lithuania; see Figure 2). Monophony was also registered in so-called Lithuania Minor[2], yet after the WWII only some traces of autochthonic traditional music could be found in this region as the music vanished together with the Lithuanian autochthons. Polyphony, containing counterpointal polyrhythmic singing – type of *Schwebungsdiaphonie* – among other stylistic variants, was documented in the northwestern part of Aukštaitija, yet it also has vanished in the middle of the 20th century and was finally substituted by homophony. Thus nowadays homophony is prevailing style in different Lithuanian regions. Usually one singer performs the leading part while the rest of a group add the lower "background" part making mostly dyads of thirds, fourths, or fifths with the leading part, according to the

[1] Alexeyev attributes the evolving scales in Yakut singing to dynamics of emotions: to his belief, the interval widening accompanied by increasing tempo leads to a rise of emotional tension (Alexeyev, 1976, pp. 56–57).

[2] Western part of Lithuania and East Prussia (present day Königsberg/Kaliningrad district) that was part of Germany for several centuries.

functional harmony. Sometimes the third, still lower part is added as well, but usually it can be considered merely as stable or heterophonic variant of the second part. The homophonic multipart singing in Žemaitija and Aukštaitija are considered to be of relatively early origin, and mostly featuring major-like mode. The homophonic style in Dzūkija is thought to be of later origin, dating from the turn of 19th and 20th centuries or somewhat earlier. Both major-like and minor-like modes are common.

Figure 1. The ethnographic regions of Lithuania and the location of the samples. The shading palette depicts the spoken dialects.

Only examples of Lithuanian monophonic and multipart homophonic performances are considered in the present paper. Phenomena of musical scales in the Lithuanian *Schwebungsdiaphonie* are definitely relevant as well, yet the peculiar psychoacoustic requirements make the sonorities relatively stable in intonation and thus the dynamic transformations of the scales are relatively negligible (refer to e.g. Ambrazevičius & Wiśniewska, 2009).

One could hypothesize that the gradual transposition as well as more sophisticated phenomena of the scalar transformations are mostly expected in the songs with narrow ambit. Presumably such cases provide "much of space" for the different transformations as they are relatively little limited by tessitura issues.

Therefore a set of recordings of the monophonic Lithuanian rye and oat harvesting songs was composed.[3] All the songs exhibit minor-like scales (at first glance, they could be roughly estimated as Aeolian or Phrygian), except of the major-like *Vai aš pjaunu pjovėjėlė*. The harvesting songs are characteristic of narrow ambit usually not exceeding the interval of fourth. Figure 3 presents an example of the rye harvesting song.

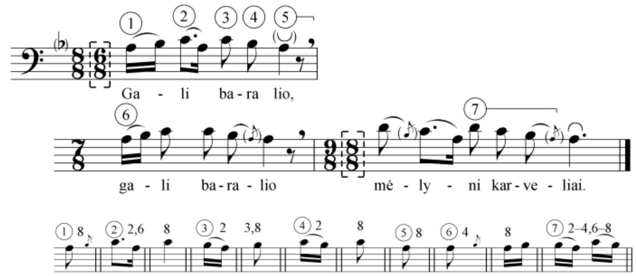

Figure 3. Schematic transcription of *Gali baralio mėlyni karveliai*[4]. The gradual transposition not presented.

The "schematic transcription" means that only the basic features of the tune are depicted. The peculiar scalar qualities (their differences from the 12TET) are in fact neglected: thereinafter we will see that the corresponding diacritic or other markings would make no sense or they would be too complicated since the scales change noticeably from the beginnings to the ends of the songs.[5] The circled numerals denote the segments varying in the succeeding melostrophes; the variations are presented on the undermost staff, complemented with the row numbers of the melostrophes.

For the pilot-type research on the transformations of musical scales in the Lithuanian traditional vocal homophony, two typical idiolects were chosen. The first sample comes from Šeduva folklore group; this small town is situated in the Western part of Aukštaitija, Radviliškis Dst. (see the locations in Figure 2). For the second sample, group of singers from Mištūnai village (Šalčininkai Dst.; Dzūkija region) is chosen. Both groups are groups of female singers. Both samples represent major-like homophony; each of them contains five songs recorded in the turn of the last two decades of the 20th century.[6]

[3] Ten recordings were applied from different published sources: rye harvesting songs *Per dzidzį dvarų*; *Bėkit, bareliai*; *Oi an marių, an mėlynių*; *Rūta žalioj* (Kalviai, Trakai Dst.); *Verkia martela*; *Laiskis laiskis, saulala* (Slabada, Kaišiadorys Dst.); *Pūtė vėjas* (Verbyliškės, Prienai Dst.) (Četkauskaitė, 2007, CD 1, N. 12, 13, 16, 18, 14, 17, 15); *Gali baralio mėlyni karveliai* (Žagariai, Seinai Dst.) (Ambrazevičius, 1999a, N. 1); *Vai aš pjaunu pjovėjėlė* (Žilinai, Varėna Dst.) (Vyčinienė, 2000, N. 1); oat harvesting song *An kalno, jan aukštojo* (Gečialaukis, Alytus Dst.) (Četkauskaitė, 2007, CD 1, N. 23).

[4] Translation of the first strophe: 'Blue doves at the end of bay'.

[5] Actually here the scale in the beginning of the song is schematized. The flat in parentheses (key accidental) denotes the neutral and floating interval of second (the second scale degree). In the course of performance, the scale undergoes certain transformations; see further.

[6] Recordings: (Šeduva) orphan song *Auga kiemi dagilis* (Četkauskaitė, 2007, CD 3, N. 7), song to welcome the bridegroom *Oi brolio brolužėlio* (Vyčinienė, 2002, N. 3), song sung on the wedding eve at the bride's home *Kad aš kelutį keliavo* (Vyčinienė, 2002, N. 1), ploughing song *Tėtėrvins subilda* (Četkauskaitė, 2007, CD 1, N. 7), song of leaving for the wedding ceremony *Oi sesutėla, ko verki* (Četkauskaitė, 2007, CD 2, N. 16); (Mištūnai; all songs from Ambrazevičius, 1999b) love song *Arškėtėli garbuonėli* (N. 20), song to welcome the bridegroom *Kad šėriau žirgelį* (N. 13), oat harvesting song *Łėkė sakałėlis* (N. 8), emigrants' song *Oi tu sakałėli* (N. 19), and (wedding) guests mocking song *Tai kieno gražus kaimas* (N. 1).

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Figure 4: Schematic transcription of *Auga kiemi dagilis*[7].

Figure 5: Schematic transcription of *Arškėtėli garbuonėli*[8].

Examples of two song transcriptions are presented in Figures 4 and 5. The tonalities are normalized: the tunes are transposed so that the tonics are equalized to G4. Other songs in the two samples actually follow the same schemes of the structures and the same rules of combinations of vocal parts (differing slightly for the two dialects).

III. MONOPHONIC PERFORMANCES

A. Gradual Transposition: General Remarks

Quasistable segments of the occurrences containing tonics were cut from the recordings of first melostrophes of all ten songs. Then software Praat was applied, LTAS spectra for each set of the segments were composed, and averaged pitches of the tonics were obtained. For example, the corresponding notes were left in the recording of the first melostrophe of *Gali baralio mėlyni karveliai* (Figure 3): *ga-* (first measure, first note of the syllable), *-li* (first measure, second note of the syllable), *-lio* (first measure), *ga-* (second measure, first note of the syllable), *-lio* (second measure), *-ly-* (third measure, second note of the syllable), and *-liai* (third measure). This technique of averaging weights automatically longer and more intense occurrences. Then the procedure was repeated with the last melostrophe and the differences between the readings for the first and last melostrophes were obtained (Figure 6).

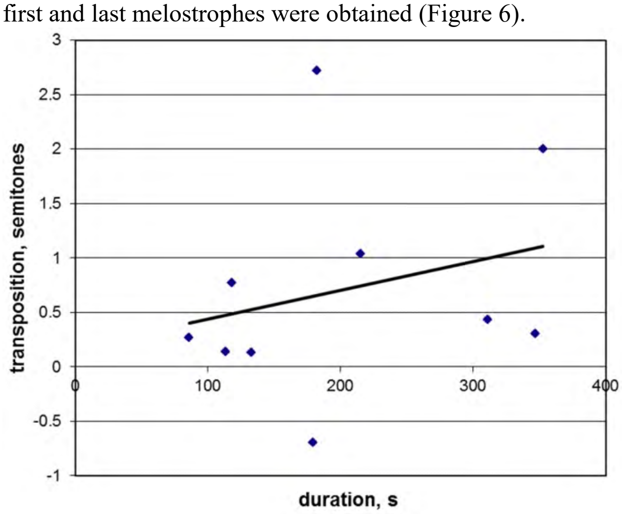

Figure 6. Dependence of transposition for tonic on the duration of song; sample of ten monophonic performances.

Generally Figure 6 shows a rising tonality for the performances. The converse process – lowering towards the end of a song – is also observed for one case (this is the song *Bėkit, bareliai*). However, the tendency of rising transposition is obviously overwhelming, as well as the rough correlation of the rise to the duration of song. Actually the correlation is expected to be rough since perhaps the phenomenon is quite individual and also depends on certain melodic patterns, circumstances of performance, and so on.

B. Gradual Transposition: Evolution of Intervals

The evolution of intervals in monophonic performance is exemplified by song *Gali baralio mėlyni karveliai* (Figure 3). The sequence 3–2–1 (third–second–prime) represented by the syllables *ba-ra-lio* (the second measure in Figure 3) is chosen. The corresponding pitches in all melostrophes are measured (Figure 7).

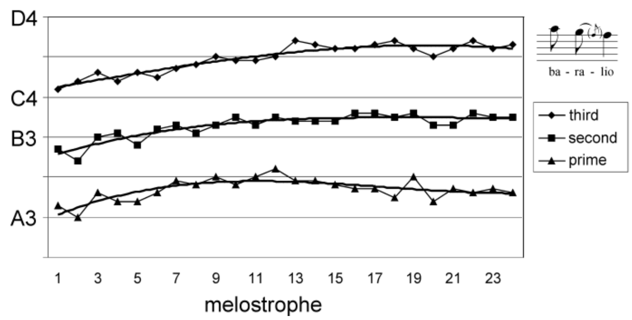

Figure 7. "Evolving" scale in *Gali baralio mėlyni karveliai*: pitches of sequence 3–2–1 in the different melostrophes.

It could be concluded that, up to around ninth melostrophe, the trichord is gradually rising, yet afterwards the tendency of rise is outweighed by the emerging tendency of widening of the trichord. The trichord sort of anchors in the second degree, while the third degree and especially the tonic recede progressively from the anchor. This change could be also interpreted somewhat differently: the gradual rise proceeds up to the end of song, yet slows down when the third degree approaches the upper limit of tessitura (or exits its most comfortable range). The second degree and tonic recede "pushing off" the restricted third degree.

In the end of song, the upper interval of second widens from 165 to 180 cents, on the average, while the lower second widens from 150 to 185 cents. Thus the interval of third (between the tonic and the third scale degree) widens from 315 to 365 cents. Hence the initial quasi-Phrygian tint of the trichord vanishes and transforms into a quasi-Ionian structure. Nevertheless, could the change be considered as a gradual transformation of one diatonic trichord into another? We propose that here one rather encounters the Alexeyev's "evolving" scale. It would be a mistake to treat an interval as changing from the minor third to the major third in the transcription, for instance, in terms of the original phonemic system, since, for the performer, it remains the same interval. In other words, the spreading intervals do not illustrate a *change* of the scale; they represent a *feature* of the scale.

[7] Translation of the first strophe: 'A green goldfinch grew in the yard, in the father's manor'.
[8] Translation of the first strophe: 'Curly eglantine, don't stand at the road'.

These transformations suggest several important issues of the perception and performance of the musical scale. First, the melodic intervals formed by the voices deviate significantly from their 12TET-equivalents. Actually this is not a surprise in the case of traditional vocal performance. Second, what is probably more interesting, the intervals undergo considerable gradual change from the beginning to the end of the song. This leads to the third insight: the intonation of the intervals and, consequently, the intervals in musical scale are only roughly fixed. The system of intervals manifests as certain rough perceptual scheme which is flexibly shaped in the course of performance. Fourth, one can try to speculate the reasons of the discussed evolution. It seems that they result from interplay of certain physiological and psychological phenomena. Perhaps the general rise can be collated to the tendency of gradual timbral brightening. It goes together with the preferred stretch for musical scales. However, the stretch is generally available for the lower scale degrees only. For the upper scale degrees, the phenomenon of stretch is restricted as these rising degrees occur gradually in the upper part of a vocal range not comfortable for voice production. Thus the upper limit of a vocal range "pushes" the high pitches down and so the intervals squeeze.

IV. MULTIPART HOMOPHONIC PERFORMANCES

A. Gradual Transposition: General Remarks

The gradual transposition in multipart homophonic performance is first exemplified by song *Auga kiemi dagilis* (Figure 4). Pitches of several characteristic dyads in all melostrophes of the song were measured. The first dyads in all measures were chosen: *Au-* ('note 1'), *da-* (6), *au-* (12), *ža-* (16), *kie-* (20), *-me-* (24), *tė-* (27), *-re-* (31). Figure 8 shows the development of pitches from the beginning to the end of the song. The pitch tracks are supplemented with marks pointing to the dyads. For example, (5-)3 means that this is the pitch track for the third scale degree which occurs in the dyads 5-3 (i.e. composed of the fifth and third degrees). Roman numerals denote pitches below tonic and Arabic numerals denote tonic and higher pitches.

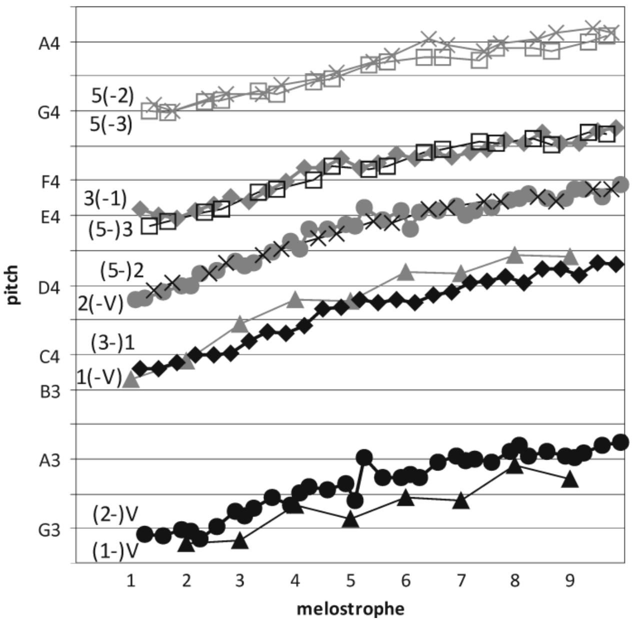

Figure 8. Transposition of dyads in *Auga kiemi dagilis*.

At the moment, it's enough to predicate that, first, the tonality rises in 2-3 semitones, second, this rise differs slightly for the particular dyads, and third, the rise slows down towards the end of the song. Let's take more songs to make more reliable statements. Figure 9 pools results for Šeduva and Mištūnai samples. The graph shows the transpositions from the first to the last melostrophes for tonics. The technique used for the evaluation of transposition in monophonic performances was also applied for the case of multipart performances. For example, the corresponding dyads were left in the recording of the first melostrophe of *Arškėtėli garbuonėli* (Figure 5): *-li* (first measure), *-buo-* (second measure), *ke-*, *-lio* (fourth measure), and *ke-* (sixth measure). Then the averaged pitch of the tonic was calculated from the LTAS. The procedure was repeated with the last melostrophe, and difference of the pitches was calculated.

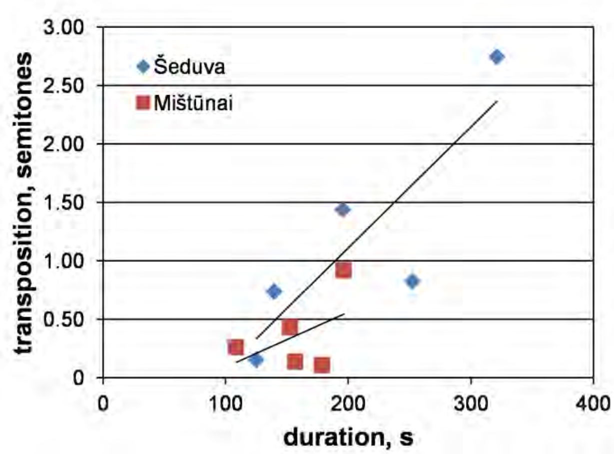

Figure 9. Dependence of transposition for tonic on the duration of song; sample of ten homophonic performances.

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As in the case of monophonic performances, the clear tendency of tonality rise can be stated. Somewhat surprisingly, here the tendency is even more prominent. In addition, the different extent of tonality rise for the two groups of singers should be noted.

B. Gradual Transposition: Evolution of Intervals

Closer inspection of the gradual transposition in *Auga kiemi dagilis* reveals that the evolution of scale degrees in the course of performance slightly differs. The tonic experiences the steepest rise while the higher degrees transpose progressively to a lesser extent (Figure 8). The lower fifth degree, again, rises slightly less than the tonic. These differences in the transposition appear especially apparent if observe the change of intervals in the vocal dyads (Figure 10). The width of the nominal major third 3-1 drops from a "very wide major third" (even closer to a fourth) to a "narrow major third" (narrower by some 20-30 cents compared to the 12TET-equivalent).

The same holds for the nominal pure fourth 5-2 which appears to be slightly stretched in the first melostrophe, but soon drops below the tempered equivalent and further narrows progressively to roughly midpoint between pure fourth and major third. Similarly, the nominal minor third 5-3 transforms from a "wide minor third" to something in between the minor third and major second. On the contrary, a slight stretch of the intervals containing the lower fifth degree (1-V and 2-V) is generally observed.

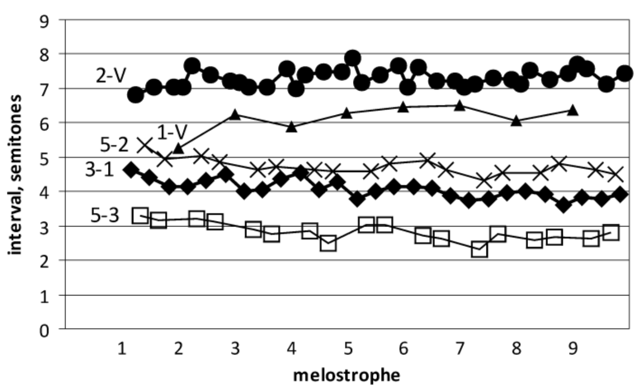

Figure 10. Evolution of dyadic intervals in *Auga kiemi dagilis*.

These transformations suggest the issues similar to those found for monophonic performance. Specifically, the harmonic intervals formed by the voices deviate significantly from their 12TET-equivalents. Moreover, the harmonic intervals undergo considerable gradual change from the beginning to the end of the song. The reasons of the discussed evolution seem to be analogous to those presumed for monophonic performance. The rise and widening might be attributed to warming-up, timbral brightening, and mastering of range, whereas the gradual shrinking manifests as the upper scale degrees reach gradually the upper part of a vocal range not comfortable for voice production.

Figures 11 and 12 pool results for Šeduva and Mištūnai samples. Quasistable segments of the occurrences of certain dyads were cut from the recordings of first melostrophes of all ten songs. Then LTAS spectra for each set of the segments were composed and averaged pitches of the dyads were obtained. For example, the corresponding segments of the dyads 5-3 were left in the recording of the first melostrophe of *Arškėtėli garbuonėli* (Figure 5): *-tė-* (first measure), *-vėk* (third measure), *-lio* (fourth measure), and *-vėk* (fifth measure). Then the averaged pitches of the third and fifth degrees were calculated from the LTAS. This technique of averaging weights automatically longer and more intense occurrences.

The same procedure was carried out with the last melostrophes. Then the pitches were normalized to the tonics of the analyzed melostrophes. Finally, deviations of the pitches of scale degrees from their counterparts in the twelve-tone equal temperament were calculated. The fourth scale degree is not shown for Šeduva sample (Figure 11) since it is faintly presented in the analyzed songs: at best, it appears in transitional notes only (as in *Auga kiemi dagilis*, Figure 4).[9]

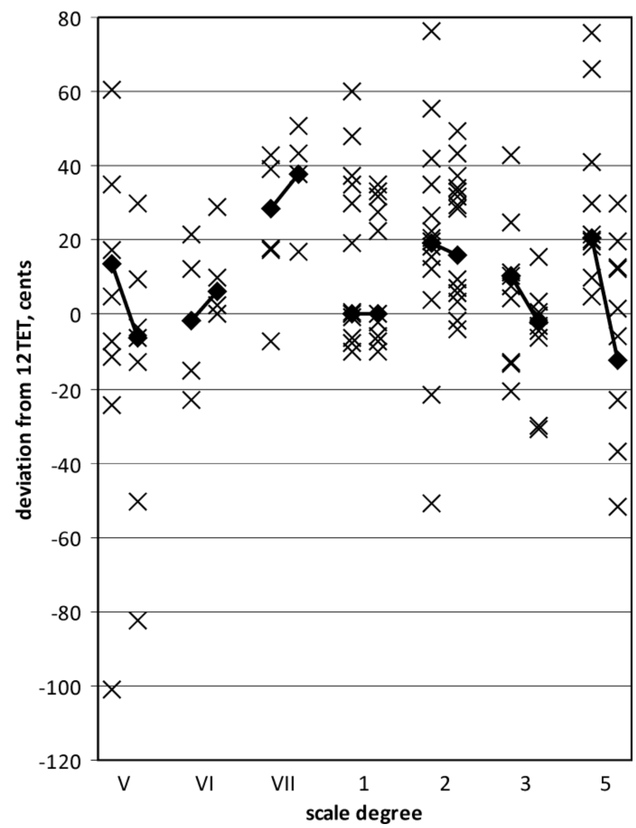

Figure 11. Pitch deviations of scale degrees from 12TET; Šeduva sample. Crosses: pitches of various dyads. Diamonds: medians of the pitches. Transposition is depicted: the values on the left stand

[9] Statistical inference about the difference between two population means (i.e. the corresponding intonations in the first and the last melostrophes) gives fairly low one-tail p-values for the following scale degrees: V (.096), VI (.082), VII (.060), 3 (<.001), 5 (<.001) (Šeduva sample; Figure 11); 3 (.005), 5 (<.001), and 6 (.002) (Mištūnai sample, Figure 12). The few remaining scale degrees (2 in Šeduva sample, 2 and 4 in Mištūnai sample) show p-values larger than .1 which means that, for these degrees and based on the samples of limited size, the tendencies of the changes discussed are either not that strong or ambiguous.

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for the beginnings of the songs whereas the values on the right show the endings.

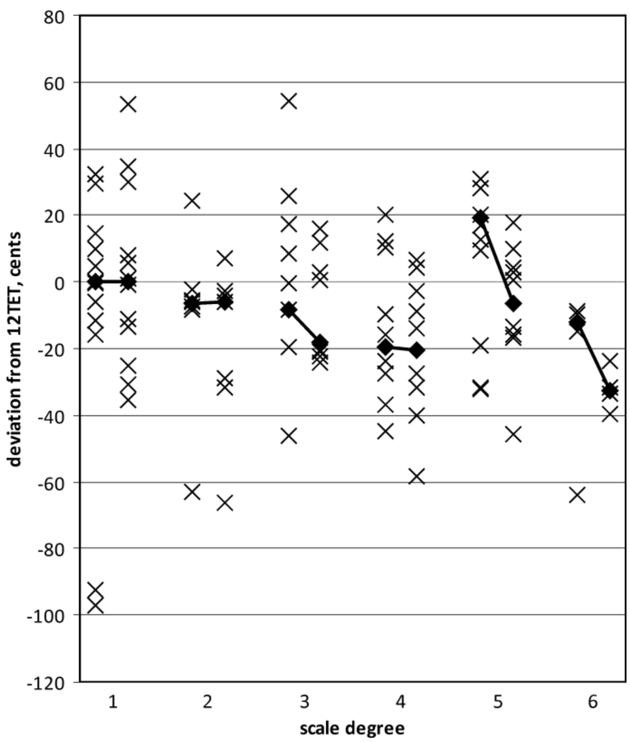

Figure 12. The same as in Figure 11; for Mištūnai sample.

Generally the results confirm the insights just derived for one single song *Auga kiemi dagilis*: the normalized pitches of scale degrees above tonic tend to drop in the course of performance (degrees 2, 3, and 5 in Figure 11, and degrees 2-6 in Figure 12) and those below tonic tend to rise (degrees VI and VII in Figure 11). This means narrowing of the intervals between the certain scale degrees and tonics, i.e. shrinking of the scales. The exception is made for the lower fifth scale degree (V in Figure 11). Probably this reflects the abovementioned tendency of "unfolding" characteristic, first of all, of the lowest tonal anchor.

Thus the tendencies of the temporal scale shrinking are essentially the same for both Šeduva and Mištūnai samples. However, the actual intervals differ quite significantly. Let's start from the fact that the tunes in both samples are based on the frame (or nucleus) of two main tonal anchors: tonic and fifth degree [10]. In both samples, the singers start from slightly stretched fifth (the fifth is some 20 cents sharper compared to its counterpart in 12TET), and this might be attributed to the common psychological preference for stretched intervals (e.g. Dowling and Harwood, 1986, p. 101-104). When approaching endings of the songs, the fifth degree becomes even flatter than the 12TET-fifth, but still similarly for both Šeduva and Mištūnai samples. However, the rest of scale degrees (i.e. not belonging to the frame of two anchors) show relevant differences in pitch for the two samples. Briefly, the pitches tend to be sharper in the context of 12TET, for Šeduva sample, but flatter for Mištūnai sample (consider, for instance, the second and third scale degrees).

To generalize, the Šeduva singers apply a "bright" version of major-like scale whereas the "dark" version of major-like scale is characteristic of Mištūnai sample.

C. Role of musical context

Figure 8 shows that certain scale degrees are systematically intoned sharper or flatter in dependence of the dyads they belong to. For example, there is a slight tendency to intone the fifth degree sharper in the dyad 5-2 and flatter in the dyad 5-3. The deviations of intonations of tonic in the dyads 3-1 and 1-V are much larger; the same can be stated on the lower fifth degree (i.e. subfourth) in the dyads 2-V and 1-V. In some cases, these deviations even approach a semitone (!) Now I will not speculate about the reasons for every single scale degree, but most probably some generalizations of the phenomenon could be inferred. First, the vertical (harmonic) context could be at work: the tendencies to intone certain dyadic intervals wider or narrower could result in the corresponding tendencies of intonation of scale degrees.[11] Second, there could be also some impact of more extensive musical context including the horizontal component. Third, it is also possible that the vocal parts (or the singers corresponding to the vocal parts) have slightly different "versions" or even "models" of the scale to be applied. (The case of tonic in *Auga kiemi dagilis* is meant: the tonic is performed by the leading voice in the dyad 1-V and by the backing voice in the dyad 3-1.)[12]

V. DISCUSSION

The detailed analysis of twenty vocal performances representing Lithuanian traditional monophony and homophony reveals how complicated phenomena of musical scales are and how the actual performances differ from the simplified theoretical presuppositions. Just to remind, the common ethnomusicological attitude would tell that we deal with major or minor scales in classical meaning. The acoustical measurements provide data which let us try to reconstruct the original emic schemata and processes. First of all, this emic basis seems to be quite far from simplified theory because of significant deviations from 12TET leading to certain doubts concerning the minor- or major-like quality. Possibly, the scales could be considered in the wider and flexible context of major-minor continuum or something like this. This is not the end of story. One can expect that these microtonal deviations could be expressed in some unsophisticated way such as a static set of peculiar intervals between the scale degrees. Maybe this

[10] Or, if based on more refined interpretation, the nether and upper tonics (Kharlap, 1972, p. 247).

[11] Actually this corresponds to the "harmonic intonation" rule in Friberg, Bresin, and Sundberg, 2006, p. 151, with a difference in target intervals which generally not necessarily have to be natural in our case.

[12] In more detail, the role of musical context is discussed in Ambrazevičius, 2014. The present paper is reworked and supplemented version of this earlier study.

might work for kind of very rough estimations, yet then the substantial properties of the scales would be overlooked and lost. These important properties include different levels of scalar dynamics: possible transposition (mostly rise) of the entire scale plus different rates of the transposition for different scale degrees, plus systematic effects of musical context on the intonation. These dynamic qualities of musical scale come from physiology and perception of singing. Interplay of these qualities result in peculiar outcomes such as evolving or shrinking scales in the course of performance of entire song.

To be analyzed, this interplay needs more sophisticated and multifaceted (or, generally, even multidimensional) techniques of measurements, evaluations, and visual presentations. A single static set of deviations in cents marked at the sequenced scale degrees is not enough.

To make things more complicated and more trivial at once, we should make clear that phenomenologically, for the performers, the musical scale of a single given song under discussion is probably unvaried from the beginning to the end of the song. [13] By the way, contemporary listeners-ethnomusicologists usually also do not notice the slight tonality changes and changes of the intervals, unless asked to concentrate attention to the considered phenomena or unless they are possessors of absolute pitch. This is because the changes are slow and gradual. If compare the occurrences at distant moments of the performance, the changes become perceivable more easily. More importantly, the seeming stability of the scales supports the attitude that we deal not with changing scales (one scale transforming into other) but rather with a single scale embodying an intrinsic feature of change.

In the very end, it is worth repeated mentioning that the explored properties of the musical scales could possibly serve as idiosyncratic markers for different vocal idiolects and dialects, the markers which also manifest as bundles of colors for a contemporary listener-outsider.

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[13] To be precise, performers of vocal tradition usually have no idea about the construct of musical scale. But let's imagine that they have learned somehow about the construct and we asked them to describe the certain cases of the scales in performances.

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Emotional effects of makams frequently used in classical Turkish music

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ABSTRACT

Background

Music can arouse wide variety of emotions in listeners. There has been many different approaches to explaining these emotional responses to music. This study assumed that, acoustic and musical cues were the main factors that determined the emotional effects of music, without ignoring the clear effects of cultural background, gender, social context, learning experiences etc. According to this view, studies indicate that different values and different patterns of acoustic cues such as tempo, sound level, sound level variability, F0/pitch level, F0/pitch variability, F0/pitch contour, tone attack, scale, microstructural regularity, and harmonic attributes cause typical emotions. Although a considerable body of research exists about emotional effects of Western music, research about emotional effects of Turkish music is very limited. Unlike Western music, which is tonal and harmonic, Turkish music is modal and melodic. Turkish *makam* music is a genre featuring distinct pitch patterns called *makam* and rich rhythmic structures called *usul*. Each makam consists of a tetra-chord and a penta-chord. Furthermore, individual *makam*s have characteristic progression patterns. *Makam*s define the usage of pitch and pitch intervals are smaller in terms of consecutive differences of frequencies, providing a basis for the tonal richness of classical Turkish music. Because of these distinctive qualities of Turkish music, emotional effects of these musical structures deserve being investigated systematically.

Aims

The aim of this study was to determine the emotional effects of Turkish *makam*s. A second aim was associate the emotional responses to *makam*s to musical and acoustic structures. Emotional responses to pieces in different *makam*s were evaluated with the Geneva Emotional Music Scale (GEMS-45; Zentner, Grandjean ve Scherer, 2008).

Method

Four hundred and four participants (266 female, 138 male) volunteered to participate in this study online. Eleven *makams*, frequently used in classical Turkish Music, were selected. These were: *Hicâz, Hüseynî, Hüzzâm, Kürdîlihicazkâr, Mâhûr, Muhayyerkürdî, Nihavend, Rast, Sabâ, Segâh, Uşşak*. Participants listened to two fast and two slow pieces selected for each *makam* and evaluated their own emotional experiences and emotional intensity on five-point scales for a list of emotional expressions. These expressions were Turkish translations of the items of the GEMS-45.

Results

Evaluations of the excerpts from each *makam* with fast and slow tempi on the nine subscales of GEMS-45 will be compared. It is expected that different *makam*s will produce different profiles on GEMS-45 and the profiles will relate to the pitch sets and progressions of the *makam*s. Data analysis is in progress and the results will be presented at the conference.

Keywords

Classical Turkish music, makam, emotion

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Music in our minds: A pupillometric study of music processing

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ABSTRACT

Background

A. Impact of Expertise.

Results in the neuroscience of music literature have reported differences in the performance of musicians and non-musicians during auditory tasks (e.g., Lehmann & Ericsson, 1997). These findings indicate that music perception and music processing are positively influenced by expertise (e.g., Pantev, Roberts, Schulz, Engelien, & Ross, 2001). Musical experts also practice attention, planning, and memory while they perform. Therefore, it is assumed that the musical experience positively influences executive functions, language functions, or even intelligence in general (see Jäncke, 2009).

B. Relationship to intelligence and working memory.

Recent studies suggest that the rehearsal and storage of both tonal and verbal information involves the phonological loop and also activates overlapping neural networks (e.g., Koelsch, Schulze, Sammler, Fritz, Müller, & Gruber, 2009). Associations between musical training and verbal memory (Moreno, Bialystok, Barac, Schellenberg, Cepeda, & Chau, 2011) have been found, indicating some evidence for an improved phonological working memory in musicians.

C. Pupillometric Approach.

Based on findings that musicians showed stronger activation in frontal brain regions (Koelsch, Fritz, Schulze, Alsop, & Schlaug, 2005) and exhibited larger P300 components to auditory stimuli than non-musicians (George & Coch, 2011), besides fMRI and EEG, an additional measure of increased activation could be the pupil peak dilation. Changes in pupil size do not reflect the allocations to specific areas of the brain, but the total allocation of cognitive resources, that is the amount of activation *actually invested* for information storage and processing (van der Meer, Beyer, Horn, Foth, Bornemann, Ries, Kramer, Warmuth, Heekeren, & Wartenburger, 2010). Dix and van der Meer (2014) found evidence for a higher allocation of cognitive resources in mathematically high performing individuals compared to a control group with average skills in mathematics.

Aims

The present study aimed at two things: first, we wanted to provide further support for the positive impact of musical expertise on the processing of musical tasks. Second, we wanted to investigate if the higher allocation of cognitive resources is also valid for the domain of musical expertise.

Method

Participants. The final sample comprised 50 participants: 25 musicians (13 female) and 25 non-musicians (12 female). Musicians were categorized through a musical expertise questionnaire. A musician was defined as an individual a) whose main profession was to be a musician, b) who has had a minimum of ten years of musical training (range 12-35 years, M= 19.8 years, SD= 6.76 years), and c) who averages at least one to two hours of practice per day (M= 3.04 hours, SD= .98 hours). Non-musicians were defined as those who never played a musical instrument and who did not have any special musical education besides normal school education.

Test procedure. The participants solved the Audiation task (Gordon, 1989). They were asked to decide whether short musical sequences, which vary in difficulty (*easy* and *difficult* trials), are identical (*same* trials) or different in terms of rhythm (*rhythmic* trials) or melody (*tonal* trials). Behavioral measures to examine speed and accuracy of processing as well as the pupil peak dilation as a measure of resource allocation were collected.

As working memory is fundamental for solving the items of the Audiation task correctly, participants' capacity of auditory and visual-spatial working memory was measured with Complex Span Tasks. We used computer-based versions of the Operation Span Task (OSPAN; Turner & Engle, 2009) for the phonological loop, as well as the Symmetry Span Task (SSPAN; Turner & Engle, 2009) for the visuospatial sketchpad. To analyze the relationship between intelligence and musical expertise, the Mehrfachwahl-Wortschatz-Intelligenztest (MWT-B; Lehrl, 2005) for crystallized intelligence and the ten-minute version of the Bochumer Matrizentest (BOMAT; Hossiep & Hasella, 2010) for fluid intelligence were used.

Results

A 2 (musicians vs. non-musicians) x 3 (rhythmic vs. tonal vs. same) repeated-measures ANOVA on response times and error rates was performed. The response times analyses revealed a significant main effect of group ($F(1,48)$= 24.957, MSE= 81253747.76, $p<$ .001, η^2= .342). Musicians responded significantly faster than non- musicians across all conditions. The analyses of error rates revealed a significant main effect of group ($F(1,48)$= 30.624, MSE= 11970.667, $p<$ .001, η^2= .390). Musicians made significantly fewer errors than non-musicians across all conditions.

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A one-way ANOVA revealed a significant effect of group (musicians vs. non-musicians) on the OSPAN (F(1,48)= 11.811, MSE= 2125.520, p< .001, η^2= .197), but not on the SSPAN task (F< 1). That is, musicians and non-musicians significantly differed in their auditory, but not in their visuospatial performances. Musicians outperformed non-musicians concerning auditory working memory capacity.

Regarding intelligence, a one-way ANOVA revealed a significant effect of group (musicians vs. non-musicians) on the MWT-B (F(1,48)= 12.293, MSE= 158.420, p< .001, η^2= .204), but not on the BOMAT test (F< 1). That is, musicians and non-musicians significantly differed in their crystallized, but not in their fluid intelligence. Musicians outperformed non-musicians concerning crystallized intelligence.

A 2 (musicians vs. non-musicians) x 3 (rhythmic vs. tonal vs. same) repeated-measures ANOVA on pupil peak dilations was performed. It revealed a significant main effect of group (F(1,48)= 68.887, MSE= .782, p< .001, η^2= .589). Musicians showed significantly larger pupil peak dilations than non-musicians across all conditions. Most notably, the *same* condition revealed the highest difference in pupil peak dilations between musicians and non-musicians, with this difference being statistically significant, t(48)= -14.299, p< .001.

Conclusions

The study yielded the following three main findings. First, musicians generally showed faster response times and fewer error rates in the Audiation task across all conditions compared to non-musicians. Second, musicians outperformed non-musicians in crystallized intelligence and auditory working memory capacity. Third, musicians exhibited greater pupil peak dilations compared to non-musicians across all types of trials and especially in the *same* condition.

Our results demonstrate that the combination of pupillometrics with traditional behavioral measures is a promising way to assist our understanding of music processing. Changes in pupil size reflect the total allocation of cognitive resources, and our data showed that higher pupil peak dilations corresponded with higher speed and accuracy of musicians in processing highly demanding musical tasks compared to non-musicians.

Behavioral evidence indicates a general enhancement of both phonological working memory and crystallized intelligence in musicians. The pupillometric findings indicate that musicians compared to non-musicians allocate more cognitive resources while performing musical tasks. Results correspond to findings for experts vs. non-experts in the mathematical domain and emphasize the important contribution of resource allocation in expertise.

Keywords

music processing, musical expertise, pupillometrics, pupil peak dilation, resource allocation, intelligence, working memory capacity

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Modeling of Georgian traditional polyphony

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ABSTRACT

Many aspects of Georgian traditional polyphony – particularly historical and ethnological aspects – have been studied, mainly by Georgian and Russian researchers. However, the underlying principles of its "grammar" have never been addressed in a systematic way. This is what led me, in 2007, and with the collaboration of my former pupil Polo Vallejo, to undertake the work which will be discussed here, and which is still in progress.

Georgian polyphony constitutes a unique musical heritage which is renowned for its beauty and its complexity. It includes a vast body of religious chants and folk songs which are *modal*, mostly in three parts, with "harmonic" flows that are unequalled in the world of oral tradition singing. As the three parts are most often rhythmically independent, their progression leads to dense counterpoint within which there are many "dissonances" according to the definitions of Western music. It was indeed the particularities of the "harmonic" organization of this heritage which intrigued me.

The trajectory of any Georgian polyphonic song includes a series of irregularly distributed vertical conjunctions, traditionally separated by *improvised passages*, which define its particular nature: these are the pillars which form its *matrix*; they constitute the *mental reference,* the *cognitive scheme* which all of the singers carry – consciously or not – in their memories.

At this stage, we should specify that within the framework of our research on the structure of Georgian polyphony, the word "chord" will be used to designate *any vertical concomitance of sounds*, which can include, in addition to the usual chords found in tonal harmony, any other sets of two or more sounds produced simultaneously. In the same way, "harmony" will mean any progression of chords defined in this way.

I. AIMS

The goal of this research is to reveal the rules of the harmonic syntax underlying this polyphony. This study has thus far included the transcription and analysis of about 300 pieces, some one hundred of which have been modeled.

II. MODELING AND MODELS

The harmonic complexity of the songs and the multiplicity of the chords that appear in them made it necessary to present them in a simplified form. This implied *modeling*.

By modeling, we mean "the action of elaboration and intentional construction, by composition of symbols, of models that can make intelligible a phenomenon that is perceived as being complex" (Le Moigne 1990: 5). Modeling allows us to apprehend the relations prevailing between the spontaneous production of a musical event and the idea it springs from.

The activity of modeling is not necessarily limited to the reconstitution of concrete objects, such as a given piece or a repertoire. It can also aim to explore, or even to reconstruct, certain properties of the components revealed by the analysis work.

By *model*, I mean at this stage "*a sound representation, both overall and simplified, of a musical entity*. The model condenses, in outline form, all of this entity's distinctive features and no others, thus revealing its uniqueness" (Arom 2010: 297). The model is thus equivalent to the barest realization of a piece that can be identified as such by the bearers of the tradition to which it belongs The model is precisely what preserves the identity of a piece of music and allows for its oral transmission.

III. METHODOLOGY

While many Georgian songs use one single mode, some contain transitions to one or several other modes. The latter necessarily occur within a *segment* of a piece[1]. Depending on the case, we had to determine the modes of the piece or of its segments.

To do this, we chose one single criterion: the mode of a song or a segment is defined by its *finalis* – which will always be considered as the first degree of any song. Most often, the *finalis* is a unison; when this is not the case, the lowest note of the chord will be considered as such: thus, in a G-D type chord, the *finalis* will be G. This criterion – even though it may seem somewhat arbitrary – is very useful, since it allows for the establishing of a point of reference which is coherent not only for a set of pieces, but for the whole Georgian polyphonic corpus. It is important to emphasize that the attribution of a number to the various degrees of any mode is the *indispensable condition* for being able to cipher the chords based on these degrees, *independently of the mode in which they appear*.

Our goal was to determine the *harmonic framework* of each musical entity – piece or when necessary segment –, in other words, to detect, among the numerous chords of a piece or a segment, those which assume a structural function and therefore constitute its framework, i.e. those which, beyond the different realizations of any song or segment, *remain stable* and ensure its identity and perennity.

This work was carried out in two stages, the first independently by ourselves, the second in close interaction

[1] By *segment* we mean here any section of a piece delimited by a cadence formula or a pause.

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with the members of the Georgian State Vocal Ensemble *Basiani*.

What is the “harmonic framework”? It is the series of *fixed chords* that each piece has and which are separated by sequences that can include variations. As a reminder, these “pillars” constitute its *matrix*, or *cognitive scheme*, which is present in the background of any of its realizations.

In order to materialize this matrix, it was essential to determine for each chord whether or not it constitutes a pillar of a given piece or segment; in other words, whether it is a component of its harmonic framework. We considered that only the chords which result from a *simultaneous change of the three parts of a piece* meet this condition. To arrive at this reduction, we eliminated the passing tones, neighboring and escape tones, appoggiaturas, anticipations and suspensions, the repetition of sequences of degrees in the bass of chords for which the ciphering is identical (for example, the succession of degrees V—VII-VI-VII-VI—V becomes V—VII-VI—V), and also – when the harmony remains the same –, the changes of position of sounds within the same chords.

As outsiders to the culture, we could not be certain that the result of such an approach would be more than purely speculative. In order to validate it culturally, we had to call on local experts. We thus benefited from the invaluable help of the members of the *Basiani* Ensemble: after explaining our objective to them, we asked them to perform the pieces that had been reduced by us, but under the following conditions:

a) Removing the words,

b) Keeping only the chords which seemed to them to constitute the pillars of the song,

c) Scrupulously respecting the time interval that separates each of these chords from those that precede and/or follow them, so that the proportions of the durations in the “real” song are not affected.

It turned out that the versions reduced by the members of *Basiani* and those by us are very close. In general, the reductions of *Basiani* are sparser than ours – they keep fewer chords. The minor differences that are observed are most often due to the intercalation, where two structural chords follow one another in the *Basiani* version, of one or several additional chords in our version.

The modeling is thus a turning point in the processes of analysis and validation. It represents the end point of any analytic approach, and it is also the starting point of the procedure by which the analysis can be validated.

The examples below illustrate some aspects of the modeling resources applied to a wedding song called “Makruli”. All of them were recorded by the Georgian State Ensemble *Basiani*[2].

Ex. 1 — “Makruli” (region of Guria):

Conventional version in re-recording – First verse

Ex. 2 — “Makruli” (region of Guria):

Modeled version in re-recording

[2] All of these transcriptions were made by Polo Vallejo.

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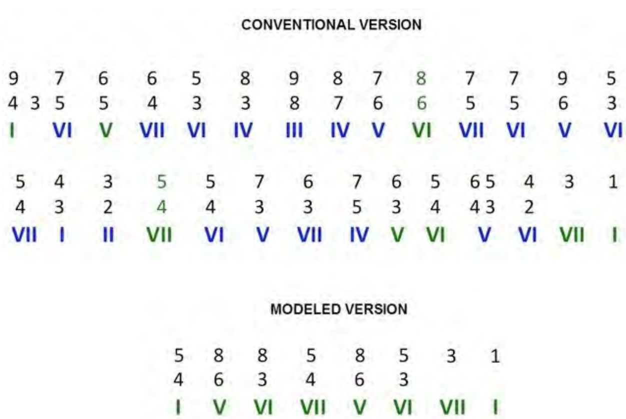
Ex. 3 — "Makruli" (region of Guria):

Harmonic syntax of the conventional version in re-recording

Ex. 4 — "Makruli" (region of Guria):

Harmonic syntax of the modeled version



Ex. — 5 "Makruli" (region of Guria):

Harmonic syntax of the conventional and modeled versions

Ex. 6 — "Makruli" (region of Lechkhumi):

Conventional version in re-recording

Ex. 7 — "Makruli" (region of Lechkhumi):

Modeled version in re-recording

Ex. 8 — "Makruli" (region of Ratcha):

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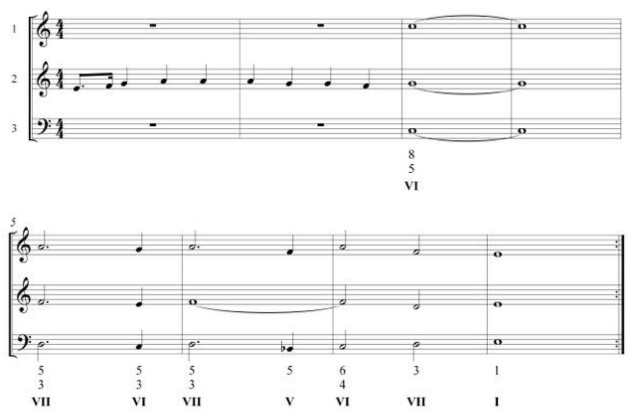
Conventional version in re-recording



Ex. 9 — "Makruli" (region of Ratcha):

Modeled version in re-recording

GURIA (B MODE)	5 3 (I	8 6 V)	8 3 VI	5 4 VII	8 6 V	5 3 VI	3 VII	1 I
LECHKHUMI (B MODE)			7 5 VI	5 3 VII		6 4 VI	3 VII	1 I
RATCHA (E MODE)			8 5 VI	5 3 VII	5 V	6 4 VI	3 VII	1 I

Ex. 10 — Harmonic syntax of the model of "Makruli" according to the region: Paradigmatic representation

IV. Outlook

Up until now, the analysis and modeling work has been done manually, which has limited the amount of data that could be processed and the number of questions that could be asked.

Recently, in collaboration with Frank Scherbaum, Professor of Geophysics at the University of Potsdam, Frank Kane, a voice teacher and specialist of Georgian folk music, and three young and gifted musicologists [3], a new methodological framework has been developed using Markov chains, among other elements, to shed light on the role of the modes and degrees in Georgian polyphony, also for the purpose of modeling.

This method allows us to make an inventory of all of the variants that are consistent with the harmonic framework of the songs and the modes. In addition to the study of the chord progressions found in the songs, it allows for analyses and comparisons on several levels, namely:

. Between songs of the same region and the same function

. Between songs of different regions and functions

. With other polyphonic systems around the world.

We are working on preparing the material for its validation with Georgian oral tradition singers.

V. Conclusion

Georgian polyphonic singing constitutes a system in the sense that it is not a disparate collection of pieces, but rather a consistent corpus with a set of underlying, coherent rules, based on which the bearers accept or refuse the working hypotheses proposed.

The fact that this knowledge is only rarely explicit does not mean that ethnomusicology faces a situation that is fundamentally different from that which other disciplines confront when trying to reveal *know-how* through productions.

In ethnomusicology as in other disciplines, the same goal is pursued by the researcher when he tries to corroborate the coherency that he postulates in an activity reconstituted based on the material gathered with the cognitive judgments made by the members of a community.

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Chord perception and frequency of occurrence: Samples from works by J.S. Bach and The Beatles

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ABSTRACT

Background

Frequency of occurrence of chords may be a contri factor to the perception of chords in isolation. A tone or that appears frequently and at crucial m becomes more important and stable within the und system of music (Krumhansl, 1990), and the listener lea internalizes regularities that organize and constrain the partly based on the frequency of occurrence of pa musical events (Castelllano, Bharucha, and Krumhansl, Oram and Cuddy, 1995; Jonaitis and Saffran, 2009).

Previous studies (Budge, 1943; Rohrmeier and Cross Bronze and Shanahan, 2013) reveal that functional chor as I, V, and IV tend to appear more frequently in pi music than less functional chords. The frequency of a c occurrence was strongly correlated with listeners' rating chord's fitness with the prime scale or chord se (Krumhansl, 1985; 1990).

However, how the frequency of occurrence of differen of chord influences the listener's perception of chords h little studied. Some chords, such as major and minor triads and the dominant seventh, are prevalent in pieces of music, while diminished and augmented triads seldom appear (Rohrmeier and Cross, 2008; Bronze and Shanahan, 2013). From these studies, it can be inferred that listeners will perceive more frequently occurring types of chord more favourably.

Aims

This study aims to investigate the influence of frequency of occurrence and acoustic features on the perception of chords in isolation. In particular, the consonance/dissonance (C/D), pleasantness/unpleasantness, stability/instability, and relaxation/tension of chords will be examined.

Method

We employed 12 different chord types (5 triads and 7 tetrads) as stimuli, all with roots of C or F#, and all played on the piano and organ, making 48 chords in total. In the experiment, three groups of participants (8 musicians, 17 participants with some musical training, and 8 non-musicians, 33 in total) rated C/D, pleasantness/unpleasantness, stability/instability, and relaxation/tension on a 7-point scale. Three contributory factors to listeners' perceptions were examined. Firstly, participants were asked to rate their level of familiarity with each of the two timbres used in the experiment. Secondly, as an estimate of the

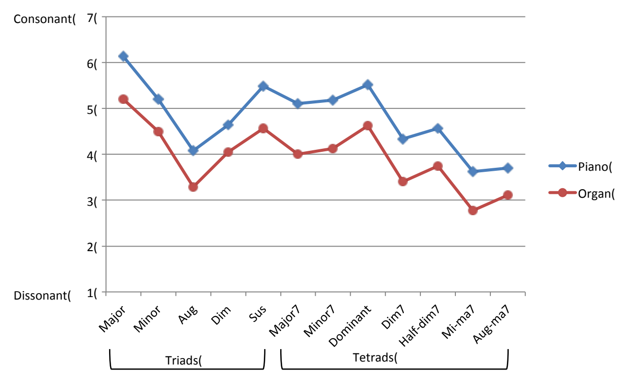

Figure 1. Mean C/D ratings for 12 chords from 33 participants in two timbres.

in J.S. Bach's Italian Concerto BWV971, and in The Beatles' 30 best-selling UK hits. Thirdly, certain key acoustic features of the 48 chords were extracted using MIR toolbox (Lartillot and Toiviainen, 2007) and Timbre toolbox (Peeters, Giordarno, Susini, Misdariis, and McAdams, 2011). The extracted acoustic features of the 48 chords used, and the frequency of each chord's occurrence, were statistically assessed in order to analyse the relationship between these and the behavioural data.

Results

A two-way ANOVA was undertaken, with Timbre and Chord Type as within-subjects factors and multiple dependent measures including listener ratings for C/D, Pleasantness, Stability, and Tension/Relaxation. Significant main effects of Timbre were found in the ratings for C/D: $F(1, 30)= 17.463$, $p < .001$, for Pleasantness: $F(1, 30)=32.824$, $p< .001$, and for Relaxation: $F(1, 30)=25.108$, $p< .001$. There were significant main effects of Chord Type for all ratings, C/D: $F(5.59, 167.69)=32.512$, $p< .001$, Pleasantness: $F(3.92, 117.80)=20.397$, $p< .001$, Stability: $F(5.268, 158.04)=18.411$, $p< .001$, and Relaxation: $F(4.99, 149.95)=24.830$, $p< .001$. Chords with Piano timbre were consistently judged as being more consonant, pleasant, and relaxed than those with Organ timbre, as can be seen in Figure 1.

There was also a significant interaction between the effect of Timbre and Chord for Tension/Relaxation ratings: $F(11, 330)=2.145$, $p= .017$. A one-way ANOVA was carried out in

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order to further investigate the effect of Chord on the Tension/Relaxation ratings of stimuli played with Organ and with Piano. There was a significant main effect of Chord on Tension/Relaxation ratings for Organ: (5.56, 178.17)=21.350, p= .001, r= .63, and for Piano (5.05, 161.720)=15.663, p= .001, r= .57, which shows the slightly larger effect size for Organ than for Piano.

As for the difference between participant groups, the musicians' chord ratings were more varied than non-musicians. Musicians tended to perceive 'dissonant' chords (such as augmented, augmented major seventh, and minor-major seventh chords) as more dissonant, unstable and tense than non-musicians; conversely, they perceived major chords as more consonant and pleasant than other groups.

Pearson's product-moment coefficient was used to assess the relationship between ratings for each chord across all four variables. Ratings for Consonance were strongly correlated with ratings for the other three variables (r< .923, df=48, p< .001), which means that more consonant chords were also judged to be more pleasant, stable and relaxed. However, analysis per group revealed that musicians' ratings of Consonance were not significantly correlated with the other three variables, although all other combinations were positively correlated.

Figure 2 shows the percentage occurrence of each chord in works by Bach and The Beatles. Major triads were the most prevalent, followed by the dominant seventh and minor triads, while the half-diminished seventh, the minor-major seventh, and the augmented major seventh appeared rarely.

Acoustic features of each chord, such as dynamics, spectral centroid, irregularity, spectral flux, roughness, key strength, were extracted. Principle Component Analysis extracted three components from variables including both acoustic features and frequency of occurrence. The first component is highly correlated with spectral flux, spectral centroid, and dynamics, and accounts for 70.13% of variance. The second component is highly correlated with the frequency of occurrence with 13.49% of variance, and the third one is correlated with irregularity with 7.23% of variance.

Regression Analysis assessed how these components predict listener ratings for four variables. As for C/D, three predictors explained 60% of variance: R^2= .607, F(3, 44)= 22.608, p= .001. Acoustic features significantly predicted C/D ratings: β= .510, p= .001, and the frequency of occurrence did too: β= .587, p= .001. However, the irregularity did not predict the ratings: β= -.039, p= .682. The standard coefficient values of acoustic features were higher for pleasantness and relaxation than for C/D and stability. This indicates that acoustic features had a larger influence on perceptions of pleasantness and relaxation than they did on perceptions of C/D and stability.

Conclusions

The findings show that the frequency of the occurrence of different types of chord is an important contributory factor to their perception. They also show that musical training enhances and changes a listener's sensitivity to C/D and stability. In addition, the findings revealed that consonance was not always pleasant, especially for listeners with musical training. This suggests that our perception of isolated chords is diverse and multidimensional, and our complex and subtle relationship with chords points to the need for varied approaches to future research.

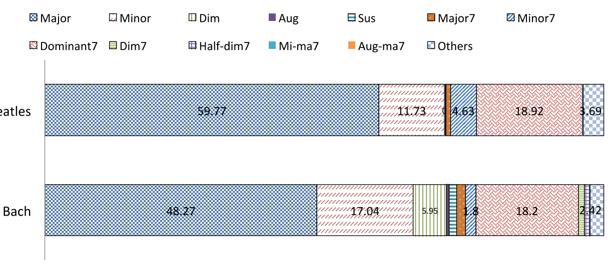

Figure 2. Percentage occurrence of each chord, from pieces by Bach and The Beatles.

Keywords

Chord perception, frequency of occurrence, C/D, pleasantness

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The effect of musical culture on pictorial notations of pitch and tempo: How traditional and Western-trained Greek musicians represent musical shape

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ABSTRACT

Background

Previous studies have demonstrated how two-dimensional representations of music are affected by musical training (Küssner & Leech-Wilkinson, 2014; Tan & Kelly, 2004), background culture (Athanasopoulos & Moran, 2013; Auh & Walker, 1999) and literacy (Athanasopoulos, Tan & Moran, in print; Athanasopoulos, G., Moran, N., & Frith, S., 2011). The following cross-modal matches between music and its representation have also been indicated: pitch-height with vertical placement on an x-y axis, timbre with pattern-sign, loudness (volume) with size and duration with length represented horizontally across the x-y axis mentioned above (Walker, 1987), though loudness has also been empirically associated with verticality (Eitan, Schupak and Marks, 2010) and length (Carello, Anderson and Kunkler-Peck, 1998). There have even been cases of onomatopoeia, as noted by Adachi (1997) in the depiction of attack rate information among Japanese child participants. Taking into consideration the above effects, in order to examine whether training in a specific musical style would affect the relationship between music and its visual representation, fieldwork research was carried out involving Greek performers from similar cultural but different musical backgrounds (classical-trained musicians; traditional musicians and musicians from a mixed musical background, all familiar with Western Standard Notation, henceforth: WSN). Performer responses were examined using original auditory stimuli to explore distinctions between cultural and musical factors of visual organization of musical sounds.

Aims

Our goal was to examine whether participants with common cultural but different musical background demonstrated any notable preferences while depicting musical stimuli in two-dimensional fashion. As participants possessed a similar store of symbols (all were literate in WSN) there was no speculation as to whether participant results would indeed be different, and if so, how.

Method

The fieldwork research involved Greek performers from distinct musical backgrounds, i.e. classical-trained, traditional and mixed background training. The procedure involved i) a free-drawn design in which participants heard short musical stimuli, varying in pitch and attack rate, and were asked to represent these graphically on paper, and ii) a forced-choice design in which participants had to match auditory stimuli with pre-constructed sets of marks varying in the representation of music articulation and directionality.

Results

Two major styles of representation emerged: *Symbolic Cartesian* (SC), where reference to sound events took place through abstract symbols, while pitch contour (y axis) and time (x axis) were represented spatially on orthogonal axes; and *Iconic Cartesian* (IC), where reference to sound events took place through drawings which attempted to imitate the events as icons represented loosely in time (x axis). In the free-drawn representational method, participants from the classical-music trained group opted for SC models, which consisted either of invented, abstract symbolic notations, or systems which blended in elements of WSN. All musicians used horizontal left-right directionality, replicating a tendency observed among performers of classical music originating from other cultural backgrounds (Küssner & Leech-Wilkinson, 2014; Athanasopoulos & Moran, 2013). Internal consistency in this group was at 100%. Participants from the traditional music group gave a mix of SC and IC responses, without presenting uniform representational methods; as a result, internal consistency varied widely. Participants originating from mixed musical backgrounds opted for SC representations, with strong internal consistency. It is noteworthy to mention that in the forced-choice design, results did not differ significantly between the groups.

Conclusions

There were no variations between the groups regarding the directionality of responses, which were horizontal and left-to-right for all participants regardless of their musical training. Differences were noted in the selection of symbolic or iconic images: musicians with western and mixed musical training opted for SC models of representation, which could be justified by the analogue symbolic nature of WSN. At the same time, IC responses from traditional participants, who were also familiar with WSN, indicate that the association between music and shape could be affected by not only cultural parameters, but also by the musical performance background of performers. This could suggest that while western and mixed trained participants appear to take strongly into account the temporal aspect of music and produce structured SC representations linking music and its visualisation, traditional musicians adopt a more open approach to the task.

Keywords

Graphic representations, notation, music and shape, cross-cultural.

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Music does not only regulate, but directly and reliably communicates social behaviors

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ABSTRACT

Background

Music's potential for social communication is often argued as a possible cue to its evolutionary origins (Cross, 2001). However, empirical evidence for this capacity to induce or regulate social behaviors with music only consists only of indirect effects - for instance, that background music can reduce conflict or that collective music making increases trust and cooperation (Anshel & Kipper, 1988). Because these effects can be mediated by other musical effects, such as emotion induction, relaxation or semantic connotations, it remains unknown whether music can directly communicate (i.e. encode, and be decoded as) social cues.

Collective improvisation provides an interesting framework to study this question, as improvisers typically negotiate through sonic and musical interaction how they relate to each other's ideas and, more generally, how they relate to each other as musicians and/or persons (Monson, 1997).

Aims

The present study aims to test the capacity of musical communication to encode, and be decoded as, a series of 5 social attitudes: being domineering (DOM), insolent (INS), disdainful (DIS), caring (CAR) or conciliatory (CON).

Method

We recorded a series of 100 improvised duets, in which one musician was tasked to express one attitude and the other to recognize it. The 5 attitudes were selected from the literature to differ along both the affiliatory (e.g. INS < CAR) and control (e.g. DIS < DOM) dimensions and to correspond to speaker behaviors (i.e., communication acts that cannot exist without the other person being present) (Whichmann, 2000) rather than propositional attitudes (e.g., being critical, impressed, disapproving) or complex emotions in relation to others (e.g., pity, shyness, resentment).

Musicians (N=20) took turns in randomized order, playing from isolated studio booth without seeing each other (*exp1*). We then selected 25 duets (5 per attitude) for a decoding study, in which third-party listeners (musicians, N=20, and non-musicians, N=20) were tasked to decode the correct attitudes from each duet (*exp2*).

Results

Decoding hit rates in *exp1* were excellent, and matched accuracies previously reported to decode basic emotions in music and vocal expression (DOM: H=70%; INS: H=45%; DIS: H=65%; CAR: H=80%; CON: H=60%) (Juslin & Laukka, 2003). Hit rates in *exp2* were lower, but scored significantly above chance for both musicians (H=54%) and non-musicians (H=34%).

We also subjected the successfully-decoded duets to both computational and psychoacoustic analysis to identify the musical cues which correlated with each communicated behavior. We found that social attitudes expressed in music covaried not only with the prosody of the encoding musician but also and foremost with the amount and coordinative nature of prolonged simultaneous discourse by the two musicians, an ensemble of cues which do not appear generic with spoken language.

Conclusions

On the whole, this corpus and associated decoding results establish that social intents, such as those of dominating, supporting or scorning a conversation partner, can be encoded and decoded in musical interactions, both by the participants of the interactions and by external listeners.

In evolutionary terms, this suggests that a lot more social communication would have been possible with music as the sole pre-linguistic "technology" than previously believed, which opens avenues for vastly more diversified views on music processing that the intra-personal, performer-to-listener view of musical expression that has dominated the recent literature.

Keywords

Social behaviors, musical communication, improvisation, dyadic interaction, decoding study.

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How does progressive rock sound? Perceptual facets of a complex genre identified using musical similarities

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ABSTRACT

Background

Progressive rock was a popular musical genre in the 70's comprising of distinctive musical features, such as structural complexity, long instrumental parts and sound experimentation (Hudson 2001). While it lost its appeal in the 80's, the imprint left by the genre itself has profoundly enriched many aspects of current popular music. It is considered today as an 'experts' genre.

Aims

We attempt (1) a definition of the genre "progressive rock" from a listener's perspective, and (2) test whether musical expertise and knowledge of the genre are required to recognize it.

Method

50 subjects (aged M = 22.4 +/- 5.4) participated in the study. We used triadic comparisons, in which listeners chose the most similar pair of stimuli out of a stimulus triple. The stimuli consisted of 13 short progressive rock excerpts (as defined by music critics and music encyclopedias) matched with 13 control stimuli, by rock bands from the same period and achieving similar commercial success. All possible triads were presented across participants using a balancing algorithm and 52 triads per subject (Allan et al. 2007). The Goldsmiths Musical Sophistication Index (GMSI) was used to measure subjects' musical abilities (Müllensiefen et al. 2014), while a questionnaire assessed familiarity with the genre. Similarity judgments were analyzed using multidimensional scaling (Weller et al. 1988, Dalla Bella & Peretz 2002) to identify underlying dimensions of similarity.

Results

Participants performed poorly in the familiarity questionnaire (*M* = 30% correct answers, chance level was 25%). However, they were all able to perform the similarity task. A MDS model with 3 dimensions was sufficient to decompose the obtained similarity matrix. These 3 dimensions were identified musically as corresponding to (a) Intense Vs Relaxed, (b) Keyboards Vs Guitars and (c) Clean consonant Vs Dirty dissonant. An analysis of individual differences revealed no significant difference between subjects' variance in similarity judgments, and no influence of familiarity with the genre. In addition, subscales of the GMSI predicted to what extent participants rely more on certain perceptual dimensions.

Conclusions

Progressive rock can be decomposed using 3 perceptual dimensions. Despite the usual view of progressive rock as an 'experts' genre, it may not require (1) knowledge in prog rock nor (2) musical training to be identifiable by listeners.

Keywords

Musical similarity, triadic comparisons, multidimensional scaling, musical genre, musical abilities, progressive, rock.

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The effects of music training on perceptions of equal-tempered and microtonal intervals: A behavioural and EEG survey

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ABSTRACT

Background

Previous research suggests that music interval perception depends on both psychoacoustic properties and familiarity (enculturation/training) with the system(s) in which the intervals are used. For listeners most familiar with Western twelve-tone equal-tempered (12-TET) music, a novel microtonal tuning system is expected to present additional processing challenges. As music expertise has been shown to mediate behavioural (subjective ratings of roughness and liking) and event-related potential (ERP) responses to 12-TET harmonic intervals (e.g. Kung et al.; Minati et al., 2009; Schön, Regnault, Ystad, & Besson, 2005), it might also shape such responses to microtonal intervals.

Aims

Our aim was to contrast behavioural and ERP measures of listeners' responses to unfamiliar microtonal intervals, to determine how these are perceived in comparison to more familiar 12-TET harmonic intervals. We focused on the extent to which our perceptions can be considered bottom-up (psychoacoustic and primarily perceptual) and top-down (dependent on familiarity and music training). We hypothesised that microtonal intervals would be less liked, and perceived as more rough, than 12-TET intervals, and that ERP responses would distinguish the two interval types. We also predicted that musical expertise would facilitate the sensory and perceptual discrimination of microtonal intervals from 12-TET intervals, with an increased ability to categorize such intervals.

Method

We used behavioural and ERP measures to compare subjective impressions of sounds with the neurophysiological processing of the acoustic signal. The 20 participants comprised 10 musicians and 10 non-musicians. They listened to two-note chords comprising 12-TET (consonant and dissonant) or microtonal (quarter tone) intervals. ERP and subjective roughness ratings were recorded concurrently; liking ratings were recorded separately.

Results

Music experience mediated the perception of differences between dissonant and microtone intervals. While non-musicians gave similar ratings for both dissonant and microtonal intervals, musicians preferred dissonant over the less commonly used microtonal intervals, rating them as less rough. Overall, ERP amplitude was greater for consonant intervals than other intervals, but musicians exhibited less positivity than non-musicians in the early response, and vice versa for later components, which are associated with more cognitive than sensory processing.

Conclusions

The interaction of musical experience with interval type suggests that musical expertise facilitates the sensory and perceptual discrimination of microtonal intervals from 12-TET intervals, and increases the ability to categorize such intervals, while non-musicians appear to have categorically perceived microtonal intervals as instances of their neighbouring 12-TET counterpart. The creation and performance of musical works based on non-12-TET systems warrants consideration of how quickly untrained listeners can learn unfamiliar microtonal systems given appropriate exposure.

Keywords

Microtone, Perception, ERP, Musical Experience, Liking, Roughness

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Parsifal and the effect of narrative on unconscious arousal

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ABSTRACT

Background

After reading Schopenhauer's *The World as Will and Representation*, Wagner firmly believed that music held a privileged position in a listener's artistic engagement when compared to other elements such as narrative. This belief poses an operationalizable question: To what extent does context play in an individual's artistic experience? Exploring this question empirically has led to contention in the overlap of the social and cognitive sciences and theoretical frameworks have been proposed to help navigate the issue (Bullot and Reber, 2013). The question has been explored in the domain of visual art, and it has been established that contextual information does play a role in an observer's evaluation of artwork (Kirk et. al, 2009). Only recently have experiments been conducted using contextual information and music (Margulis, 2010), with similar results not being found in measures of self-report. This experiment's aim was to further explore this question to investigate how contextual information influences an individual's unconscious musical experience using measures of explicit and implicit emotional arousal.

Aims

For this experiment, our aim was to investigate how contextual information influences an individual's musical experience using measures of implicit and explicit emotional arousal. Additionally, we sought to further investigate how an individual's level of arousal would affect their memory for musical material.

We hypothesized that a more provocative narrative would generate more unconscious arousal, as measured by electrodermal activity. Additionally, we hypothesized that that when individual's were more aroused, as indicated through their measures of electrodermal activity (EDA), they would be more likely to remember musical material.

Method

The experiment used a between-subjects design with two conditions. The independent variables examined were experimental condition as determined by given narrative, musical training (Müllensiefen, 2014), and Wagner affinity (Müllensiefen, 2014). The dependent variables were a participant's memory score, a participant's response to the GEMS-25 scale (Zentner et al., 2008), an implicit memory measure, as well as their electrodermal activity (EDA). Measures from the independent variables were then used in a regression model to predict an individual's sensitivity index.

A convenience sample (N=30) was used, with the only exclusion criterion being the participant hand to be unfamiliar with the opera *Parsfial*. The sample was made up of 16 females (53%) and 14 males (47%) with a mean age of 25.66 (R=18-62, SD=8.02). All participants were to be used in the musical structure memory calculations, but participants were to be screened out if they were deemed a non-responder to the EDA device. A non-responder status was determined during the analysis if the participant's EDA showed no fluctuations when pre-screened. Written consent was obtained from all participants and participants had the option of accepting £10 compensation for travel and time expenses. Funding was made possible by the Transforming Musicology project.

The recording used for the stimulus was the 1990 Herbert von Karajan recording of *Parsifal* played through high-quality headphones. Excerpts used as probes in the memory paradigm were taken from the *English National Opera's Guide to Parsifal* and chosen at the discretion of the leading author. The musical stimuli (letimotives, selected and musical structures) were MIDI files created in MuseScore. The first group was given a narrative that depicted the events from a provocative scene from *Parsifal*, while the second narrative was created to employ the overused "three-tasks-to-save-the-princess" trope.

Narratives were constructed in collaboration with the third author on the paper, taking care not have the libretto confound the plot. Both implicit and explicit levels of emotional arousal were measured using EDA and self-reported emotional engagement (Zentner et al, 2008). After the listening phase, participants were asked to take an explicit memory quiz to probe what musical material they retained. Data from the EDA was analyzed by comparing the number of significant skin conductance responses as a result of continuous decomposition analysis (Benedek and Kaernbach, 2010) as calculated by the Ledalab V3.4.7 package in Matlab 2013 in time windows where leitmotives were present with randomly selected, equal duration windows of measurement in the listening passage.

The second question of group differences in unconscious arousal was determined by comparing averaged group means of the global mean as calculated by Ledalab V3.47.

Measures of EDA were measured using Shimmer Sensing's Shimmer 2R devices, sampling at a rate of 128 Hz. Data was to be down sampled in the analysis.

Upon arriving at the experiment participants were initially asked to sign a consent form in compliance with the Ethics Board of the Psychology department of Goldsmiths, University of London. After consent was obtained, participants washed their hands with soap and water and then were fitted with the EDA device with the aid of the experimenter. The EDA device was fitted on all participants' right hand attaching at the

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underside of the section of the first and middle finger nearest the knuckle. This position was decided seeing as there is no general consensus in the literature for placement on the hand or side (Dawson, et al., 2007).

After fitting, participants were told that for the experiment they would be asked to listen to a narrative describing the background and events of an excerpt they would hear from the opera *Parsifal*, then they would listen to the passage and follow along with slides on a screen depicting the narrative as it occurred. Individuals were then informed that they would be asked questions based on how the music made them feel, some musical material, and a survey about the background. After wearing the EDA device for enough time to make a connection with their skin, participants were shown how the machine works by demonstrating a test run of the software that displayed real-time display of their EDA. All participants were tested, but in the EDA analysis participants were excluded if they did not respond to the machine.

After listening to either narrative as determined by their random condition, participants were played the corresponding music and slides on the Nexus 7. Upon completing the listening, participants were asked to create the GEMS-25 and then complete the memory test. Two randomized versions of the same material were used to control for fatigue effects of the thirty- question memory test. After completing the memory test participants completed the survey of listener background. The experimenter was available at any point to clarify any of the directions. If a participant was in the false narrative condition, they were informed and given the true narrative after completing the survey.

Results

Differences in implicit memory rate based on musical structure were determined by comparing the recognition rates in terms of pleasantness of each memory probe group with the other groups. After calculating a one-way independent ANOVA, it was found that there was no significant effect across groups for ratings of pleasantness, the measure of implicit memory, $F(2,27) = .016$, $p>.05$.

Given the two experimental conditions, it was hypothesized that the dramatic narrative that a participant was exposed to would have an effect on felt emotions as measured by the GEMS-25 scale (Zentner et al., 2008). To investigate this an independent t-test was conducted on each of the cumulative sub-groupings. Of the 9 sub-groupings, only the emotions of Peacefulness and Tenderness were significantly different. On average, participants rated the false narrative higher on peacefulness (M=8.21), than the real narrative (M=5.52). This difference was significant $t(26.19)=3.08$, $p<.05$. Additionally, participants rated the false narrative as more tender on average (M=7.76) than the true narrative (M=5.82). This difference was also significant $t(23.28)=2.16$, $p<.05$. None of the other seven factors emerged as statistically significant.

Differences in explicit memory rate based on musical structure were determined by comparing the hit rates from the old leitmotives to the old musical structures with a t-test. On average, participants recognized more hits in the leitmotives (M=18.6), than hits from the musical structures (M=16.2). This difference was nearing significant $t(18)= 1.32$, $p=.10$.

It was hypothesized that when individuals listened to leitmotives, they would respond on an unconscious level significantly more than randomly chosen window of measurement in the listening passage.

To test this an independent t-test was performed comparing the mean number of skin-conductance responses in windows of leitmotive measurement from randomly selected windows of measurement. On average, participants experienced more skin-conductance responses while listening to leitmotives (M=1.94), than listening to randomly chosen passages (M=1.99). This difference was not significant $t(402.17) = -0.41$, $p>.05$. It was also hypothesized that individuals in the true narrative condition would become more aroused than in the false narrative condition. To test this an independent t-test was performed to compare the mean skin-conductance response value within all widows of measure in both conditions. On average, participants had a higher mean global response (M=2.55) in the real narrative condition than the fake condition (M=2.27). This difference was significant $t(633.46) = -4.48$, $p<.001$.

Conclusions

These novel findings using music are consistent with evidence found in other domains of aesthetic appreciation that suggest that context plays a significant role in an individual's engagement with music, albeit unconscious. These findings also suggest the importance of framing what type of knowledge an audience is given before musical performances in order to fully maximize their emotional engagement. While other hypothesized variables did not reach significance, further testing should be made to confirm such null findings.

Keywords

Narrative, Electrodermal Activity, Emotion, Memory.

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Neurophysiological markers of tonalities

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ABSTRACT

Background

To analyze the processes that characterize the human intellectual activity, the emotion studies are of special interest since just the emotions motivate, organize and direct perception, thought and action (Izard, 1991). At that, the study of emotions generated when listening to music (Eerola &Vuoskoski, 2013; Juslin & Vastfjall, D., 2008, and many other publications) makes it is possible to rely on the theory of music and musicology, especially on the ethnic and ancient music and so on.

One of the important problems is the development of a measurement model in order to study neurophysiological processes related to the emotional sphere.

Sir Thomson, Lord Kelvin, accentuated that "...when you can measure what you are speaking about, and express it in numbers, you know something about it..."

At present, some models for measuring emotions are known. They link certain statistical parameters of music and that of its performance (in particular, dynamics, timber, harmony, register, rhythm, articulation, structure) with listeners' emotions (Eerola, 2012). These models can be useful for analysis of whole musical compositions or rather long fragments, in particular, when studying the features of composer's and performer's means. However, such models do not explain the relationship revealed and do not describe the "mechanism" of emotion origination in response to an acoustic impact.

The first attempt to model this "mechanism" was made by metrologists (Taymanov, Sapozhnikova, 2003), and later the measurement model proposed was significantly developed (Taymanov, Sapozhnikova, 2010, 2014, 2014a).

The development of the model was carried out on the basis of computational and analytical analysis of known data related to the audience perception of simple structural elements of music, experiments made by Prof. Wood as well as reactions of ocean inhabitants to various natural phenomena. The interpretation of musical fragments, obtained with its help, carries conviction, which is a further substantiation of the model. In a future, after finishing the work on the model it will be possible to apply the model when analyzing music compositions and fragments of any duration.

To enhance the prospects for its use, the authors of the present paper carry out a study of the existence of structural similarities between the functions of model blocks and functions of those blocks of a "mechanism" that form the emotions.

The proposed measurement model, in particular, allows the perception of a chord to be associated with an expected emotion of listeners. Chords (thirds and triads) are the smallest elements of music that are characterized by emotional connotation (colour).

The model is based on the assumption that a nonlinear conversion and low-pass selecting of sounds take place in the brain of a listener when he/she perceives music (Fig.1).

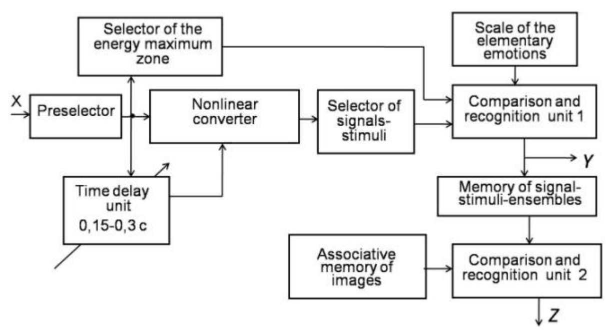

Fig.1. Measurement model

Model calculations have shown that the major tonic chords, unlike the minor ones, have to generate intermodulation oscillations of significant levels within the infrasound and lower part of the sound frequency range, which corresponds to the brain biorhythm range. The frequencies of these oscillations are specific to the chords of each tonality. Therefore, such oscillations can be considered as internal "signals-stimuli" generating various emotions. These "signals-stimuli" can be called neurophysiologic markers of tonatities.

An efficient method for investigation of neurophysiologic brain reactions is encephalography, in particular, alpha activity analysis (Bazanova & Vernon, 2014).

Aims

An ultimate aim of the research is the verification of the accepted measurement model and then at a positive result, its further improvement.

The aim of the present study (the first stage of the work planned) is confirming the existence of the neurophysiological markers of tonalities in experiments as well as finding ways to optimize the procedure of their determination.

Method

Series of identical major and minor tonic triads that included 20 identical chords of different tonalities, which followed in 5 seconds, (C-dur and c- mol, in the first octave; B-dur and b-mol in the small octave) were presented to investigation participants.

To eliminate the influence of subjective factors depending on a performer, the chords were synthesized from harmonic oscillations with a help of a computer. The expected frequencies of the intermodulation oscillations were determined by means of calculations (8.5 Hz for C-dur; 5.0 Hz for B-dur).

During the experiments, the electro-encephalograms (EEGs) of the participants were recorded in pre test eyes closed and eyes open conditions in silence, then in eyes closed during the chord presentations. The analysis of EEGs was performed using a Short-time Fourier Transform. A rectangular time window (mask) was used with the duration of the window of 0.5-1.0 s. To improve the resolution in the frequency domain, the signal samples were supplemented with zero counts. A shift of the time window was implemented with a step of 0.1 s. The range of frequencies analysed was limited to 30 Hz.

Results

When the major and minor chords were presented, an amplitude suppression of the EEG within an individual alpha-frequency range took place. The major chords caused the emergence of signals of a significant level at frequencies predicted by the measurement model. This effect manifested itself mainly for the first chord carrying new information. For the remaining chords the effect was much weaker and had a random character.

Conclusions

The results of the work fulfilled confirm that acoustic impact consisted of several sounds, their frequencies being in a certain correlation, causes intermodulation components in the brain. They correspond to those formed as a result of the non-linear conversion of the same sounds and their subsequent low-pass selection. Thereby, it is shown that the analogy exists between the functions of the main part of the model considered and a number of functions of a neurophysiologic "mechanism" of emotion formation. Origination of the tonality markers predicted by the measurement model is demonstrated.

The observed effect related to the dependence of the marker level on the novelty of the chords presented was taken into account in a subsequent investigation procedure.

At the next stage of the study it is planned to obtain a statistically reliable confirmation of the marker existence for a greater number of tonalities, to improve data processing methods and substantiate the elementary emotion scale for the model considered.

Acknowledgements

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Keywords

Major, minor, chords, emotion, measurement, EEG.

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Affect self-regulation through music: Which concepts do we use and how?

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ABSTRACT

Music engagement is often used for affect self-regulation, i.e. inducement, maintenance or change in affect by the individual. Research on the involved processes has been blooming over the last two decades; however, this is still an emergent field composed by a heterogeneous variety of traditions, approaches, and concepts. This research aims to identify the current frameworks used by researchers in the field, assess the overall state of conceptual clarity, and propose useful suggestions for future studies. The data was collected and analyzed through an integrative literature review. From a systematic online search of databases, 34 publications were selected, analyzed and interpreted. It was found that a wide variety of terms related to affective states – such as emotion, mood, feelings, and affect – and to regulatory processes – such as emotion regulation, mood management, and coping – is used in the field. As for conceptual clarity, this was hampered by the low rate of use of definitions (e.g., nearly half of the publications did not provide a definition for their targeted phenomena) and by the inconsistent use of terms (e.g., 12 of 34 publications used affective terms interchangeably). The review did not find a comprehensive model for music-based affect regulation. The amount of research on this topic is fairly small and the knowledge produced is not, yet, solid, clear, and cohesive across studies. Recommendations for future research are presented.

I. INTRODUCTION

The concept of emotion regulation (i.e., the internal and external processes for monitoring, assessing and modifying emotional reactions, whether positive or negative; Thompson, 1994) has been gaining ground in the research of regulatory processes through music (e.g., Thoma, Ryf, Mohiyeddini, Ehlert, & Nater, 2012). Emotion regulation is not, however, the only affective concept being used. There is a variety of close (and sometimes hard to disentangle) terms: mood regulation (e.g., Saarikallio & Erkkilä, 2007), mood enhancement (e.g., Sleigh & McElroy, 2014) and coping (e.g., Miranda, Gaudreau, & Morizot, 2010).

This variety mirrors the complexity of affective phenomena and, possibly, the attempt of portraying different processes. However, the differences between these processes are not clear and their definitions are not always stated in the literature. Affect has been used as an umbrella term for affective dimensions such as preferences, attitudes, moods, affective dispositions, interpersonal stances, aesthetic emotions and utilitarian emotions (Scherer, 2005). Similarly, and as for regulation through music, Van Goethem (2010; Van Goethem & Sloboda, 2011) suggested the use of the term affect regulation as the concept including all the regulatory processes related with the diverse dimensions of affect.

In this paper, in line with the abovementioned, affect and affect regulation will be used as umbrella terms, as it fits the purpose of being comprehensive and allowing a flexible inclusion and analysis of diverse literature with varying terminology. Given that the field of affect regulation through music is still quite recent, without much conceptual discussion about the self-regulatory processes, some heterogeneity and lower degrees of definition are expected.

The aim of this study is to review pertinent publications on affect self-regulation through music and analyze their conceptual and theoretical backgrounds. The focus is solely in the processes initiated by the individuals towards themselves (self-regulation), excluding regulation performed by others or targeting the affective states of others. We wish to answer the question of how conceptually homogeneous and precise this field currently is.

II. METHODS

An integrative literature review was conducted to collect the data. This method allows the synthesis, analysis and critique of findings from multiple paradigms in order to generate new frameworks and paradigms (Torraco, 2005).

A. Literature Search

A broad online search of the literature was conducted in the databases Pro Quest, PsychINFO, ProQuest Social Science Journals, ProQuest Psychology Journals, ERIC, Science Direct, Web of Science, and Scopus. The following keywords were used: music AND (emotion OR mood OR affect) AND (regulation OR strategy OR coping). The search was limited to journal articles and dissertations.

B. Data Screening

The data were screened for inclusion/exclusion according to specific criteria. The inclusion criteria were: empirical study, focuses on at least one component of affect self-regulation through music, written in English, and published between 1 January 1994 and 30 June 2014. Publications that did not fulfill these criteria were excluded. When there was both an article and a dissertation about the same study, the article was preferred and the dissertation excluded.

The process of data screening following the steps portrayed in Figure 1 resulted in a final sample of 34 publications, selected from the initial 2004 hits.

C. Data Analysis

The selected publications were organized into subgroups according to how directly they were focusing on affect self-regulation through music. Three subgroups were formed:

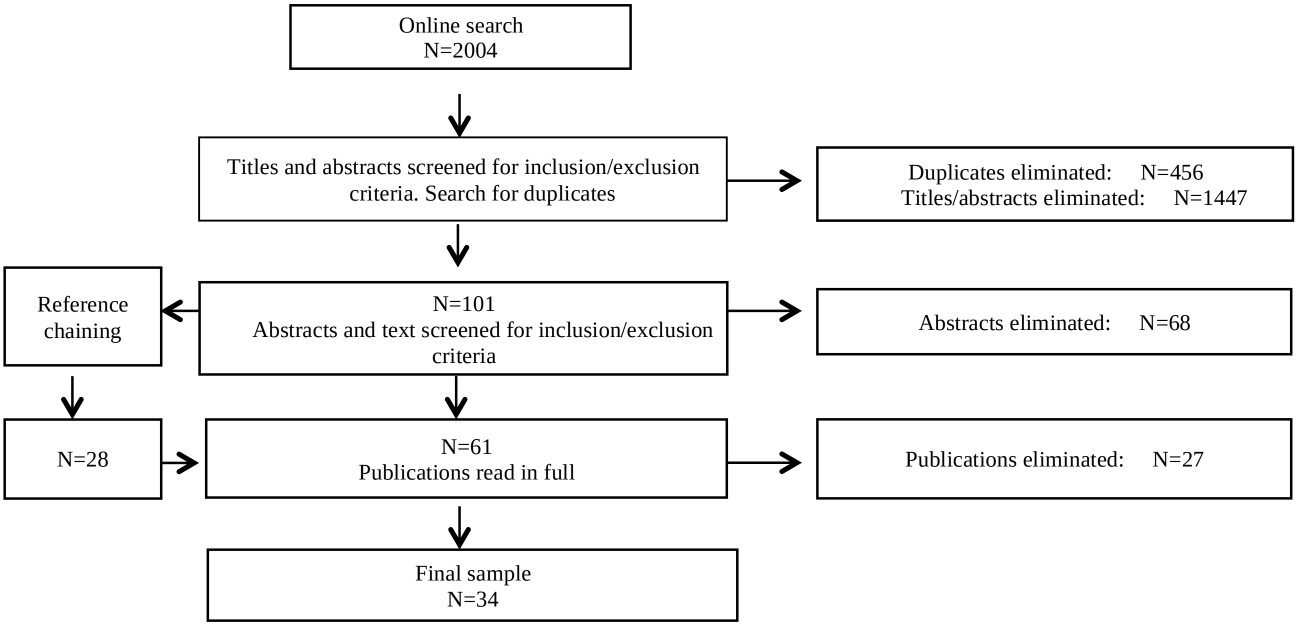

Figure 1. Flowchart of the data screening process

1) composed by studies focusing directly on affect self-regulation through music engagement; 2) studies that approached this process in relation to other phenomena; and 3) studies that provided more indirect information, as they were focused on different but related phenomena.

Across these three subgroups, data concerning concepts and definitions were extracted and coded. The first information extracted from each publication was the regulatory process on focus and the affective concepts identified. Data was coded according to the concepts used. The second analysis concerned the conceptual clarity and precision of the studies, for which pre-defined criteria were used: the presence/absence of a definition of the studied affective phenomenon; the presence/absence of a definition of the studied regulatory process; the consistency/interchangeability in the use of affective terms; and the presence/absence of a framework or model for the results.

III. RESULTS

The data search and screening resulted in a sample of 34 publications, of which 2 were dissertations and 32 were journal articles. The fields of these publications varied from psychology of music to health and wellbeing, cognition and emotion, music perception, personality, communication and media psychology, aesthetics, music therapy, and sports psychology.

A. Subgroups

The categorization of the publications in three subgroups resulted in the following distribution: subgroup one: 17 publications; subgroup two: 7 publications; subgroup three: 10 publications.

B. Regulatory and affective concepts

The terminology related to regulation and affect varied across publications. As seen in Table 1 and Figure 2, the regulative processes approached in the selected publications were emotion regulation (9 publications), mood regulation (5 publications), coping (4 publications), mood management (3 publications), self-regulation (3 publications), mood repair/enhancement (2 publications), emotion modulation (2 publications), affect regulation (2 publications), and others/non specified (6 publications). The affective phenomena targeted by the publications were equally varied (Table 1). Although some publications refer to one to three concepts, others referred until ten affective dimensions. The inclusion of these terms in the table does not mean that they were defined, conceptualized, or formally assessed in the studies.

Table 1. Self-regulation concept and the affective concepts reported in each publication.

First author, year	Self-regulation concept	Reported concepts in relation with music and regulation
Barcewicz (2012)	Mood regulation	Emotion, mood
Bishop et al. (2007)	Manipulation of emotional state	Emotion, mood, attention, arousal levels, physical reactions, pleasure, confidence, imagery, energy levels
Boer et al. (2011)	Self-regulation	Emotion, mood, feelings, physical reactions, attention, stress, attitudes
Chamorro-Premuzic et al. (2009)	Emotion regulation	Emotion, mood

Chen et al. (2007)	Mood repair	Mood
DeNora (1999)	Emotional self-regulation / regulation of self	Emotion, mood, attention, arousal levels, physical reactions, energy levels, feeling, motivation, desire, comportment
Dingle et al. (2012)	Emotion regulation	Emotion, mood, arousal levels, feelings, confidence
Gebhardt et al. (2007)	Emotion modulation	Emotion, activation, arousal, affective disorders, neuroticism, stress-related and somatoform disorders, disorders of personality and behaviour
Gebhardt et al. (2014)	Emotion modulation	Emotion, activation, arousal, affective disorders, neuroticism, stress-related and somatoform disorders, disorders of personality and behaviour
Getz et al. (2012)	Emotional use of music	Emotion, positive affect, negative affect
Greenwood et al. (2009)	Emotion regulation	Emotion, mood
Hakanen (1995)	Mood management	Emotion, mood, arousal levels
Heasley (1995)	Mood regulation	Emotion, mood, attention, arousal levels, feelings, energy levels
Knobloch et al. (2002)	Mood management	Mood
Laukka (2006)	Mood regulation	Emotion, mood, arousal levels, feelings, attention, pleasure, energy levels
Laukka & Quick (2013)	Emotion and arousal regulation	Emotion, mood, arousal levels, feelings, attention, motivation, energy levels, physical reactions, physical performance, confidence
Miranda & Claes (2009)	Coping	Emotion, depression
Miranda et al. (2010)	Coping	Emotion, depression, neuroticism
Saarikallio (2011)	Emotional self-regulation	Emotion, mood, arousal levels, attention, energy levels, feelings
Saarikallio & Erkkilä (2007)	Mood regulation	Emotion, mood, arousal levels, attention, energy levels, feelings, physical reactions, behaviour
Saarikallio et al. (2013)	Emotional self-regulation	Emotion, mood, arousal levels, attention, energy levels, feelings
Schäfer & Sedlmeier (2009)	Functions of music	Emotion, mood, arousal levels, feelings, energy levels
Schäfer et al. (2013)	Arousal and mood regulation	Emotion, mood, arousal levels, feelings, attention
Skåland (2011)	Coping	Emotion, mood, arousal levels, physical reactions, stress
Skåland (2013)	Affect regulation	Emotion, mood, physical reactions, feelings
Sleigh & McElroy (2014)	Mood management	Emotion, mood, arousal levels
Tahlier et al. (2013)	Emotion regulation	Emotion, mood, feelings
Ter Bogt et al. (2011)	Mood enhancement / Coping	Emotion, mood
Thoma, Ryf, et al. (2012)	Emotion regulation	Emotion, mood
Thoma, Scholz, et al. (2012)	Emotion regulation	Emotion, stress, feelings
Thomson et al. (2014)	Mood regulation	Emotion, mood, depression, anxiety, stress
Van den Tol & Edwards (2013)	Self-regulation	Emotion, mood, affective state, pleasure, feelings, attention
Van den Tol & Edwards (2014)	Self-regulation	Emotion, mood, affective state, pleasure, feelings, attention
Van Goethem & Sloboda (2011)	Affect regulation	Emotion, mood, affect, arousal levels, feelings, attention

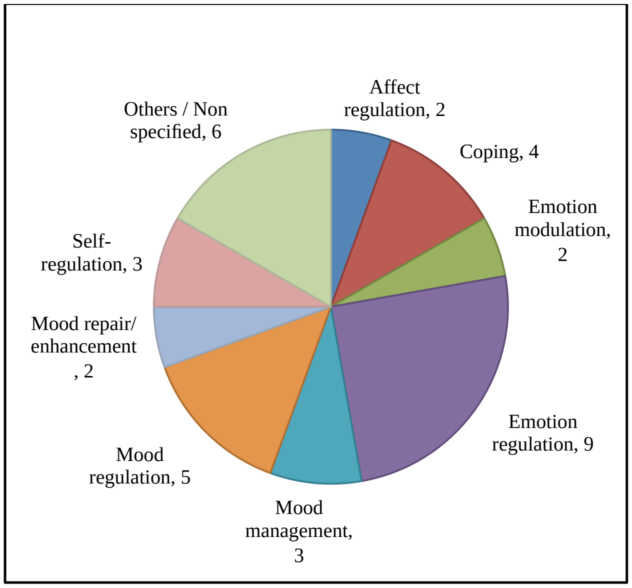

Figure 2. The different regulatory concepts in the publications and the total amount for each.

Table 2. Conceptual clarity of the publications: Presence of definitions of affective state, presence of definitions of regulatory process, consistence in terminology and proposal of models

Authors, year		Clarity of definition			
First subgroup of closeness		A	B	C	D
Barcewicz (2012)		O	O	O	O
Bishop et al. (2007)		O	/	O	X
Gebhardt & Von Georgi. (2007)		O	O	X	O
Gebhardt et al. (2014)		O	/	X	O
Heasley (1995)		X	X	/	X
Knobloch & Zillmann (2002)		O	X	X	O
Saarikallio (2011)		X	X	/	X
Saarikallio & Erkkilä (2007)		X	X	O	X
Skåland (2011)		X	X	X	O
Skåland (2013)		X	X	X	O
Sleigh & McElroy. (2014)		X	O	O	O
Tahlier et al. (2013)		X	O	O	O
Thoma, Ryf, et al. (2012)		O	X	O	O
Thomson et al. (2014)		O	X	O	O
Van den Tol & Edwards (2013)		X	X	X	X
Van den Tol & Edwards (2014)		O	O	X	X
Van Goethem & Sloboda (2011)		O	O	X	O
Subtotals	X	8	9	8	6
	O	9	6	7	11
	/	-	2	2	-
Total of publications in the first subgroup					17
Second subgroup of closeness		A	B	C	D
Chamorro-Premuzic et al. (2009)		O	/	O	X
Chen et al. (2007)		O	X	X	O
Greenwood & Long (2009)		O	O	O	O
Miranda & Claes (2009)		O	X	X	O
Miranda et al. (2010)		O	X	X	O
Saarikallio et al. (2013)		O	O	O	O
Thoma, Scholz, et al. (2012)		O	X	X	X
Subtotals	X	0	4	4	2
	O	7	2	3	5
	/	-	1	0	-
Total of publications in the second subgroup					7
Third subgroup of closeness		A	B	C	D
Boer & Fischer (2012)		O	/	X	X
DeNora (1999)		O	/	X	O
Dingle et al. (2013)		O	O	X	X
Getz et al. (2012)		O	O	X	X
Hakanen (1995)		O	O	O	X
Laukka (2006)		O	O	X	O
Laukka & Quick (2013)		X	O	X	O
Schäfer & Sedlmeier (2009)		O	O	X	X
Schäfer et al. (2013)		O	O	X	X
Ter Bogt et al. (2011)		O	O	X	X
Subtotals	X	1	0	9	7
	O	9	8	1	3
	/	-	2	0	-
Total of publications in the third subgroup					10
Totals	X	9	13	21	15
	O	25	16	11	19
	/	-	5	2	-
Total sample of publications					34

A – Definition of the affective phenomena in focus: X– present; O– not present
B – Definition of the regulatory process in focus: X– present; /– present, not sustained by the literature or diffuse definition; O- not present
C – Consistent use of affective terms: X- consistency; /- assumed or explained interchangeability; O- unjustified interchangeability
D – Model or framework for the data: X– present; O– not present

C. Conceptual clarity

The first criterion for conceptual clarity was the presence/absence of definition for the studied affective state. As it can be seen in Table 2, column A, 25 of 34 publications did not define their affective concepts under study. Looking at the three subgroups, we can see that only 8 of 17 publications in the first group of closeness and 1 of 10 in the third group presented a definition for their studied affective states.

As for the second criterion (Table 2, column B), which concerned the definition of the regulatory process, the total numbers show that 16 publications did not provide a definition, 13 publications defined the studied regulatory process, and 5 defined it in a less formal way (e.g., without citing supporting literature). The first and second subgroups of closeness had similar rates of definition (9 of 17 and 4 of 7, respectively), whereas none of the third subgroup publications presented a clear definition for the studied regulation process. Additionally, two publications in the first group, one in the second, and two in the third group defined the studied regulatory processes in a less precise way.

In the column C, we have the results for the criteria of consistency in the used of affective terms throughout the publication. In total, 13 of 34 publications used affective terms interchangeably, of which 2 stated or justified that interchangeability. Twenty-one publications were consistent in the use of their terminology. At the subgroups level, it is possible to observe that this consistency was more present in the third subgroup (9 of 10). In the first and second subgroups, only 8 of 17 and 4 of 7 (respectively) were consistent.

Regarding the proposal of a model for their results, column D shows that nearly half of the publications framed their results with a model (15 of 34). The proposal of models was more present in the third subgroup (7 of 10). In the first subgroup, 11 of 17 do not present a model. The numbers for the second group are 5 of 7 not presenting a model.

IV. DISCUSSION

The results collected in this paper portray a pertinent overview of the field of research on affect regulation through music. The focus of this paper on the adopted concepts and on how they are defined allows us to raise some remarks that will now be discussed.

Self-regulatory functions have been studied through different approaches inside the field of psychology, with, for example, the concept of defense mechanisms from the psychoanalytic tradition and the concept of coping from the study of stress (Gross, 1998). Different schools of thought are also visible in the topic of affect self-regulation through music. The analysis of our results yielded nine different categories of regulatory processes: affect regulation, emotion regulation, mood management, mood regulation, mood repair/enhancement, self-regulation, and others/non-specified.

If, on one hand, this variety enriches the field with different perspectives and approaches, on the other hand it can cause confusion to the researchers and readers when the concepts are not clearly defined. The analysis of conceptual clarity shows that only 9 of the 34 publications define their concept of affect self-regulation.

Similarly, the affective dimensions mentioned throughout publications were highly diverse (e.g., emotions, feelings, arousal, motivation, focus…). Affective experiences are known to be complex and involve multiple dimensions with, frequently, different expressions and results (Scherer, 2005). However, given the lack of definitions on the terms used and the high rate of interchangeability between them, it is hard to know what is being studied and how different results can be compared between publications. The results from this integrative literature review show that only 13 of the publications provided a definition for the affective states on focus and that an additional 5 presented definitions that were not literature-based. Besides, the interchangeability of affective terms (observed in 13 of the publications) makes it harder to pin down the phenomena involved in music engagement.

This situation of heterogeneity of terms and difficulty in grasping solid definitions is likely to be related to the inherent complexity of all affective experiences and with the novelty of the topic. Research on music, affect, and regulation is still in an early stage of development.

This fact is also visible in the inexistence of a comprehensive model for the affect regulation through music. Although some of the analyzed publications suggested a model to frame the obtained results, these were mainly for those publications that were concerned with topics more distant to the affect self-regulation through music (7 of 10 in the third subgroup of closeness) and none of them encloses all the dimensions of the process of affect self-regulation.

Recommendations for future research

One of the practical applications for results emerging from literature reviews is the extraction of recommendations for the future. Taking into account the state of the field shown in the current results, we argue that it would be beneficial if future research would:

- Adopt precise definitions;
- State them clearly in each publication;
- Consider the use of the umbrella term “affect” when more than one affective component might be involved (e.g., moods and emotions);
- Thrive for comprehensive and integrative approaches;
- Suggest a model for the description and explanation of the affect regulation process through music.

V. CONCLUSION

This theoretical study provides useful insights into the state of the art of research on affect self-regulation through music. Being a recent topic, it still has not had the time to mature and reflect upon the theoretical, conceptual, or methodological issues. This study is an attempt in doing a step further in this matter.

Affect regulation through music is a smaller topic inside the field of research on music and affect, consisting of a fairly small number of publications directly dedicated to it. Although the results of this field are pointing to promising directions in research, there is still the need of creating guidelines, frameworks, and models that can provide future research solid foundations for comparative and cumulative creation of new knowledge.

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Alpha EEG/EMG ratio during finger movement as an index of musical performance ability

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ABSTRACT

Background

The production of voluntary movements by musicians often has many more elements contributing to performance than are absolutely necessary to solve a given motor task. Nevertheless, only top musicians perform well by eliminating 'redundant degrees of freedom' [Bernstein, 1996]. Context redundancy reflects the inefficiency of inhibitory processes of the sensorimotor coordination. Previous research has shown that redundant muscle inhibition leads to an increase in electroencephalographic (EEG) amplitude of the upper alpha frequency range, with simultaneous decrease in electromyographic (EMG) power of redundant muscle tension during fine motor performance providing an index of cortical "top-down" control [Klimesh et al., 2007; Sammler & Grigutsch 2007; Bazanova et al., 2009, Bowers et al., 2014; Kiefer et al., 2014]. In contrast a decrease in alpha amplitude and increase of forehead muscle tension indicate an increase in cortical activation [Barry et al., 2007; Bazanova & Vernon, 2014]. Changes in alpha EEG and EMG power provide a mechanism to select relevant neuronal populations, although the relative contributions of these neurophysiological indices to musical performance ability remain unclear.

Recently it was demonstrated the efficiency of new educational and training approach aimed at increasing performance skills using simulation (Williamon et al., 2014). In analogy mental motor imagery is the recognising tools of ability to learn how produce movement because motor imagery corresponds to a subliminal activation of the motor system, a system that appears to be involved not only in producing movements, but also in imagining actions [Mizuguchi et al, 2015]. Here we hypothesized that musical motor capacity is part of a wider sensorimotor condition characterized by movement performance fluency and precise imagination of motor task performance, where inhibition of redundant activation is reflected by changes of brain alpha EEG and muscles EMG power.

Aim

The aim is to study association between fingers movement fluency, its mental imagery and neurophysiological activity during timed fingers motor task performance in novices, musically trained participants and experts.

Method

Musical performance ability level and fluency in timed finger motor task performance were assessed in eighteen non-musicians, thirty musical students and in twelve top performers musicians. Evaluation of musical potent abilities in non musicians was provided by experts according to tests from Gifted and Talented Identification Handbook (Haroutounian, 2008-2009). Musicians had performed two video reordered available cantilena and active music fragments (3-5 min length) that were evaluated by experts according musical aptitude batteries [Law & Zentner, 2012].

Simultaneous monitoring the EEG, EMG were provided in (1) rest, (2) motor task performance and (3) imagination of motor task performance conditions. In all conditions, each trial had began with eyes closed (EC) 60 s then eyes open (EO) 30 s with the presentation of a grey cross-eye fixation target

Timed motor performance task was as sequential finger movements – opposing each finger with the thumb in sequence, i.e. 'index, middle, ring, little' comprises a set. Subjects reported number of sets both after performance and after mental imagery of this performance. Before task, the examiner gave verbal instructions while demonstrating the expected performance to ensure that the participant understood the instruction. Brief, untimed practice followed. After practicing the examiner said, 'When I say "go", do the same thing as fast as you can until I stop you'. The fluency of timed finger motor task performance and mental imagery of the required movements was computed as the number of sets per minute.

The EEG was recorded monopolarly with a sampling rate of 720 Hz from Pz scalp electrode referenced to the left mastoid, ground at the right mastoid. Simultaneously EMG recorded from two bipolar electrodes placed at the forehead skin.

Motor task-related alpha EEG and EMG power changes were defined as the percentage in relation to a reference interval in rest condition [Bazanova et al., 2008). The efficiency of motor performance was calculated as a ratio ln% alpha EEG change to ln % EMG power change.

To determine whether ratio of EEG alpha/EMG power changed across motor task performance and mental imagery conditions, a series of repeated measures analyses of variance ANOVAs were run. Changes in fluency, alpha oscillatory and EMG power observed during the motor imagery task were compared with the changes observed during an actual task that used the same visual input and response contingencies, but where no imagery was required. A three-way

repeated-measures ANOVAs were used to evaluate matching performances fluency, alpha EEG and EMG with factors of GROUP (3 levels: non musicians, musical students and professional musicians), CONDITION (3 levels: rest, motor performance and imagination of motor performance), and OPENING EYES (2 levels: eyes closed and eyes open) Whenever necessary, Tukey HSD post-hoc test was performed. The level of significance was set at $p < 0.05$. Spearman's correlations were used to estimate intraobserver, interobserver, and test–retest reliability.

Results

As expected, musical performance abilities associated with fluency in motor task performance ($r= 0.56$, $n= 60$) in whole sample. Fluency was highest in professional musicians vs musical students and nonmusicians [$F(2, 176)=12.23$, $p=0.001$]. Fluency during imagined fingers movements was lower than during actual motor task in non musicians and musical students group ($-t \leq 4.56$, $p \leq. 0.02$). But in high skilled musicians fluency of imagined motor task was higher than fluency of actual finger movement ($t \geq 7.72$, $p \leq. 0.001$)

There were no significant differences of alpha EEG and EMG power between non-musicians, musical students and professional musicians in rest condition ($p>0.05$). A main effect of group was observed [$F(2, 176)>8.23$, $p<0.001$] in the ratio of alpha EEG / EMG power during the actual motor task performance and indicated greater increase in professional musicians ($t=10.2$; $p=0.001$) than in musical students and non musicians This ratio during actual motor task performance does not change in musical students and decreases in non-musicians ($t=-5.9$,$p=0.002$) and positively correlated with fluency of actual motor task performance in non musicians ($r=0.65$, $n=18$; $p=0.005$) and musical students ($r=0.54$; $n=30$; $p=0.009$) groups. Alpha EEG/EMG power during actual motor performance significant correlated with this ratio during motor task imageryin high professional musicians. In contrast Alpha EEG/EMG during mental imagery of movements is not associated with the level of musical performance skill and fluency of execution in non musicians. Results are discussed in the broader context of dynamic, alpha EEG/EMG indices of motor task performance in eyes closed and eyes open condition proposing that top-down internally generated states interact with bottom-up sensory processing to enhance motor task performance.

Conclusions

This study one more time validates expanded sensorimotor organization in professional musicians, compared with musical students and nonmusicians.

We consider that high musical motor capacity is part of a wider sensorimotor integration characterized by fluent movements, accurate co-ordination and precise imagination of fine motor task performance with increased inhibition of redundant neural and muscles activation that reflected by brain alpha EEG and frontal muscles EMG power.

These findings indicate that high musical performance abilities associate with increasing upper alpha EEG /forehead muscles EMG ratio during both actual motor task performance and either mental imagery of motor task. It allows to conclude that alpha EEG /forehead muscles EMG ratio during the finger motor performance task could predict the motor capacity in structure of musical ability and so could be used as a feedback signal in Neurofeedback training of musical performance improvement and high level of sensorimotor coordination achievement.

These results have implications for musical performance training and rehabilitation. They indicate the utility of EEG and EMG for learning assessment in musicians. They also indicate learning strategies with a partial movement focus may be a beneficial strategy to support the development of complex musical performance skills training and rehabilitation strategies focused on reacquisition of skills prior to performance reintegration.

Keywords

Musical performance ability, fingers motor task, mental imagery, fluency, alpha EEG, frontal muscle EMG.

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Predicting the benefits of musically cued gait-training in Parkinson's Disease

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ABSTRACT

Background

Auditory cueing is a known method to improve gait kinematics in patients with Parkinson's Disease (PD). In the presence of rhythmical auditory cues (e.g., a metronome or music) PD patients tend to walk faster and to increase their stride length. These beneficial effects of are seen immediately during the stimulation, and can carry over to uncued gait after a period of training. However, important individual differences can be observed. Some patients benefit from the training, whereas others are non-responders.

Aims

A positive response to auditory cueing may be linked to spared timing mechanisms, which allow patients to synchronize their steps to the auditory cues during training.

Method

This possibility was examined in 15 PD patients, who were submitted to extensive testing of perceptual and sensorimotor timing as well as gait kinematics before and after a four-week auditory-cuing training program. During the training, patients walked with familiar music having an embedded metronome presented at a tempo around their spontaneous cadence. Perceptual and sensorimotor timing was evaluated with the Battery for the Assessment of Auditory Sensorimotor and Timing Abilities (BAASTA). Patients' performance was compared to that of 20 age-, gender-, and education-matched healthy controls.

Results

Musically cued gait-training led to improvements in most of the patients' gait behavior (i.e., with increased speed and greater stride length), visible up to 1 month after the intervention. The performance in a synchronized tapping task before the training was a good predictor of the success of auditory cueing. Patients showing high accuracy and low variability in synchronization were most responsive to the training. Moreover, patients, who were most responsive to cues before training (i.e., showing immediate increase in speed and stride length) were most likely to improve their gait after the training.

Conclusions

These findings indicate that individual differences in terms of sensorimotor timing, a crucial skill needed when walking with an auditory cue, are crucial when deciding on training programs such as auditory cuing in the rehabilitation of PD.

Keywords

Parkinson's Disease, auditory cueing, gait, individual differences, music

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The relationship between immanent emotion and musical structure in classical piano scores

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ABSTRACT

By focusing on notated music and separating immanent emotion (latent in the score) from performed emotion (contributed by the individual performer), we model immanent emotion as a linear combination of simple predictors for valence and arousal. We calculated a series of relevant measures - such as strength of tonal center, dissonance, average pitch variation, and overall tempo - from a set of musical scores partly selected from the piano repertoire and partly rearranged by one of the author, in order to reproduce different musical structures by varying each aspect one at a time. Performances corresponding to 16 different structures (recorded on a MIDI grand piano Disklavier at 2 different tempi (slow, fast) and in 3 different performing styles - deadpan, moderately expressive and exaggeratedly expressive or "emotional", for a total of 96 performances) are randomly presented to musicians and non-musicians, who are asked to rate them according to both dimensional and categorical models of emotions. Preliminary results are consistent with hypotheses that positive immanent valence is associated with major or clear tonality, and immanent arousal with tempo and melodic pitch range. We will test the hypothesis that low tonal clarity and high degree of dissonance are correlated with emotions such as uncertainty, anxiety and fear, and associations such as darkness, insecurity and death.

Background

How does musical emotion depend on musical structure and expression? Our approach consists in separating emotion in notated music into immanent emotion (emotion that is somehow latent in the score, e.g. the heroic character of Beethoven 3rd symphony or the gloomy character of Liszt *Lugubre Gondola*) and performed emotion (emotion that is contributed by the individual performer).

Regarding immanent emotion, Sloboda (1991) related structural elements (sequences, unexpected harmonies) to responses (shivers, tears), and Zbikowski (2010) explored relationships between remarkable passages (dissonances, modulations) and emotion. Regarding performance, Clynes (1977) related the emotional quality of an event to its loudness and tempo contours, Juslin (2001) related basic emotions (happiness, anger) to the musical surface (tempo, dynamics, articulation), and Juslin et al. (2002) presented a computational model of expression in music performance where generative structure rules, emotional expression and movement principles are integrated in a common picture (GERM model).

In a preliminary study, we have developed a model of immanent emotion as a linear combination of simple predictors for valence and arousal. By relating basic musical structures to specific categories for emotion, we have calculated a series of relevant measures from a set of musical scores, such as average pitch variation, dissonance (frequency of occurrence of pitch class sets and root ambiguity), strength of tonal center (based on frequency of occurrence of scale steps), and overall tempo. We have also explored qualitative relationships between music structure, emotion, and free associations using and extending the Hevner adjective list of emotions (consisting of clusters of words grouped by similarity of meaning and arranged in a circle; Hevner, 1935; 1936) as revised by Farnsworth (by improving the consistency of the Hevner checklist across and within each cluster: Farnsworth, 1954; 1969) and Schubert (by updating the checklist with a wider spread of emotional ranges: Schubert, 2003).

Aims

We investigate the relationship between structure and immanent emotion, and expression and performed emotion.

Method

First, we selected 4 classical piano pieces corresponding to 4 different tonal strengths: 1 in a clear major tonality, 1 in a clear minor, 1 piece in uncertain tonality, and 1 atonal. Second, a composer modified each of these pieces to create 4 pieces x 4 different structures (as listed above). Specifically, we introduced 2 different levels of harmonic dissonance by modifying some of the chords, and 2 different melodic ranges by shifting some of the pitches without changing the harmony. Changes in harmonic dissonance and melodic range have been calculated and compared by means of the Humdrum Toolkit (Huron, 1995). Third, 3 professional pianists with expertise in research on music performance recorded all 16 pieces on MIDI Grand Disklavier in both MIDI and audio formats at 2 tempi (slow, fast), and in 3 performing styles based on previous studies on music performance and emotion (van Zijl et al., 2002) (unexpressive - moderately expressive, i.e. by focusing on local variations of tempo and dynamics, as suggested by the analysis of structural aspects such as phrase segmentation and accents - exaggeratedly expressive). Fourth, musicians and non-musicians listened to the recordings in random order, rated their valence and arousal, and described the emotion with 5 words from a modified Hevner Clock (Bodinger et al., 2014) and 5 words of their choice. Due to the low level of familiarity of the pieces, we expect that all the modifications in the

structure and in the performance (with respect to the original composers' intentions) do not negatively affect participants' ratings.

To run the test, we have developed computer interfaces in Java and Psychopy - an open source application to allow the presentation of stimuli and collection of data for psychology and psychophysics experiments; words from the modified Hevner Circle were presented on the screen for selection (in the participants' mother language).

Data analysis consists of two stages. In the first stage, we focus on immanent emotion: by treating variations in tempo, dynamics and articulation inside each group of performances of each piece (as extracted from the MIDI data) as covariant of the other variables, we are attempting to clarify the relationship between melodic and harmonic structure and immanent emotion. Stimuli corresponding to different structures are to be associated with valence and arousal (using a Likert scale) and with new categories of emotion (derived from the previous model by including all the new words spontaneously added by the participants). The aim of the current paper is to develop and test this stage. In a second stage, we will investigate the role of expression on performed emotion by analysing how different expressive renditions of a same piece may influence participants' evaluations.

Results

Preliminary results are consistent with hypotheses that positive immanent valence is associated with major or clear tonality, and immanent arousal with tempo and melodic pitch range. We will test the hypothesis that low tonal clarity and high degree of dissonance are correlated with emotions such as uncertainty, anxiety and fear, and associations such as darkness, insecurity and death.

Final results will be presented at the conference. Differences due to expressive performance styles will be also discussed.

Conclusions

We model immanent emotion as a linear combination of predictors for valence and arousal such as strength of tonal center (based on frequency of occurrence of scale steps), dissonance (familiarity of chord types based on prevalence in a large database), average pitch variation, and overall tempo. Expressive parameters in the 16x2x3 performances (such as variations in timing and dynamics, as extracted from the midi data) are compared with participants' evaluations.

Keywords

structure - expression - emotion - music performance - music cognition

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Pianists' use of nonverbal audio and visual cues during duet performance

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ABSTRACT

Background

Musicians exchange nonverbal auditory and visual signals during duet performance to communicate their intentions and coordinate their actions. When structural characteristics of the music make predicting co-performers' intentions difficult (e.g. following long pauses or during ritardandi), musicians' reliance on incoming auditory and visual signals may change. In particular, attention to visual signals might be expected to increase. Musicians' success at interpreting incoming visual signals improves when they have prior experience in performing similar actions. As a result, better synchronisation might be achieved when duet pairs play the same instrument than when they play different instruments, especially at points in the music where successful interpretation of incoming visual signals is critical.

Aims

This study tested whether attention to visual cues during piano-piano and piano-violin duet performance increases when structural characteristics of a piece make co-performers' timing difficult to predict. The hypothesis that same-instrument pairs (piano-piano) would synchronise more successfully than mixed-instrument pairs (piano-violin) was also investigated. The potential effects of auditory feedback deprivation on duet synchronisation was investigated as well, to determine whether access to their own auditory feedback would help secondos imagine and synchronise with the primo parts in the absence of primo audio.

Method

Highly-skilled pianists performed the secondo part to three duets, synchronising with recordings of violinists or pianists playing the primo parts. The duets differed in style and a range of potential challenges for synchronisation, including fermatas, ritardandi, and passages in which the secondo played the leading melody. Secondos performed in five audiovisual conditions: 1) while hearing their own auditory feedback and receiving both audio and visual signals from the primo (baseline), 2) while hearing their own auditory feedback and receiving audio but no visual signals from the primo, 3) while hearing their own auditory feedback and receiving visual but no audio signals from the primo, 4) while not hearing their own auditory feedback and receiving audio but no visual signals from the primo, and 5) while not hearing their own auditory feedback and receiving visual but no audio signals from the primo.

Results

Secondos synchronised more successfully with the primo recordings when primo audio was available, and less successfully when primo audio was removed and only visual signals were available. Pianists used incoming visual cues effectively following long pauses in the music, however, even in the absence of primo audio. Auditory feedback deprivation did not affect synchronisation, regardless of whether primo audio and/or visual signals were available. Some differences in the quality of synchronisation achieved by piano-piano and piano-violin duos were observed, though these effects were not consistent across pieces: piano-piano duos synchronised more precisely than piano-violin duos in some conditions with primo audio (for two of the three pieces) and in some visual-only conditions without primo audio (for one of the three pieces).

Conclusions

While the success of secondos' synchronisation with primo recordings depended primarily on the presence of primo audio signals, secondos used primo visual cues with particular effectiveness at entry and re-entry points in the music. Secondos may attend more closely to incoming visual cues at these points, and primos may perform especially clear or exaggerated cueing gestures. Duet synchronisation may be affected by instrument pairing, but pianists' success at synchronising with violinists and other pianists is likely moderated by other factors as well, including piece characteristics, familiarity with their co-performer's playing style, and individual differences in the clarity of cueing gestures used.

Keywords

Ensemble performance, sensorimotor synchronisation, interpersonal coordination, musical gesture, action prediction

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Children and adolescents' singing in everyday life and at school

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ABSTRACT

Background

Extensive research has shown the numerous benefits of singing and overall engagement in music for the intellectual, social, personal and musical development of children and young people (Hallam, 2010; Welch *et al*, 2010). Previous studies on singing in everyday life and at school suggest that young people actively engage in singing in and out of school. Although they enjoy it in both contexts, some adolescents dislike singing at school because they feel uncomfortable when being exposed and stressed when they are evaluated in singing tests or competitions (Mito & Boal-Palheiros, 2012; 2013). A number of studies in various countries showed the students' low interest for school music and for school singing in particular (Boal-Palheiros & Hargreaves, 2001; Kobayashi, 2004). We need to investigate the possible gap between singing in everyday life and at school and how these contexts relate to each other in order to understand the impact of singing in children and adolescents' lives.

Aims

This study is part of an ongoing research on singing activities of young people in Japan and Portugal, which aims to understand the functions of singing in their lives. The present study focused on the perceptions of Portuguese children and adolescents of their singing practice in both school and everyday life. It explored the frequency of and their reasons for singing, as well as their overall attitudes towards singing in both contexts.

Method

Participants (n = 78) were 43 girls and 35 boys in a public school in Porto, Portugal: 38 primary school children aged 8 to 10 years, and 40 secondary school adolescents aged 12 to 15 years. During a music lesson, participants completed a questionnaire with open-ended questions about singing both at school and in their everyday life: (a) frequency and repertoire of songs; attitudes towards singing at school; (b) frequency of and reasons for singing out of school; types of songs and singing situations: where and with whom they sing; possible influences on their motivation for singing.

The questions were refined based on a pilot study carried out with five other children. The responses of the main study were categorized and the categories were revised. A reliability test was carried out in which an independent judge assigned the responses of ten participants into the categories.

Results

Previous research suggested that Portuguese music teachers regularly include singing in Years 5 and 6 of middle schools (Boal-Palheiros, 2005). In this study, participants reported that singing is regularly practiced in music lessons (84.6% out of all responses). They sing mainly 'didactic' songs (to learn specific musical contents), especially in primary school. Some participants (19.3%) could not specify the songs' musical styles whilst others (14.1%) indicated Portuguese and Brazilian popular songs, and Pop and Rock songs. Most participants (85.5% out of 76) liked singing in music lessons and indicated following reasons: *Emotional mood* (32.9%) ('Singing makes me happy'); *Enjoyment* (27.6%); *Learning* (13.2%) ('I train my voice'; 'I learn new songs'); *Identity* (7.9%) ('It inspires me for giving concerts when I will grow up'). Those who did not enjoy singing at school (14.5%) reported either *Disliking singing* or *Singing poorly* ('My voice is out of tune').

Most children and adolescents (71.8% out of all responses) also reported singing regularly out of school. They sing mainly at home, in their bedroom, but also in their family's car, in public places, and a few at karaoke settings. Most of them usually sing alone (56.7%), and some sing with their family (22.4%) or with friends (20.9%). As far as the repertoire is concerned many did not specify the songs' musical styles (33.7% out of 85 responses) and others did not respond (27.1%). Pop and Rock songs were the most sung (28.6%), Hip Hop and Rap (8.3%) were sung by adolescents only and a few (3.6%) sang Portuguese Traditional songs. Most participants (55.1%) reported that nobody has influenced their singing. Some mentioned their family – parents or siblings, and only two referred to their teachers.

The reasons for singing out of school are similar to those for singing at school. They do not usually sing mainly because they *Dislike singing* and only a few think that they *Sing poorly*. They usually sing because of: *Enjoyment* (41.3%) ('I just love singing', 'It is fun'); *Emotional mood* (26.1%) ('It puts my sadness away'); *Identity* (6.5%) ('I can sing well'; 'It is my life'). *Accompaniment of music listening* (26.1%) ('I can't listen to music without singing along to it') emerged in the everyday life context only, and it agrees with some studies on children's music listening (Boal-Palheiros & Hargreaves, 2001).

Conclusions

This study suggests that children and adolescents are actively engaged in singing in and out of school. Their perceived functions of singing (enjoyment, emotional mood, and identity) are similar in both contexts, except for learning at school and

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accompaniment of listening out of school. Not surprisingly, their favourite song repertoire in everyday life is quite different between the two age groups and it is also different from the school repertoire, which points to the much debated issue of the selection of repertoire for school music. Some participants believe that they sing poorly at school and therefore view singing as a negative experience. In fact, many adults report negative memories of their school music singing (see Welch, 2006), which has relevant implications for music education.

Research has focused upon children's age and musical training regarding enculturation and training as central aspects of their musical development. Context remains a key issue in analysing children's musical activities and more research is needed to further explore the role of context (Lamont, 2009). Besides other individual variables, a complex set of factors is involved in children's learning, such as their motivation, conceptions and self-perceptions of ability, interests and values (Austin *et al*, 2006). Among broad developmental, cultural, educational and social issues, the teachers' role is crucial in school singing (Welch *et al*, 2010). Thus, further research needs to include teachers' perspectives on children's singing.

Keywords

Children, adolescents, singing, school, out of school.

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Gender identity and personality dimensions as correlates of music performance success

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ABSTRACT

Psychological research shows that gender identity roles have a certain place in the personality profile of creative people, especially musicians (Kemp, 1996). The aim of the research was to investigate how gender identity and the Five-Factor Model (FFM) personality characteristics of young music performers relate to their success in music performance. The sample consisted of 264 students of the Faculty of Music in Belgrade, 95 of which were males and 169 females. The participants filled in the NEO-PI-R and adapted version of the Bem Sex-Role Inventory (BSRI). The criteria for success in music performance were represented by objective measures, i.e., frequency of public performances, and frequency in participation and number of awards acquired in competitions during the period of 11 to 14 years of vocal and instrumental tuition, as well as self-perceived music success. Results show that femininity in men is strongly related to music achievement measured through public performance and competitions. Women with pronounced masculinity or femininity perceive themselves as being more successful, even though they are not more successful when objective indicators of music achievement are taken into account. Out of the five-factor model personality dimensions, neuroticism negatively correlates to self-perceived success in music, but only in women. Closer examination of this relationship shows that only the facet of vulnerability to stress contributes to self-perception of being less successful. Additional analyses indicate that gender identity in male music students is not related to personality dimensions. As for female music students, androgynous females have higher scores on extraversion, consciousness, agreeableness, and neuroticism in comparison to masculine females, while feminine females are higher on neuroticism and lower on conscientiousness than androgynous and masculine females. Findings implicate that gender identity has its role in attaining the complexity and sensitivity of artistic creation, which is then positively related to higher accomplishments.

I. INTRODUCTION

Gender identity could be rather independent of biologically determined sex ('male' and 'female') and according to the socio-cultural model, gender role identity regarding masculinity and femininity is a culturally labile product and is acquired through socialization or is, so to speak, socially constructed. There are four theoretical models which interpret the main effect of masculinity and femininity and the interaction of these effects with sex (biological and physiological characteristics that define men and women): a) the stereotypical gender-typed model which demonstrates that congruence of sex and gender is more socially desirable, especially during adolescence; b) masculinity might be more desirable in modern societies; c) additive androgyny model where both are desirable (Bem, 1974), and d) interactive androgyny model which suggests that an androgynous gender type might show better social adjustment in social interaction than other types (Lee, 2004).

Further on, being a musician and dealing with music for many years develops aspects of personal identity that are inextricably linked to musical behaviours (MacDonald et al., 2009). Musical personality and musical identity are closely interwoven and constructed in relation to other people and different situations, to social categories and cultural musical practices, respectively (Hargreaves et al., 2002). When the concepts of gender identity, musical personality and musical identity are intertwined, we realize that simple bipolar understanding of male and female identity has severe constraints and that there is space to think about the concept of psychological androgyny of musicians. The first systematic investigation on this matter was done by Anthony Kemp (1996) who wrote about psychological androgyny of musicians.

A systematic research on personality of musicians has been done in the Kemp's landmark study (Kemp, 1996) and was based on the Cattel's theoretical framework by using HSPQ and 16PF inventories. The number of studies where a new paradigm – the Five-Factor personality model (Costa & McCrae, 1995) is used to investigate the structure of musicians' personality and is related to their achievements and abilities, is small. Costa and McCrae (1995) defined the Five-Factor personality model by comprising the dimensions of neuroticism (emotional instability, vulnerability), extraversion (warm, gregarious, assertive, active, seeking excitement and positive emotions), openness (proactive search for new experiences, active imagination, aesthetic sensibility, inner-receptivity), agreeableness (positive social attitudes, good nature, trusting, helpful disposition) and conscientiousness (self-discipline, perseverance, striving for competence and achievement, dutifulness). Each of these dimensions has six facet scales and they are measured by NEO-PI-R (Costa & McCrae, 1995). A part of the results of a wider research project dealing with the structure of musicians' personality showed that more successful music teachers (highly competent in pedagogy and whose students achieve high results) have higher scores on extraversion, agreeableness and conscientiousness (Bogunović, 2010); however, there is still no data that would tell us more about the personality profiles of the music students. With regard to gender differences in personality profiles, findings showed that female musicians have higher scores on openness, agreeableness and conscientiousness than male musicians (Bogunović, 2012). As to our knowledge, there has not been a

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study dealing with the relations of personality and gender identities relaying on the Five Factor personality model yet.

A. Psychological androgyny

Psychological androgyny means that a person can have traits which are socially characterized as masculine and feminine in the same ratio, i.e., both assertive and yielding, both instrumental and expressive, depending on the situational appropriateness of these various behaviours (Bem, 1974). Until the 1970s, masculinity and femininity were thought to constitute a single bipolar dimension, but since then these two were considered to be two separate dimensions. Masculinity (e.g. assertiveness, toughness and self-confidence) was more desirable in males and femininity (e.g. tenderness, sensitivity and submissiveness) was more desirable in females. The existence of both masculine and feminine traits in a person's behaviour was labelled as psychological androgyny.

An androgynous individual should be able to remain sensitive to the changing constrains of a situation and engage into whatever behaviour seems most effective at the moment, regardless of what is considered appropriate for one sex or the other. A mixed or androgynous self-concept allows an individual to freely engage in both masculine and feminine behaviours (Bem, 1975). Therefore, these individuals are developing a wider range of behavioural patterns that make them more socially adaptable, efficient and healthy. Psychological androgyny may be the most desirable personality.

Sandra Bem constructed the Bem Sex-Roles Inventory (BSRI) which was based on a new concept of masculinity and femininity during 1970s and 1980s. Psychological androgyny emerged as a framework for the sex-type which is characterized by the equal number of traits defined by sex-typed standards of a desirable behaviour for men and women in the (American) society. She considered it to be healthier and more adaptable for a wider range of social situations. It was confirmed that the dimensions of masculinity and femininity are empirically, as well as logically, independent, that the concept of psychological androgyny is a reliable one and that highly sex-typed scores reflect a rather specific tendency to describe oneself in accordance with the self-typed standards of a desirable behaviour for men and women (Bem, 1974, 1975). Self-ratings on a list of personality traits enable classification into four groups: androgynous (high masculine/high feminine), masculine (high masculine/low feminine), feminine (low masculine/high feminine) and undifferentiated (low masculine/low feminine).

Bem confirmed the psychometric and theoretical properties of the BSRI that were brought into question later on and reassessed several times by other authors (Auster & Ohm, 2000; Hoffman &Borders, 2001), but were never rejected; on the contrary, they have been used widely. Later on, Sandra Bem conceptualized Gender Schema Theory where she emphasized a generalized readiness to process information on the basis of sex-linked associations that constitute gender schema. This is important because the self-concept itself gets assimilated to a gender schema (Bem, 1981).

B. Gender Identity Roles and Musicians

Psychological research shows that gender identity roles have a certain place in the personality profile of creative people, as well as musicians (Kemp, 1996). Kemp indirectly made conclusions about psychological androgyny of musicians by relying on his conclusions on the sex-identity ambivalence of musicians when compared to the general population, and this was also observed by other researchers before him. He reported a consistent pattern of gender differences in the following three age groups of musicians who were compared to the groups of non-musicians. Female musicians demonstrated significant trends towards aloofness (A-) and self-sufficiency (Q2), which are, according to social standards, considered to be typical of men; male musicians, on the other hand, had a very consistent presence of sensitivity (I), which is considered typical of women (Kemp, 1982). Kemp explained the results by using the concept of the androgynous person whose behaviour is moving freely from that typical of males to that of females, depending on the demands of various situations, also referring to the Bem's Sex-Typed Theory. Kemp interpreted psychological androgyny as a necessity for using a full range of cognitive, emotional and behavioural responses, regardless of socio-cultural expectations related to gender, in order to reach high creative and artistic accomplishments (Kemp, 1996).

Kemp applied the BSRI to a small group of musicians and his results showed that, when compared to the group of non-musician, female musicians were indeed both more masculine and feminine, while male musicians were found to be more feminine and less masculine. So, although the pattern of androgyny confirmed the earlier findings concerning women, this was not the case with men. Kemp tried to explain these results by the institution of a potential local atmosphere from which the participants originated (Kemp, 1996). His reasoning only confirms the high extent to which desirability of certain traits and behaviours influences a gender identity formation.

The fact that socio-culturally determined standards are relative and influence the sex-role types, was shown in a sample of Serbian adolescent musicians, where the obtained results were different from those obtained by Kemp. Female musicians were more sensitive (I+), group- dependant (Q2-) and outgoing (A+) in comparison to male musicians. It could be said that the pressure to conform to social norms is stronger than the standards of the profession, in this sample (Bogunović, 2010).

C. Biological Determinants of Musicians' Psychological Androgyny

It is agreed that there exists the intertwined influence of socialization and biological foundations of gender identity, but it seems that the range of the impact of both of these is not completely defined. To a certain extent, some relations could be made between Kemp's findings and the biologically founded research results (Hassler, 2000). It is confirmed that lower

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testosterone levels were linked to higher scores on feminine items. Hassler and Nieschlag (1989) expected musicians of both sexes to be psychologically androgynous and to have different testosterone levels to those of the sex-typed males and females. Salivary testosterone was measured in adults and adolescents. Creative musical behaviour in composers was associated with very low testosterone values in males, and high in females. Sexual activity levels and motivation did not differ between the males with testosterone levels ≤ 200 pmol/1 and those with testosterone levels >220 pmol/1. The authors tentatively suggest from their data that, among the complex interaction of biological and social factors, the optimal testosterone range may exist for the expression of creative musical behaviour. Exceeding this range in the course of adolescence may be detrimental for musical creativity in boys.

D. Research Background

Why is the issue of masculinity and femininity interesting for the researchers of the musicians' personality? Firstly, this is because of the previous research results of Kemp (1996), and also because of the data which speak about neurobiological basis of psychological androgyny and curiosity about a question: how is this feature imbedded into the personality of musicians and is reflected on the performance efficiency and artistic achievements? Why bring this theme up now, after more than 30 years? Society has changed and the standards and social concepts of typical gender identity roles changed and become more flexible, perhaps in the direction of new and more human standards of our behaviour, as Sandra Bem hoped. So, it was interesting to get back to the same concept again and try to determine whether the "old" gender roles are still valid and could they be clearly differentiated among the music students. The rationale was the investigation of gender identity roles of musicians, already identified by Kemp's personality research, but this time, a specified sex-typed inventory was applied to the sample of musicians. One of the aims was to envisage gender identity roles and, if possible, psychological androgyny in a wider context of personality dimensions on one hand, and professional, music performance context, on the other.

II. METHOD

The aim of the research was to investigate how gender identity and the Five-Factor Model of personality dimensions of young music performers relate to their success in music performance.

The sample consisted of 264 students, vocal-instrumental performers and students of theoretical departments (musicology, music theory, ethnomusicology, music pedagogy) at the Faculty of Music in Belgrade, who filled in the BSRI and NEO-P-R; 95 of the students were male and 169 female. A smaller sample of 182 students (47 males and 133 females) filled in the Questionnaire of musical achievements indicators.

Three groups of variables, while administrating three instruments, after regular lessons and with the consent of students have been measured:

The adapted version of the original BSRI was used, which was made on the assumption that there could be a discrepancy between the Serbian and the American sex-typed behaviour. The author counted on differences in socio-cultural backgrounds of these two cultures and, hence, the differences in standards relating to socially desirable behaviour for men and women (Vuletić, 1985). The masculinity and femininity scales were constructed in the same manner as in the Bem's research, but the traits estimated as socially desirable in the Serbian/Belgrade sample were used. In the adapted version, where the scales of masculinity and femininity include 15 traits typical of men and women and 16 traits of the social desirability scale, is unlike the original BSRI where all three scales consisted of 20 personality characteristics. The last scale primarily serves to provide a neutral context and is not used for calculating the scores on the masculinity and femininity scales. Traits were assessed on a 7-point Likert scale. By using the median-split method as a criterion, participants were sorted as masculine, feminine, androgynous, and undifferentiated. The reliability of the scales counted by the split-half method were r=0.61 and r=0.71. In our research, reliability measured by Cronbach's Alpha was 0.78 for the masculinity scale and 0.87 for the femininity scale.

The revised NEO Personality Inventory (NEO PI-R) was used to measure personality dimensions of the musicians. The participants rated 240 items on a scale of 1 to 5, which load onto the Big-Five personality dimensions (neuroticism, extroversion, openness, agreeableness and conscientiousness), each of which contains six facets (Costa & McCrae, 1995).

Participants filled out the Questionnaire of musical achievements indicators, formulated for the purpose of the study. The criteria for success in music performance were represented by objective measures: (a) the frequency of public performances at different levels of distinction (7 types) and (b) the frequency of participation and awards at different levels of competition (4 types), during the period of 11 to 14 years of vocal and instrumental tuition. Public performances and awards were first weighed according to their distinction and level of competition, and then the final scores were calculated. Students also rated self-perceived music success (7 points Likert scale). Finally, the composite measure was made: the Index of musical success (public performances, competitions). This measure was standardized (concerning the level of distinction), summed up and converted to Z scale.

III. RESULTS AND DISCUSION

A. Gender Identity of Musicians

Descriptive analysis of the data gathered by the adapted version of the BSRI showed interesting dispersion of results concerning four groups of sex-type roles (Table 1). Namely, androgynous and undifferentiated students are represented by the higher percentage in the both sample groups, male and female. A relatively lower percentage of those who had high scores on the femininity and masculinity scales alone has been identified. The percentage of androgyny corresponds to the findings in other research reports and spreads approximately between 30 and 40 per cent (Bem, 1974, 1975; Vuletić, 1985), whilst the number of the undifferentiated is higher in the sample of musicians. It is also noticeable that male musicians are less decisive in regard to the exclusively masculine attributes and female musicians less determined to choose feminine attributes for themselves. There are even more women who preferably choose masculine attributes. Although, the results of the previous study conducted 30 years ago on the sample of Serbian students who were not musicians cannot be compared to the sample of musicians (Vuletić, 1985). However, it is important to mention that, at that time, female students were more likely to identify with feminine and male students with masculine attributes. This was probably socially desirable, as well as strongly accepted under the social pressure to adopt the sex-typed behaviour. So, we could wonder whether the differences which were found in our sample of music students were influenced by the nature and the demands of music profession or by changes in social values and orientations. This is yet to be discovered in a future research which would include both samples and enable reliable comparisons. So far, we can say that there is an obvious grouping towards androgynous and undifferentiated sex-roles in our sample of music students and that there is a striking equality between masculinity and femininity in the both subsamples of male and female music students.

Table 1. Sample dispersion in the sex-type roles of the androgynous, masculine, feminine and undifferentiated.

Sex-type roles	Male students (N=95)	Female students (N=169)
Androgynous	30%	27%
Feminine	17%	20%
Masculine	16%	22%
Undifferentiated	37%	31%

B. Gender Identity and music Performance Achievements

We explored relations between the femininity and masculinity of music students and different objective measures of success in music performance, i.e., public performances, competitions, and composite Index of music success, as well as the self-perceived success in music. Due to the fact that our sample consisted of a relatively small number of male participants, we could only calculate the correlation (Pearson correlation 2-tailed) and not the regression analysis which would enable us to explore whether achievements in music performance could be predicted by masculinity, femininity and their interactions (i.e., androgyny). The results showed very clearly that music achievements measured by all the three objective indicators of music performance achievement (public performance, competitions, the Index of musical success) significantly correlate to femininity in male students, while any kind of sex-type role does not correlate to music success of female students.

Table 2. The correlations between masculinity and femininity of both male and female students and the measures of music performance success and self-perceived success in music

	Male (N=23)		Female (N=52)	
Music performance success	Masculinity	Femininity	Masculinity	Femininity
Index of music performance success	0.298	0.657**	0.101	-0.043
Public performance	0.277	0.699**	0.216	0.084
Competitions	0.239	0.472*	-0.068	-0.180
Self- perception of success	0.348	0.429	0.339*	0.323*

* $p<0.05$; ** $p<0.01$

How to understand these findings? It seems that being a biological male and having psychological feminine traits has to do with higher levels of musicianship, interpretation and aesthetic expression, all of which are the ingredients of high levels of musical performance. This dual identity profile enables young musicians to overcome the stereotypical bipolar masculinity *versus* femininity attitude and is necessary for reaching higher levels of artistic achievements. It could be said that "expressiveness" of women (understanding and dealing with emotions in oneself and others or having affective attitude) is complementary to the, so called, male "instrumental" orientation that is related to reaching the goals outside the process-goal interaction, and with the attitudes such as approval and respect. (Gill et al., 1987). This result partially coincides with the one reported by Bem (1975) concerning greater intellectual development of boys and girls (non-musicians, but highly capable) that is quite consistently correlated to the cross-sex-typing, i.e. with masculinity in girls and femininity in boys.

Interestingly enough, female students with pronounced masculinity or femininity perceive themselves as being more successful, although they are not more successful when objective indicators of music achievement (public performances and competitions) are taken into account. This finding supports the theoretical rationale that identity presents the result of individual perception of one's own attributes, in a framework of their professional environment, and not real achievements and is, therefore, socially constructed. In that way, it conducts individual's behaviour and feelings.

C. Personality Dimensions nad music Performance Achievements

The regression analysis was uses to determine if success in musical performance could be predicted by the Five-Factor model personality traits (Table 3). The results suggested that these personality traits are not related to objectively assessed music achievements. Self-perceived music success was, to a great extent, related to the FFM dimensions, i.e., only to neuroticism (β=-0.194), showing that music students with higher neuroticism perceive themselves as less successful in music performing. We analysed if this relationship is moderated by gender and found out that the observed relationship exists in

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the female subsample only (males R^2=0.077, F=0.633, p=0.676; females R^2=0.160, F=4.738, p=0.001). A closer examination of this result showed that only the facet of vulnerability to stress contributes to self-perception of music success (β=-0.394), saying that perceiving oneself as being less successful is probably due to the lack of self-esteem.

Table 3. Predicting the music performance success based on the Five-Factor Model of the entire sample

Indicators of music performance success	Adjusted R^2	F	p
Index of music performance success	0.003	1.114	0.355
Public performance	0.010	1.365	0.240
Competitions	-0.002	0.937	0.458
Self-perception of success	0.078	3.949	0.002

D. Personality Dimensions and Gender Identity

Canonical discriminant analysis was used to determine if the three types of sex-roles (androgyny, masculinity and femininity) in women and men could be differentiated in relation to the FFM personality traits. At first, we applied the analysis to the group of undifferentiated male and female students as well, but then chose to present the results for male and female participants with undifferentiated sex-role type excluded. The results were relatively similar but in this way we got finer differences between the masculine, feminine and androgynous groups of male and female music students with respect to the personality dimensions. The results showed that there are no significant discriminant functions which can differentiate between the three sex-types roles in the group of male musicians (statistical parameters of the first discriminant function: Wilk's λ=0.707, χ^2=14.929, p=0.135). So, androgynous, masculine and feminine male musicians cannot be differentiated by their personality dimensions.

When it comes to female musicians, canonical discriminative analysis resulted in two significant discriminative functions (the first function: Wilk's λ=0.674, χ^2=39.009, p<0.001; the second function: Wilk's λ=0.885, χ^2=12.060, p=0.017). The coefficients of canonical discriminative functions are shown in Table 4, while the centroids of the groups are presented in Table 5. The results suggest that androgynous females have higher scores on agreeableness, consciousness, neuroticism, and extraversion than masculine females. Androgynous females do have support in their personality profile that certainly shows the "expressive" female characteristics (warmth, compliance, emotions) and the "instrumental" characteristics of men (dutifulness, order, achievement striving). However, higher neuroticism shows that being dual in identity has its "price". Interestingly enough, none of the three sex-role type are related to the dimension of openness which primarily has to do with imagination, aesthetic experiences and feelings, i.e., to inner receptivity.

Table 4. Canonical discriminative functions' coefficients (females)

Five Factor Model dimensions	Function	
	1	2
Neuroticism	0.679	0.742
Extraversion	0.533	-0.138
Openness	-0.261	0.029
Agreeableness	0.889	0.236
Conscientiousness	0.634	-0.458

Table 5. Group centroids (females)

Groups (females)	Function	
	1	2
Androgynous	0.551	-0.275
Feminine	0.114	0.552
Masculine	-0.749	-0.164

The second discriminant function is defined by higher neuroticism and lower conscientiousness, which is typical of feminine female musicians as opposed to those who are androgynous or masculine. If we take into account the results showing that more vulnerable female musician perceive themselves as being less successful in music performance, we can conclude that feminine female musicians have more psychological difficulties in the field of self-esteem, they perceive themselves as less successful, and they are more emotionally instable and vulnerable to stress. Lower scores on conscientiousness in combination with higher neuroticism in these musicians have probably a lot to do with lower self-esteem and aspirations while several facets of this dimension are related to striving to achievements, competence and self-discipline.

There are studies carried out among general population, which confirmed the relationship between gender role identity, on one hand, and neurotic symptoms and well-being, on the other. Namely, some results regarding gender role differences, apart from musicianship, point out that gender role socialization has been discussed as a risk factor for the symptoms of depression in women who are forced into a stereotypical feminine role after their marriage (according to Lee, 2004). A relatively newer validation study of the Bem's concept of socially desirable expectations in terms of sex roles showed that female, rather than male respondents, were more likely to believe that society's traditional gender expectations persist in terms of the desirability of particular traits "typical of women" (Austel & Ohm, 2000). There are findings that claim that due to the social changes, women's self-ratings on masculinity have been slowly increasing. In other words, masculine traits are seen as desirable for both men and women (Austel & Ohm, 2000). Further on, a meta-analytic study and a prospective study concluded that only masculinity is related to well-being (Barett & Raskin, 2002).

IV. CONCLUSION

The findings implicate that gender identity has its role in attaining the complexity and sensitivity of artistic creation, which is then positively related to higher accomplishments. Also, gender identity, as well as certain personality traits, could be an important cue for self-perceived music performance. Basically, results of Kemp (1996) were confirmed, in a sense that the significantly different pattern of personality traits in men and/or women is identified when it comes to gender identity. What the results show, further on, is the interweaving of gender identity and personality, and how these personality characteristic affect continuous musical success. The non-stereotypical gender identity roles of both sexes seem to play an important part in music performance, because of the wide range of cognitive, emotional, social and personal challenges that music performers are faced with. The findings give an incentive for continuing the research in the given direction, especially by using a larger sample of male participants in order to gain more reliable results, and, particularly, in order to be able to directly test the hypothesis regarding the relationship between psychological androgyny and musical performance. It would also be worthwhile to compare musicians and non-musicians in terms of their results on the BSRI scale. With these results we could get a more definite answer regarding the degree and manners that professional experience and socio-cultural field are related to the development of sex-typed roles and gender identity of musicians. Certainly, the picture gets more intriguing when biological foundations of androgyny are taken into account.

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Intelligence and mode preference

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ABSTRACT

Background

The major/minor dichotomy is one of the most important in Western music. The majority of classical music was composed considering a particular mode and almost all of the popular music from every epoch was based on that dichotomy. The association between major/minor mode with the perception of happy/sad emotions has been extensively investigated in the past. In more recent times the basic role of bimodal musical mode in the human perception, distinguishing different kind of chords (Cook, 2002), relating major/minor mode to emotions (Costa, 2013; Lahdelma & Eerola, 2014) and founding elements of musical mode in the human voices (Bowling, 2013; Curtis & Bharucha, 2010).

The relationship between intelligence and music has been explored in four main directions: (a) the distinctive role of musical intelligence in the framework of Gardner's multiple intelligence theory (Gardner, 1983); (b) the relationship between general intelligence and auditory discrimination; (c) the possible contribution of music training in developing intelligence in non-musical domains; (d) how intelligence modulates music fruition and music preference.

Another approach originates from the studies that have explored the connections between sensory discrimination and psychometric intelligence (Deary, 2000).

In this study the preference for major-minor mode was associated to the level of fluid intelligence measured by a subset of the Raven's Advanced Progressive Matrices Test (APM) (Raven, 1994; Raven, Raven, & Court, 1993; Raven, Raven, & Court, 1998). This test provides a measure of higher-order general mental ability and it is not very cultural dependent.

Connections between uses of music and established personality have been investigated by Chamorro-Premuzic, Gomà-i-Freixanet, Furnham and Muro (2009). They found that individuals higher in Neuroticism were more likely to use music for emotional regulation (influencing their mood states), those higher in Extraversion were more likely to use music as background to other activities, and those higher in Openness were more likely to experience music in a cognitive or intellectual way. Self-estimates of intelligence were also linked to cognitive use of music.

Aims

The aim of this study was to investigate a possible association between preference for the minor mode and the level of general (fluid) intelligence.

Method

Seventy-seven females (mean age: 21.98 ± 5.15) and 19 males (mean age: 21.57 ± 1.80) university students participated in the study.

Intelligence was assessed by a subtest of the Advanced Progressive Matrices (APM) (Raven, Raven, & Court, 1998). In order to control if the preference for the major or minor mode was related to a contextual mood or to specific dimensions of personality, the *Brief Mood Introspection Scale* (BMIS) and *Ten Item Personality Inventory* (TIPI) were also administered.

Mode preference was assessed presenting 20 pairs of musical stimuli that varied for mode only: major versus minor.

The stimuli were not part of known musical composition and were composed by the first author according to these criteria: a) time duration from 2-10 s; b) presented with a flute synthesised timbre in order to minimise the contribution of harmonics and to emphasise the fundamental tone; c) the flute timbre allowed a legato between the notes and avoided an emphasis on rhythmic percussion in the transition between notes; d) stimuli were composed by isochronous notes (same duration).

Results

The scoring of mode preference was performed assigning positive values in case of major mode preference (from 1, slightly preference to 5, extreme preference), whereas for minor mode preference scores were converted to negative values (from -1, slightly preference to -5, extreme preference).

The correlation between the Raven's APM subtest score and mode preference was $r = -0.38$ ($p < 0.0003$). Furthermore a generalised mixed multiple linear regression model was used. Mode preference was entered as dependent variable.

Independent variables were: Raven's APM subtest score, the five dimensions of the TIPI (*Ten Item Personality Inventory*), all the mood scales from the BMIS (*Brief Mood Introspection Scale*), and Sex. The model was significant: Adjusted $R^2 = 0.19$, $F(23, 61) = 1.86$, $p < 0.02$. The significant predictors were: Raven's APM subtest score ($t = -2.48$, $p < 0.05$, ß = -0.29), Conscientiousness ($t = 2.35$, $p < 0.05$, ß = 0.28), Gloomy ($t = -2.45$, $p < 0.05$, ß = -0.40). Sex was not significant. Subsequently we tested a linear model including only the significant predictors: Raven's APM subtest score, Conscientiousness and Gloomy. This model had an Adjusted $R^2 = 0.24$.

Moreover a significant negative correlation emerged between Conscientiousness and the Raven's APM subtest score: $r = -0.26$, $p < 0.01$.

Conclusions

The results of this study show a significant and positive association between the preference for the minor mode and the level of fluid intelligence. The connection was mainly explained considering the simpler stimuli consisting of chords, either harmonically or melodically presented.

The preference for the minor mode by more intelligent individuals could be ascribed to a possible link between intelligence and preference for more complex stimuli. In fact minor stimuli could be considered as more complex than major ones because considering the order of the harmonic series and considering the mathematical pitch ratio. The major third has a pitch ratio of 5:4, while the minor third has a pitch ratio of 6:5. According to this hypothesis intelligent individuals would prefer stimuli that, on a sensorial level, exhibit more complexity. In this context complexity was intended as the difficulty in the perceptual elaboration and not in the more usual macro sense of music with richer harmonic, timbre, melodic, rhythmic variety. Rentfrow and Gosling (2003) showed that more intelligent individuals preferred "reflective and complex" genre of music (which included classical, jazz, blues, and folk), but they also preferred "intense and rebellious music". Less intelligent individuals preferred upbeat and conventional music. Chamorro-Premuzic and Furnham (2007) found that more intelligent individuals are more likely to use music for cognitive purposes. Intelligence, on the contrary, was not correlated with the emotional use of music. Beyond complexity it should be emphasised that the chord typology has also a qualitative facet. Cook (2002) and Fujisawa and Cook (2011), using a fMRI approach, have found distinct brain activations for resolved (major and minor) and tension chords (augmented and diminished), underlining the qualitative difference between these two categories.

The negative correlation between intelligence and Conscientiousness mirrored previous results found by Moutafi, Furnham, and Paltiel (2004). This relationship in particular emerged considering abstract reasoning (fluid intelligence), and not verbal reasoning (crystallized intelligence) (Moutafi, Furnham, & Crump, 2003).

In this paper intelligence was combined with preference for the minor mode and future research is needed to better understand the causal model underlining this association. It would be interesting to explore if this association is valid for fluid intelligence only or for other intelligence types (i.e.: linguistic, spatial, bodily-kinesthetic, interpersonal, and intrapersonal). Furthermore it should be clarified if intelligence would impact preferences in structural aspect of music other than mode, such as tolerance to dissonance, atonality, timbre complexity.

Keywords

Major mode, Minor mode, Intelligence, Raven, Advanced Progressive Matrices

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Perceptual coherence predicts consonance-dissonance and influences listeners' cognitive and affective responses to music

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ABSTRACT

Background

Applying the principles of Auditory Scene Analysis (Bregman, 1994), Bonin (2014) demonstrated that various psychoacoustic manipulations can be used to reduce the dissonance elicited by atonal music. Timbrel and spatial psychoacoustic manipulations that increased the music's perceptual coherence reduced the experience of dissonance while those manipulations that decreased the music's perceptual coherence exacerbated the experience of dissonance. Critically, the effects of these manipulations occurred without any ancillary changes to the notation, tonality, or performance of the music.

These results indicate that the continuum of consonance and dissonance might not only rely on the cultural and sensory constraints of musical processing, but also relate to the multidimensional psychoacoustic parameters and perceptual coherence of musical sounds. This interpretation was termed the *Source Dilemma hypothesis* and predicts that dissonance arises when musical stimuli exhibit psychoacoustic properties that lead to incoherent perception of the auditory environment, while consonance arises from musical stimuli exhibiting psychoacoustic properties that lead to coherent perception of the auditory environment.

Aims

The present report addressed two primary research interests. First, we sought to replicate the Bonin (2014) findings that timbrel and spatial psychoacoustic manipulations influence the consonance and dissonance of musical sounds. In doing so we hoped to extend the generality of this observation by using a novel stimulus set. Second, we investigated a corollary prediction of the Source Dilemma hypothesis: If dissonance accompanies incoherent auditory perception, then one might expect dissonant music to require greater cognitive processing than consonant, perceptually coherent music.

We tested these predictions with three experiments that measured participants' affective and cognitive responses to musical stimuli differing in their perceptual coherence. In each experiment, we selectively manipulated one of the music's harmonic, timbrel, or spatial characteristics to create coherent and incoherent musical counterparts. We expected that the incoherent musical stimuli would be perceived as more dissonant and interfere to a greater extent with performance on a concurrent cognitively demanding task than the coherent musical stimuli.

Method

Each of the three experiments consisted of three blocks. In each block, participants completed a cognitively demanding task (the visual 2-back task; 2500ms SOA, 20% target rate) presented on a 24" Phillips 244E monitor (1920x1080, 80pt Helvetica font) while listening concurrently over stereo headphones (Sony MDR-MA100) to no music, coherent music, or incoherent music. The no music condition served as a practice block and was always presented first, while the order of the music blocks were counterbalanced between participants.

The musical stimuli were derived as "coherent" and "incoherent" counterparts that differed only in the psychoacoustic parameter of interest for that experiment. In Experiment 1, participants (n=48) listened to no music, tonal (harmonic), or atonal (inharmonic) music. In Experiment 2, participants (n=68) listened to no music, atonal music exhibiting timbrel coherence (2 segregated timbres), or atonal music exhibiting timbrel incoherence (1 fused timbre). Finally, in Experiment 3, participants (n=69) listened to no music, atonal music exhibiting spatial coherence (2 segregated spatial locations), or atonal music exhibiting spatial incoherence (1 fused spatial location). Participants' performance on the concurrent 2-back task was analyzed both in terms of accuracy and response times. After each block in which music was presented, we asked participants to rate the music they had just heard in terms of "pleasantness," "unpleasantness," "consonance," and "dissonance" on a 7-point Likert scale.

Results

As expected, perceptual coherence predicted the listeners' consonance-dissonance ratings of the musical stimuli in all three experiments. The cognitive interference data revealed an unexpected effect of our psychoacoustic manipulations and provided only partial support for our predictions. Consistent with our predictions, in Experiment 1 we found that incoherent atonal music interfered to a greater extent with cognitive performance on the 2-back task than coherent tonal music. Surprisingly, however, we found in Experiments 2 and 3 that the timbrelly and spatially coherent atonal musics imposed greater cognitive loads on the listener than their incoherent counterparts despite the fact that they were rated as less dissonant and unpleasant.

In Experiment 1, participants rated the atonal music as more dissonant, more unpleasant, less consonant and less pleasant than the tonal music (all $t(1,47) > 2.5$, all $p < 0.01$). Furthermore, consistent with our second hypothesis, atonal music also led to slower response times ($t(1,47) = 5.7$, $p < 0.001$) and less accurate responses ($t(1,47) = 2.8$, $p < 0.01$) on

the concurrent cognitively demanding task compared to tonal music. These results are consistent with the findings of Masataka and Perlovsky (2013) that dissonant music leads to slower and less accurate performance on incongruent Stroop trials compared to consonant music, but are at odds with the Bodner, Gilboa and Amir (2007) findings that dissonant music enhances performance on cognitively demanding tasks relative to consonant music.

In Experiment 2, participants rated the atonal music exhibiting timbrel coherence as less dissonant and less unpleasant than the atonal music exhibiting timbrel incoherence (all $t(1,67) > 2.2$, all $p < 0.05$). Surprisingly, however, the atonal music exhibiting timbrel coherence interfered to a greater extent with performance on the concurrent 2-back task than did the atonal music exhibiting timbrel incoherence, eliciting slower ($t(1,67) = 2.6$, $p < 0.01$) and less accurate ($t(1,67) = 4.8$, $p < 0.001$) responses.

Mirroring the effects observed in Experiment 2, participants in Experiment 3 rated the atonal music exhibiting spatial coherence as less dissonant and less unpleasant than the atonal music exhibiting spatial incoherence (all $t(1,68) > 3.2$, all $p < 0.002$). However, again in contrast with our predictions, the spatially coherent atonal music led to slower ($t(1,68) = 1.8$, $p < 0.05$) and less accurate ($t(1,68) = 4$, $p < 0.001$) response times on the cognitively demanding 2-back task than did the spatially incoherent atonal music.

The unexpected (and reversed) cognitive interference effects between the timbrelly and spatially coherent stimuli and their incoherent counterparts produce several interesting implications. First, they are in contrast to the corollary prediction of the source dilemma hypothesis that more dissonant music should require greater cognitive processing than less dissonant music. Such results indicate that participants found the perceptually coherent musics more consonant and enjoyable despite the fact that the brain was working harder to process them. Additionally, these results, in conjunction with those from Experiment 1, indicate more generally that the cognitive demands of musical stimuli are not sufficiently predicted by the affect that they induce (i.e., that it is not simply the case that atonal musics are difficult to process because they induce negative affect).

It remains to be determined from where this additional cognitive load arises in the timbrelly and spatially coherent atonal musics in Experiments 2 and 3. One possibility is that the segregated timbres and spatial locations in these stimuli produced a divided attention requirement that the fused timbre and spatial location did not, and that this requirement overshadowed any nuanced differences in the cognitive demands produced as a function of perceptual coherence.

Consistent with this possibility is a recent publication from Demany, Erviti and Semal (2015), demonstrating that attention can be divided between segregated musical tone streams, and that response sensitivity declines as divided attention requirements increase. Future empirical studies could address this issue by investigating the interactive influence between perceptual coherence and divided attention on cognitive processing demands.

Conclusion

We conclude that perceptual coherence readily predicts the perception of dissonance across a variety of psychoacoustic manipulations. Based on our results, however, the relationship between consonance-dissonance and cognitive processing demands remains unclear and requires further empirical investigation. Our results provide what we hope are compelling insights regarding the consideration of multidimensional psychoacoustics in dissonance research.

Keywords

Dissonance, Psychoacoustics, Tonality, Auditory Scene Analysis, Cognition, Interference, Emotion

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The beginners' methods in piano education: Evaluation of motivation and learning in an Italian sample

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ABSTRACT

Background

The piano methods used in Italy proposed practice strategies and performance models related to different teaching traditions or based on the excellence of a methodology founder. The first piano book establishes an important relationship with the instrument, leaving a long lasting impression. In recent decades, beginners' piano methods acquired a more appealing publishing format, with respect to the past, especially for younger students. Nevertheless the pleasantness of the graphic layout does not always correspond to an innovative and efficient didactic support. Although the model of knowledge based on cumulative processes is considered obsolete, the teaching experience proposed by most of these initial methods still maintains the aspect of a repetitive and standardized training, which produces boredom, making this first important training period tiring or unproductive.

Aims

A deeper understanding of the initial methods can show what the abilities are and the learning strategies proposed, what are the factors that determine the real methodological value of these books and what are the opinions of the pianists. The following study attempts to highlight abilities, competences, and learning strategies adopted and developed by the pianists of the sample, and those not considered. Moreover, it underlines the information that could improve the existing methods advising the research for new methods and introducing relevant methodology principles such as motivation and adequacy to pedagogical and musical purposes.

Method

This study is based on the outcome of a survey administered to 200 pianists, age between 20 and 60 and selected in relation to specific prerequisites which allowed to consider their opinions reliable. The pianists of the sample have completed their musical studies and maintained a good relationship with their instruments, according to what they expressed themselves on this matter without meeting with prejudices caused by negative musical experiences or by atypical circumstances. The questionnaire posed the following types of questions:

- Generic personal data, related to three age ranges defined as born before 1970, born between 1970 and 1985, and born after 1985;
- Data related to the age when piano study began;
- Data related to the method (author, title, city in which this was used);
- Opinions related to the possibility of improvement of the method utilized by adding appendixes, prefaces, attached materials or support on CDs;
- Reporting memories and personal sensations that define aspects of the method used, either positive or negative, which have left clear and motivated impressions.

Results

Data suggests a relevant preference of five beginning methods, which have been analysed according to a series of methodological and analytical criteria. The views expressed by the pianists were divided into four categories: absence of views, methodological, technical/gestural, aesthetic opinions. The great majority of the sample expressed positive opinions, supporting them with methodological arguments and considered their "first book of piano" useful. The majority of the pianists born before 1970 were trained under the *F. Beyer* method, which progressively lost its preeminence in favor of other choice of methods that became available in the subsequent generations. In fact, the pianists born between 1970 and 1985 experienced an increase of accredited historical methods like *Mikrokosmos* by Bela Bartok and the *Russian Method.* In the group of pianists born after 1985 there was a significant decrease of all the historical methods and an important increase in the variety of methods chosen, certainly linked to a richer and more varied publishing activity in the last 20 years. This diversification of the editorial market for methods seems to affect Northern Italy more than Southern, where the historical methods (Bartok, Cesi-Marciano, Russian Method) show higher values.

Conclusions

The five most utilized methods propose learning strategies which are substantially finalized to reading music and to learning basic gestures, neglecting fundamental competencies such as the use of the voice, musical ear, creativity, and ability to transpose and to improvise. The approach to teaching technical gestures shows lack of information and disinterest in the most recent methodological and pedagogical studies. The majority of pianists of the sample believe that the methods used have been effective for methodological reasons: this may explain, at least in part, an evident resistance to methodological renewal and a resilience of outdated or inadequate methods. Over the past 20 years, the methodology for beginners in Italy seems to have undergone a period of disorientation due to the loss of historically accredited guidelines, evidently inadequate, and to be engaged in a process of renewal and search for new solutions able to satisfy new educational and pedagogical needs. The study contributes to the debate on the renewal and the improvement of piano methodology through two perspectives: the development of new repertoires for beginners and the proposal of new methodologies that are able to respect the needs and the emotional world of piano beginners.

Keywords

Piano education, beginners' methods, learning, motivation.

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"You can count on me" Effects of prosocial music on the affective and cognitive aggression level

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ABSTRACT

Background

There is comprehensive research about the "harmful" effects of aggressive song lyrics and songs with violent content (e. g. Anderson, Carnagey & Eubanks, 2003), but little is known about prosocial music. Only some studies by Greitemeyer (2009a, 2009b, 2011) considered the possibility that music with prosocial lyrics is able to enhance empathy, altruism and decrease hostile feelings. While aggressive content increases aggressive thoughts, feelings and behaviour it is interesting to know, whether prosocial content decreases such effects.

Aims

The primary purpose of this study is to investigate the effects of prosocial music on the aggression state. Through the General Learning Model by Anderson and Buckley (2006) the capability for empathy (Hall, 1984) and the studies by Greitemeyer the following hypotheses are conducted:

H1/H2: After the reception of a song with prosocial lyrics the recipients experience less aggressive thoughts/feelings than recipients who listened to a song with neutral lyrics.

H3/H4: After the reception of a song with prosocial lyrics the female recipients experience less aggressive thoughts/feelings than the male recipients.

Method

An online-based experimental 2x1 between-subjects design was used to compare the influence of prosocial respectively neutral song lyrics on the aggression level ($N = 381$, $M = 22.36$ years old, 52% female). Therefore pairs of songs by the same artists were rated by music experts and students in a first study. The best known, most liked pair of songs with the biggest difference in the received prosocial content was taken as the experimental stimulus (Bruno Mars - "Lazy Song" and "Count On Me"). Furthermore the songs were comparable in terms of evoked arousal, length, instrumentalization and good lyrics comprehension.

Independent variable was the prosocial and neutral content of the songs. The most important dependent variables were the accessibility of aggressive thoughts (1) and aggressive feelings (2). The first construct was measured by a Word Completion Task (Anderson, Carnagey & Eubanks, 2003), whereas Schwenkmezger, Hodapp and Spielberger's (1992) STAXI inventory was used for the investigation of aggressive feelings. For example, the word fragment "sch___" could be completed with a neutral word like "schlafen" (engl.: to sleep) or with an aggressive word like "schlagen" (engl.: to hit). The Intercoder-reliability (.95) and Intracoder-reliability (.98) were very good.

Results

H1 can be confirmed. Recipients of prosocial songs used less aggressive words than the recipients of neutral songs ($t(379) = -2.69$, $p = .01$, $d = .28$). The participants in the experimental group (prosocial lyrics) completed 17% of the word fragments with an aggressive meaning. In the control group there was an average value of 13%. The results did not support the expectation that aggressive feelings are decreased through the reception of prosocial music. Thus, H2 must be declined ($t(379) = -1.37$, $p =$ ns.). Besides that, these data support the view that women experienced less aggressive thoughts than men ($t(194) = -2.40$, $p = .02$, $d = .31$). Hence H3 can be confirmed. However, the results reveal no significant difference between men and women in terms of experienced aggressive feelings ($t(194) = .625$, $p =$ n.s).

Conclusions

There is a small effect on the cognition when recipients listen to prosocial music. As the General Learning Model postulates the prosocial lyrics are a key stimulus that triggers prosocial thoughts and suppresses aggressive thoughts. However there is no effect on aggressive feelings. Furthermore on the basis of the results of this research, it can be concluded that women experienced less aggressive thoughts (after listening to prosocial lyrics) than men. But there is no significant difference in terms of experienced aggressive feelings. It is possible that the happy melodies and harmonies in both songs dominate the effects on the feelings. This aspect should be investigated in future studies. Furthermore it is interesting to know, whether there are any long-term effects of the reception of prosocial music or whether the reception has an effect on the social behaviour in common situations. In addition the study provides some practical implications: As more and more charity organisations utilize famous artists for their campaigns, it may be important to analyse, whether their (prosocial songs) would underpin the appeal of the campaigns in terms of promoting prosocial thoughts or reducing aggressive thoughts. Such cooperations could also be a chance for artists, who wish to improve their image or just want to aim publicity.

Keywords

Prosocial, aggression, lyrics, popular music, experimental, empirical musicology, music and emotions, social psychology of music

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The influence of personality, experience and gender on the subjectively perceived effect of music while gaming

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ABSTRACT

Background

Few studies have examined the impact of music while gaming. Experimental research studies investigated effects of music on immersion and the aesthetic perception of the virtual environment of games (e.g. Lipscomb & Zehnder, 2004), on performance in Racing games (e.g. Cassidy & McDonald, 2008, 2009, 2010; North & Hargreaves, 1999), and on emotions such as fear (e.g. Yamada, 2008). Besides methodological short comings of those studies general statements about the influence of music on the gaming experience are not possible, because a) only a specific game of one genre was played and b) music was chosen by experimenter based on different criteria. Furthermore individual factors like experience with video games and personality and their effects on how music is perceived were predominantly ignored. In a first study a questionnaire, which based on a pool of 146 Items about the general use, relevance of music while gaming and its effects was constructed via factor- and scale-analyses. The scales could be validated by two pre-studies (Bötsch, 2014; Bötsch, I., von Georgi, R. & Bullerjahn, C., 2014a; Bötsch, I., von Georgi, R. & Bullerjahn, C., 2014b).

Aims

This study at hand investigates the influence of experience with video games, gender and personality on subjectively perceived effects of music during gaming. Furthermore it was assumed that gender covaries with experience, because male gamers often got a higher expertise than female gamers.

Method

200 students (108 female, 92 male; M=24.2; SD=4.9) with an average gaming experience of 8.5 years (SD=5.6) completed questionnaires on personality (PANAS-d; SKI) and on subjectively perceived effects of music while gaming (CamQ), which consists the following scales: *perceived effect* (PE) (α=0.93), *disturbance of concentration* (DC) (α=0.89), *personal music preference* (PM) (α=0.90) and *game-external relevance of soundtracks* (ER) (α=0.85). The hypotheses were tested by multiple regression and covariance analysis. The significance level was set at α=0.05.

Results

The results show that the subjectively perceived concentration-disturbance by music is influenced by neuroticism (β=0.198; p=0.01). *Game-external relevance of soundtracks* is influenced by orderliness (β=-0.233; p=0.02). Regression analysis showed that experience with video games affects the perceived impact of music (β=0.220; p=0.001). Results of the regression analyses can be found in table 1.

Tabel 1: Overview of the results of the regression analyses (standardised beta-coefficients)

Method	Scales	PE	DC	PP	ER
PANAS	PA	0,115	-0,078	0,127	0,047
	NA	0,025	0,198 **	0,007	0,087
SKI	Ego-Strenght	0,033	-0,146	0,069	0,042
	Attractiveness	0,074	0,188	-0,069	-0,020
	Confidenceness	-0,026	-0,011	0.096	-0,054
	Orderliness	-0,102	0,097	-0,069	-0,233 ***
	Enforceness	0,088	-0,059	0,118	0,055
Experience	Experience (in years)	0,220 **	-0,062	-0,210 **	0,140

PANAS: Positive and Negative AffectSchedule (Krohne et al.: 1996); SKI: Selbstkonzeptinventar (von Georgi & Beckmann: 2004); PE: perceived effects; DC: disturbance of concentration; PP: personal music preferences; ER: game-external relevance of soundtracks; *. p≤0,05; **. p≤0,01; ***. p≤0,001;

Covariance analysis showed clear main effects of gender (p=0.001) and experience (p=0.002). However there was no significant difference depending on the grade of experience for concentration-disturbance. The interaction of gender and experience was significant (p=0.029) and showed significant results for the scales *perceived effect* (p=0.044) and *game-external relevance of soundtracks* (p=0.07) (see table 2).

Table 2: Results of the covariance analyses

Test	p(MANKOVA)			Scales	p(ANKOVA)			G	
	G	E	GxE		G	E	GxE	m	f
CamQ	0,001	0,002	0,029	PE	,001	,002	,044	31,39	26,86
				DC	,019	,104	,123	19,67	22,13
				PP	,037	,023	,281	23,81	26,49
				GR	,001	,034	,007	16,10	12,68

MANKOVA: Multivariate covarianz analysis; ANKOVA: Univariate covariance analyses; p: Level of significance (Pillai-Spur); G: mean effekt gender; E: mean effect experience; GxE: Interaction effect gender x experience; m: mean male; w: mean female; CamQ: Computer and Music Questionaire; PE: perceived effects; DC: disturbance of concentration; PP: personal music preferences; ER: game-external relevance of soundtracks; N: 89 male; 100 female

Conclusions

It seems that emotional lability modulates the ability to concentrate on gaming while listening to music. However modulation of arousal by music seems to be unimportant. Gamers with expertise seem to be more unconcerned in general. Gender and experience seem to be important moderating variables: male gamers seem to be more sensitive for music in games. The present study shows that the perceived effect of music depends on individual factors, which should be considered in further research.

Keywords

Music, video games, personality, gaming, gender

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Exploring the presence, experience and influence of background music in gambling situations

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ABSTRACT

Gambling is a leisure activity, sometimes accompanied by background music. Studies suggest that background music can influence behaviour in a range of everyday contexts including gambling situations. However, further investigation is required to determine which psychological mechanisms may underlie such effects, how music is currently used in gambling environments, the character of gamblers' experiences of music and their music listening habits. This paper explores the presence, experience and influence of background music in gambling situations from different perspectives, using a mixed-methods approach. Subjective opinions and objective evidence was gathered within three studies: (1) interviews with casino managers, (2) an online questionnaire administered to gamblers and, (3) a laboratory experiment. Studies One and Two identify the functions that music serves within a range of gambling situations. Music enhances the gambling experience, with factors including control, musical preferences and mood being implicated in the way that gamblers and gambling-operators utilise music. The manipulation of music tempo was previously thought to quicken betting speed in laboratory virtual roulette gambling. However this hypothesis was not confirmed when Study Three examined the effect of music tempo alone on betting speed. Therefore there appears to be some circumstances under which the effect of music tempo does not operate, leading to the conclusion that the effects of music characteristics on betting speed may be combinatorial. This research has extended the current understanding of music in everyday life to gambling and the results have implications for the way that music's effects on behaviour are investigated in future research.

I. BACKGROUND

There is a body of research which suggests that background music is present and influences a range of behaviours within retail and commercial environments (see North & Hargreaves, 2008 for a review). Gambling is a suitable paradigm in which to explore music's effects on behaviour as it is a popular leisure pursuit which requires individuals to use a range of psychological processes including attention, judgement, memory and decision-making. Music in gambling contexts can be considered as both a situational characteristic (i.e. helps to attract gamblers to a gambling environment) and a structural characteristic (i.e. induces individuals to begin or continue to gamble) (Griffiths & Parke, 2003). Research suggests that background music often features within the design of gambling activities (Bramley & Gainsbury, 2014) and environments (Griffiths & Parke, 2005), therefore it appears that individuals are exposed to music when gambling. However, at present the investigation of which music accompanies gambling and whether it can influence gambling behaviour has been somewhat limited in terms of the environments and gambling activities studied.

The consideration of music's influence on gambling behaviour in real-life situations has been limited to one activity – slot machine gambling. In an amusement arcade Griffiths and Parke (2005) found that gambling-operators used music to demarcate different areas and chose music to appeal to the clientele's musical preferences. Therefore gambling-operators seemingly make decisions about which music to play and where, however it is not yet clear whether music is presented to gamblers in similar ways across different gambling environments or why certain music is played. Researchers have hypothesised that background music may initiate, maintain or reinforce gambling behaviour (Griffiths & Parke, 2005), although currently no objective evidence exists to either support or refute this idea.

Within real-life gambling environments gamblers may opt-out of listening to gambling-operator selected music by listening to music of their own choice. A recent survey conducted by Parke *et al.* (2012) found that online gamblers reported that one of the "best things" about internet gambling was "doing something simultaneously" such as playing whilst listening to music of their own choice. To date, this music listening behaviour in relation to gambling has not been widely acknowledged, despite self-selected music accompanying other everyday activities including housework, running, cycling, desk work (Sloboda, 1999), driving (Dibben & Williamson, 2007), when travelling (Heye & Lamont, 2010) and whilst at work (Haake, 2011). Self-selected music can serve a number of functions – provide enjoyment (Heye & Lamont, 2010), pass time (North, Hargreaves, D.J. & Hargreaves, J.J., 2004), create the right atmosphere (North et al., 2004), create or accentuate an emotion (North et al., 2004), aid concentration (Dibben & Williamson, 2007) and relaxation (Dibben & Williamson, 2007). Therefore it is possible that self-selected music serves similar functions for gamblers, given that there are cognitive, emotional and behavioural aspects of gambling (Orford, 2011). However, more research is needed to understand the motivations for listening to self-selected music whilst gambling and whether this type of music can support the psychological processes associated with gambling.

Research which has investigated music tempo's effects in non-gambling domains suggests that there is a link between music tempo and the rate at which certain behaviours are performed. The manipulation of tempo can increase the speed at which certain behaviours are performed including eating (Roballey et al., 1985), drinking (McElrea & Standing, 1992),

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moving through a supermarket (Milliman, 1982) and reading (Kallinen, 2002).

There is evidence that effects of tempo, as observed in retail and commercial environments may transfer to certain gambling behaviours. Noseworthy & Finlay (2009) found that fast tempo music led slot machine players to underestimate the time they had spent gambling. Mentzoni, Laberg, Brunborg, Molde and Pallesen (2014) found that slow tempo music led participants to place more bets and fast tempo music led to quicker reaction times during a simulated card game. Three studies have found that fast tempo music leads to quicker betting in laboratory virtual roulette (Bramley, Dibben & Rowe, 2014; Dixon, Trigg & Griffiths, 2007; Spenwyn, Barrett & Griffiths, 2010). Roulette is a game of chance, and during play gamblers bet and receive feedback at a regular rate (Orford, 2011). However, the claim that effects on betting speed in laboratory virtual roulette can be attributed to tempo alone is somewhat open to challenge. One reason why is because tempo appears to have been operationalised with insufficient rigor. For example, a common feature within the three studies discussed above is that different pieces of music were utilised for each condition, therefore it appears that the musical stimuli differed in parameters additional to just tempo (Bramley et al., 2014; Dixon et al., 2007; Spenwyn et al., 2010). As a result there is no reliable evidence to suggest that musical stimuli which differs by tempo alone influences speed-related behaviours in laboratory virtual roulette gambling.

The theorisation of the psychological mechanisms which underlie music tempo's influence on betting speed in laboratory virtual roulette also remains speculative. Arousal has been hypothesised as mediating music tempo's effects on betting speed in laboratory virtual roulette (Dixon et al., 2007; Spenwyn et al., 2010), following the suggestion proposed by Berlyne (1971) that music which is fast or loud has more arousal potential and increases in arousal may lead to faster physical movement. A number of studies have shown that fast tempo music can increase listeners' heart rate (Coutinho & Canglosi, 2009; Gomez & Danuser, 2007; Bernardi, Porta & Sleight, 2006) and skin conductance level (Coutinho & Cangelosi, 2009; Gomez & Danuser, 2007; Carpentier & Potter, 2007). Furthermore, a study which measured arousal changes when exercising and simultaneously listening to music that differed in tempo found that fast tempo music increased heart rate and led to higher treadmill speeds (Edworthy & Waring, 2006). Listeners' subjective arousal can also be increased by fast tempo music (Balch & Lewis, 1996; Husain, Thompson & Schellenberg, 2002). Therefore, it appears that a relationship exists between listening to fast tempo music and higher levels of physiological and subjective arousal. However this hypothesis has not been tested within a laboratory gambling situation.

II. AIMS

Based on the preceding discussion, this paper explores the presence, experience and influence of background music in gambling situations from different perspectives, using a mixed-methods approach. Four research aims are addressed: 1) to examine the utilisation of music by casino managers; 2) to examine gamblers' beliefs surrounding whether music can influence their gambling experience; 3) to investigate whether gamblers self-select music to accompany gambling and why, and 4) to determine whether tempo alone influences laboratory virtual roulette gambling behaviour and whether arousal is responsible for such effects. Subjective opinions and objective evidence are gathered within three studies: (1) interviews with casino managers, (2) an online questionnaire administered to gamblers and, (3) a laboratory experiment. Studies One and Two identify the functions that music serves within a range of gambling situations. Study Three investigates whether the previously observed effect of tempo on betting speed in laboratory virtual roulette occurs when the musical stimuli only differs by tempo and also examines whether arousal is the psychological mechanism which underlies tempo's effect on betting speed.

III. METHOD

Study One: Interviews with casino managers

Semi-structured interviews were conducted with five casino managers to reveal how they utilise music. The interview data were analysed using Thematic Analysis (Braun & Clarke, 2006).

Study Two: Online questionnaire

One hundred and forty-four gamblers completed an online questionnaire designed to probe their experiences of gambling-operator selected and self-selected music heard in traditional and online gambling environments. The questionnaire probed gamblers' beliefs towards music being able to influence cognitive, behavioural and emotional aspects of gambling, using a scale developed specifically for this study – the Music and Gambling Experience Scale (MGES). Descriptive and inferential statistics were used to analyse the questionnaire responses. Participants' free-text responses were analysed using Thematic Analysis (Braun & Clarke, 2006).

Study Three: Effects of tempo on laboratory virtual roulette

A laboratory study was conducted to test whether music tempo alone influences gambling behaviour via an effect on arousal using a virtual roulette task. One hundred and forty-four participants played virtual roulette whilst listening to fast tempo ($n = 47$), slow tempo ($n = 43$) or no music ($n = 47$). The musical stimuli utilised were strictly controlled so that tempo was the only musical parameter which differed between the fast and slow tempo music. During the task participants' betting speed, expenditure and risk-taking were recorded. Participants' subjective arousal level was collected prior-to and after the gambling task. Participants' heart rate and skin conductance level were also recorded before and during the gambling task. Following the gambling task participants completed an Experimental Questionnaire which collected demographic data, opinions of the musical stimuli, information about participants' gambling habits (e.g. frequency of gambling and gambling expenditure) and participants' problem gambling

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status via the completion of the Problem Gambling Severity Index (PGSI, Ferris & Wynne, 2001).

IV. RESULTS

This section outlines the headline findings from the three studies. Full and comprehensive results will be presented at the conference.

Study One: Interviews with casino managers

The interview data revealed music was considered as a necessary part of casinos and was played constantly. Three types of music could be present in a casino – gambling-operator selected recorded background music, gambling-operator selected live music and music self-selected by gamblers. The most common reason given by the Casino Managers for why music was present in casinos was to create and appropriate atmosphere and ambiance, rather than using music with the specific intention of influencing individuals' gambling behaviour.

Some casino managers reported that gamblers listened to self-selected music and the casino managers suggested that this type of music could aid gamblers' focus, promote relaxation and was listened to because it matched gamblers' personal musical preferences. Some gamblers therefore opted-out of listening to the recorded background music or the live music provided by the gambling-operators.

The interviews demonstrated one way in which a greater understanding of music's utilisation in casinos can be obtained. The interview data highlighted a number of factors which may mediate music's ability to influence gamblers including control over the music, appropriateness of the music, the type of gambling activity engaged in, gamblers' attitudes towards the music, gamblers' awareness of the music and the manipulation of certain musical parameters.

Study Two: Online questionnaire

This study examined gamblers' music listening habits within traditional and online gambling environments. An exploratory factor analysis performed on the responses to the MGES revealed a two-factor solution.

Factor One was named "Micro" and comprised statements referring to music being able to influence expenditure, betting speed, attract gamblers to areas within the gambling environment and affect gamblers' ability to judge the amount of time that they had spent gambling. The "Micro" factor seemingly referred to the decisions being made by gamblers on a moment-to-moment basis.

Factor Two was named "Macro" and comprised statements referring to music being considered to aid concentration, extend the duration of gambling sessions, create the right atmosphere and attract gamblers to areas within the gambling environment. The "Macro" factor referred to whether music could initiate and maintain gambling participation.

The "Macro" factor scores were significantly higher than those obtained for the "Micro" factor across the different types of music (gambling-operator versus self-selected music) and gambling situations (i.e. traditional versus remote gambling environments).

Over a third of respondents reported listening to self-selected music whilst gambling. Gamblers reported listening to self-selected music for a mixture of general and precise reasons. Some gamblers listened to self-selected music as it matched their personal musical preferences, whilst others used music to provide specific emotional and cognitive benefits (e.g. aid concentration, provide a positive distraction, to alter or match their mood).

In general, music was considered by gamblers as being able to support some of the cognitive and emotional aspects of gambling. The online questionnaire provided an overview of gamblers' subjective opinions of music within gambling situations and acted a starting point from which actual influences of music on gambling behaviour could be compared with gamblers' views.

Study Three: Effects of tempo on laboratory virtual roulette

Music tempo alone did not influence betting speed, expenditure or risk-taking. Furthermore tempo did not influence participants' physiological or subjective arousal levels, nor participants' opinions of the musical stimuli in terms of liking, familiarity, fit or its ability to aid concentration.

The findings contradict those obtained in previous research (Bramley *et al*., 2014; Dixon *et al*., 2007; Spenwyn *et al*., 2010) and suggest that there are some circumstances under which the effect of music tempo does not operate; therefore the effects of music characteristics on betting speed may be combinatorial.

VI. DISCUSSION

This body of research has considered the presence, influence and experience of three types of music (i.e. gambling-operator selected, self-selected and experimenter-selected) for over 280 gamblers, five casino managers, within three different gambling contexts (i.e. traditional, online and laboratory gambling environments). Music has been considered broadly, in terms of its use and functions as an auditory accompaniment to gambling, and more narrowly, through manipulating one musical parameter (i.e. tempo) and investigating its influence on a specific gambling activity (i.e. laboratory gambling roulette).

The mixed-methods approach adopted within this project enabled accounts to be obtained from two of the main stakeholders associated with gambling – gambling-operators and gamblers themselves. In doing so, this research represents a shift from considering gamblers as (passive) individuals, who respond to gambling-operator selected and experimenter-selected music in gambling situations, to viewing them as music listeners who, if permitted, actively listen to music, consider its influence on their gambling participation and use music to construct an appropriate gambling environment. Music appears to be a tool which is utilised by gambling-operators and gamblers to support gambling. Therefore music's roles within gambling situations are not static, but change in response to the needs of

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gambling-operators and gamblers. Music is important in gambling situations as it is considered as able to support the cognitive and emotional aspects of gambling participation. However, music may have less of a role in influencing indices of gambling behaviour – as evidenced by the results of Study Three.

In conclusion, this research has extended the current understanding of music in everyday life to gambling, a leisure activity, which up to now had not been extensively researched in the context of music. Music affords predictability, enjoyment, excitement and comfort when engaging in gambling - an activity which has unpredictable outcomes and is uniquely complex. At the conference, we will discuss the implications of this research for gambling-operators, gamblers and the way that music's effects on behaviour are investigated in future research.

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Car-aoke: Vocal performances indicate distraction effects of in-car music

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ABSTRACT

Drivers engage in a host of driving-unrelated tasks while on the road. Most frequently, drivers listen to music and sing-along with the words in a *karaoke* fashion. At times drivers accompany songs by pounding-out drum-kicks, fingering guitar-licks, singing background, and even dancing in their seat. However, there is controversy over in-cabin music: Does background music facilitate driver performance via increased arousal leading to more focused concentration, or cause distraction placing drivers at greater risk. In an effort to shed light on the debate over the utility of in-car music, the current study explored how driving tasks might subsequently affect vocal performances during simulated driving. Eighteen young drivers recorded two versions of two songs (baseline *vs*. low-demand, baseline *vs*. high-demand driving). The results indicate that as the perceptual demands of the primary driving task increase, the performance of the secondary activity (i.e., karaoke-like singing) declines. That is, vocal performances during high-demand driving contained significantly more errors of both intonation/rhythm and lyrics compared to low-demand driving, while both were far less accurate than baseline recordings. Such a picture supports evidence that engaging in music activity does actually preoccupy vital mental resources. In-car music may not necessarily be handled very well, nor is it blocked-out entirely by drivers during high-demand driving – as has been previously reported in some literature. Singing along with in-cabin music background may contribute to increased risk for incidents, events, and near-crashes, and should be reconsidered by traffic scientists investigating human factors, vehicular control, and road safety.

I. INTRODUCTION

Drivers engage in a host of driving-unrelated tasks while on the road. Drivers report they very often listen to music and sing-along with the words in a karaoke-like fashion while driving in traffic. At times they even accompany the songs they listen to while driving, by pounding-out drum-kicks and syncopated rhythms on the steering-wheel, playing licks and solos in an air-guitar fashion, vocalizing background fills and runs, and even dancing in the driver's seat. However, there is a controversy about in-cabin music. For example, Unal and colleagues (Unal, Steg, & Epstude, 2012; Unal, de Ward, Epstude, & Steg, 2013; Unal Platteel, Steg, & Epstude, 2013) claim that in-car music facilitates driver performance via increased arousal leading to a more focused concentration, and that drivers can implement cognitive strategies to reduce task-demands on the road by blocking-out auditory distracters such as music and radio broadcasting. Therefore, Unal et al. conclude that in-car music does not impair driving performance. Further, Dibben and Williamson (2005) assert that unlike conversation with either local passengers or distant callers which require the driver to sustain a necessary level of attention throughout, singing with music played in the car allows drivers the flexibility to start and stop at will with no ill consequences. On the other hand, Hughes, Rudin-Brown and Young (2013) found that singing while driving alters driving performance and impairs hazard perception, while Brodsky (2002, 2015; Brodsky & Kizner, 2012; Brodsky & Slor, 2013), demonstrated that background music causes distraction and places drivers at greater risk for increased driver miscalculation, inaccuracies, deficiencies, errors, traffic violations, and driver aggressiveness. These later studies present evidence that music activity clearly hampers perceptual motor control leading to decrement of vehicular performance with increased incidents, events, and near-crashes.

It should be pointed out that all research efforts thus far have investigated how engaging with in-cabin background music affects driving behaviour and vehicular control; these studies employ computerized simulated driving, closed-circuit test-tracks, and real world on-road 'naturalistic' driving. Such a stance is inherited from studies exploring in-car cell-phone use, as well as those investigating the effects of conversation. Among the later studies, Crundall, Bains, Chapman, and Underwood (2005) examined how drivers adapted to the flow of conversation on urban roads; they found that such adaptation (referred to as *conversational suppression*) reflects a higher level of traffic demand and control, and demonstrates the degree to which secondary activities impinge on the primary driving task. Therefore, it would also seem warranted to explore how driving tasks might subsequently affect vocal performances (i.e., singing songs) as this avenue might shed light on the debate over the utility of in-car music activity. It is hypothesized that as the perceptual demands of the primary driving task increase, *car-aoke* (i.e., singing-along to music while driving) will decline. The study questions if drivers experiencing higher demand driving conditions simply discontinue singing at will with no ill-consequences, and/or block-out the background song-stimuli altogether in their attempt to cope with driving tasks. Or, in their effort to preserve the primary driving task, do drivers prioritize undertakings related to driving by concurrently disrupting the irrelevant activity, and as they are unable to block-out the aural background, demonstrate persistent suboptimal vocal performances.

II. PRE-STUDY DEVELOPMENT

The study employed three well-known popular songs that everyone from the target sample could easily sing. Initially, pop-music radio song-charts were employed to enlist a set of suitable songs. However, several problems with these exemplars arose, including the facts that most music charts contain songs from specific years that are not necessarily

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relevant to a target sample of young adults, that songs from the latest song-charts are not necessarily as popular (or well known) as other 'classic' pop/rock songs of previous years, and that songs ranked high in the popular music charts are not necessarily suitable to sing along with. Therefore, a list of eleven songs based on five criteria was assembled, and presented to 75 young adults with comparable demographics as the target sample. These criterion were: (a) Language – local Hebrew vernacular; (b) Popularity – recorded by well-known Israeli artists or ensemble groups, and appear on a best-selling album; (c) Complexity – simple structural form (introduction, verse, chorus, verse, chorus, coda); (d) Diapason – within a vocal range not extending beyond one-and-a-half octaves; and (e) Vocal Rendition – lack of elongated instrumental solo void of song text. These criteria are similar to those used by Hughes, Rudin-Brown, and Young (2013). The participants of the survey were undergraduates from a Faculty of Humanities and Social Sciences between the ages of 20-30 years old (M_{Age} = 24.97, SD= 2.01), with a biased (♀=73%) gender proportion (although this proportion is similar to the registry of students in the Faculty). All participants received extra course credit. The on-line survey was developed with *Qualtrics*. Each participant was required to rank the popularity of eleven songs on a 4-point scale (1 = 'Not At All Popular or Well-Known'; 4 = 'Highly Popular and Well-Known'). In addition, each participant had the opportunity to suggest the name of another song that in their opinion was more popular and well known than the eleven titles listed. Although no time limit was imposed, the maximum time taken to complete the survey was ten minutes. See Table 1.

Table 1. Results Of Song Survey

	Song Title	Artist / Band	Ranking	
			MN	SD
1	Ani Ve'ata	Arik Einstein	3.80	0.49
2	Oof Gozal	Arik Einstein	3.76	0.52
3	Ve'ech Shelo	Ariel Zilber	3.65	0.58
4	Badad	Zohar Argov	3.60	0.70
5	Yom Shishi At Yoda'at	Bezin Band	3.59	0.68
6	Roni	Gazoz Band	3.48	0.70
7	Shuvi El Beiti	Idan Raichel	3.40	0.68
8	Shlach Li Malach	Mashina Band	3.28	0.79
9	Tagidi	Shlomo Artzi	3.27	0.78
1		Gazoz Band		0.90
0	Galshan		3.24	
1		Fortis & Saharov		0.80
1	Nitsotsot		3.11	

As can be seen in Table 1, the popularity of the songs was high (Range = 3.11-3.80), with the average popularity ranked 3.47 (SD = 0.21). The most popular Top-3 songs were selected as stimuli for the current study.

III. THE STUDY

A. Methods

1) *Participants*. Twenty-nine undergraduates from a Faculty of Humanities and Social Sciences participated. The criteria put in place to participate, were: (a) Drivers License – certified as valid for at least three years; (b) General Health – declaration that no pharmaceutical intervention for hyperactivity or high blood pressure had ever been prescribed; and (c) Sing-ability – willingness to sing during simulated driving. During the study seven participants were dropped from the sample. In one case there was a technical failure, in another the participant could not remember the lyrics, three participants were not able to complete one of the driving tasks within a reasonable amount of time, one suffered from simulator sickness (involving dizziness/nausea), and one participant requested to discontinue participation within the first 10-minutes of the active experiment. The remaining 22 participants were between 23-29 years old (M_{Age} = 25.73, SD = 1.40), with more females (64%) in the sample. On average the participants held a certified Drivers License for an average 7.36 years (SD = 1.87). By self-report, none of the participants had previously been charged with a traffic offense requiring a period of probation or cancellation of their license. While 27% claimed they had never been in an accident, 58% reported to have been involved in 1-2 incidents (referred to as a 'fender-bender'). The overriding majority of the participants (86%) stated that they 'always' listen to music when driving: 90% reported they listen to songs described as 'fast' or 'extremely fast-paced', and 90% stated that they reproduce music in the vehicular cabin at levels considered to be 'loud' or 'very-loud' intensities. Most specifically, 86% claimed that 'most of time' they drive while singing along with the songs heard in the background from audio sources including music radio broadcast, CDs, and MP3 players. It should be pointed out that these undergraduates were not music majors; 68% reported to have never had previous music experience. Among the 31% who claimed to have had music training, the majority (77%) learned an instrument during childhood for an average 2.41 years (SD = 4.27) with either a private instrument teacher or at a neighbourhood music school.

2) *Equipment.* The study employed a PC-controlled driving simulation task involving singing along with music heard in the background. Simulated driving was conducted via the *Midtown Madness* 'Chicago Edition' (Microsoft) software, in a single-user cruise mode with limited vehicles on the road, emulating a *New Beetle* (Volkswagen) cockpit with realistic dashboard digital speedometer, gauges, and rearview mirror. The software was run on a desktop PC with a 17" flat monitor (Compaq), coupled to a *MOMO® Force Feedback Racing* steering wheel with accelerator and brake pedals (Logitech). All aural signals, including environmental driving sounds (vehicle and roadway), the background music, and the drivers' own vocal performances, were routed and subsequently equalized with a 5-channel mini mixer (Samson) through a 4-channel mini stereo headphone amplifier (Samson) to *RH-5MA* full-frequency (20Hz-20kHz) supra-aural (40mm speakers) closed-back monitor headphones (Yamaha). The drivers' vocal performances were captured with an *H2* handy digital recorder (Zoom) to SD memory cards as 24bit/96kHz linear PCM (.wav) files. The background music (MP3 files)

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was controlled and reproduced via an *iMac* (Apple) desktop computer.

3) *Music Stimuli*. Three songs (Nos. 1-3, Table 1) were used in the study. These songs were performed by one of two male vocal artists, with pop-ensemble accompaniment (i.e., piano, guitar, bass, and drums). On average, the songs were four minutes duration (M_{Minutes} = 3:58, *SD* = 0.56, Range = 3:20-4:20), with about 100 words (M_{Words} = 98, *SD* = 27, Range = 71-127), and roughly 200 notes in the melody line (M_{Notes} = 215.33, *SD* = 63.13, Range = 150-276).

B. Procedure

Two nights before the actual experiment, each participant received the lyrics of the songs and a *YouTube* web-link for each song (in a similar fashion as employed by Hughes, Rudin-Brown, & Young, 2013). The participants were instructed to practice each song several times during the two days leading up to the active experiment. The study was conducted in an acoustically treated Music Psychology lab. Upon arrival to the lab every participant signed an Informed Consent Form, and completed a 1-page demographic questionnaire. The participants were requested to choose two of the three songs to be used in their particular experiment, to place the headphones over their ears, and begin singing a full rendition of each song along with the same *YouTube* video clip accompaniment that they had practiced with previously; they sang from memory without the texts in front of them. The participants were told that no one, not even the experiment monitor, could hear them sing as they were isolated behind a soundproof glass partition – with the experiment monitor clearly in sight on the other side of the partition. However, they were notified that their vocal performances would be recorded as audio files for later analyses. The recordings were made in such a way as to detach each participant's singing from all other aural stimuli – including the background music accompaniment. This strategy was employed in an effort to preserve isolated vocal performances. During this phase the computer monitor was turned off (i.e., black screen). The vocal performances of the two songs were performed in a random order; these renditions served as Baseline versions. After recording the two vocal performances, the computer monitor was switched on; the participants viewed a traffic scene with moving vehicles, walking pedestrians, active traffic lights, and other environmental street sounds. A short oral briefing about the simulator (steering wheel, pedal controllers) ensued, and then regulations about traffic were outlined (driving in the right lane, stopping for red lights, obeying traffic signs, not exceeding a maximum speed of 50mph). Finally, every participant received a 5-minute practice of simulated driving.

The experiment was carried out as two trials (reflecting two driving conditions) counter-balanced across the sample. In each condition the participants were asked to sing along with one of the two songs in its entirety until the trial ended; the songs were employed in a counter-balanced manner (albeit juggled between three songs across the sample). One trial consisted of *low-demand* driving whereby participants freely cruised throughout the city-centre streets of Chicago while singing one of the songs; this trial ended upon conclusion of the song. The second trial consisted of *high-demand* driving in which each participant was required to navigate throughout the city-centre to a destination plotted on one of two A4-size city maps placed to the right of the computer monitor. The two maps (each indicating one of the two destinations) were also counter-balanced across the sample. It should be noted that in the right lower quadrant of the monitor was a small (2.5 x 2.5 inch) window with an animated *GPS* application that allowed the drivers to check their progress and location in real time as compared to the printed map. Before each high-demand trial, one of the two songs began playing in the background, to which drivers were instructed to sing along continuously throughout the entire trial until they arrived at the designated location. It should be noted that the song was heard continuously in a looped fashion until reaching the final destination; the majority of drivers (77%) required 2-3 repetitions of the song (singing throughout) before arriving at the designated location.

C. Results

The overriding goal of the study was to compare between the two vocal performances per driving condition (baseline *vs*. low-demand, baseline *vs*. high-demand), as well as to contrast the two driving conditions themselves. Such analyses required the examination and scoring for errors of the sung notes (inaccuracies of intonation, rhythm, and tempo) as well as for errors of the sung lyrics (inaccuracies of the text by word-replacement or neglect). This musicological evaluation was undertaken by an independent music expert who was both blind to the goals of the study, as well as to the fact that vocal performances were recorded during simulated driving. The adjudicator was a 56-year-old professional musician with absolute hearing; his background includes 51 years experience as a pianist, 36 years experience accompanying vocalists at auditions, and most importantly, 35 years experience as a *répétiteur*. A répétiteur is the pianist-accompanist responsible for coaching singers during music and production rehearsals. As a vocal coach, the répétiteur is responsible for advising singers on how to improve their pitch and pronunciation, as well as for correcting errors of notes (intonation), phrasing (rhythm), and text (lyrics).

After aural examination of each sound file, and marking perceived errors on the music notation lead sheet for each performance, the data from all participants with scores indicating > 90% errors (of intonation and rhythmic properties) at baseline were removed from the set. This strategy assured that effects of the study reflect differences between driving conditions with the least amount of corruption by drivers who consistently sing out-of-tune (also referred to as *tone-deafness*). Such inabilities might indicate problems of processing and/or distinguishing between tones, as well as deficit in accurately reproducing vocal pitches (i.e., consistently singing 1/10$^{\text{th}}$ above/below the precise pitch). As a result, the data of four drivers was removed from the study, leaving 18 subjects in all subsequent analyses. Initially, errors of intonation and rhythmic properties, as well as lyrics, were calculated and then reconfigured as percentages. See Table 2.

To answer the question if driving tasks might cause driver distraction and ill-effects on *Car-aoke* vocal performances (i.e., draining of mental efforts needed to sing well-known and highly familiar songs), the error percentages of vocal performances were entered into two repeated-measures analyses of variance. The results indicate that vocal performances during low-demand driving were slightly more in-tune and in-rhythm than baseline versions – although as these did not achieve statistical significance such differences might simply reflect noise among the data ($F_{(1,17)} = 3.35$, $MSe = 130.45$, $p = 0.084$, $\eta^2_\rho = 0.17$); nevertheless, the lyrics contained significantly more errors during driving ($F_{(1,17)} = 7.92$, $MSe = 9.00$, $p = 0.012$, $\eta^2_\rho = 0.32$). Further, compared to baseline recordings, vocal performances during high-demand driving were significantly more out-of-tune with significantly less rhythmic precision ($F_{(1,17)} = 5.10$, $MSe = 39.80$, $p = 0.038$, $\eta^2_\rho = 0.23$), and the lyrics contained significantly more errors ($F_{(1,17)} = 14.41$, $MSe = 46.06$, $p = 0.0014$, $\eta^2_\rho = 0.46$). Then, to answer the question if there are differences of vocal performances between the driving conditions (low-demand *vs.* high-demand driving when compared to baseline), *delta* (Δ) change variables were calculated and entered into a repeated-measures analysis of variance. These results indicated that vocal performances during high-demand driving were significantly more corrupted for both intonation and rhythm ($F_{(1,17)} = 6.58$, $MSe = 187.23$, $p = 0.0201$, $\eta^2_\rho = 0.28$), as well as for lyrics ($F_{(1,17)} = 5.07$, $MSe = 59.24$, $p = 0.038$, $\eta^2_\rho = 0.23$).

Table 2. Errors (%) Of Vocal Performances

	Baseline		Low-Demand		High-Demand	
	MN% (SD)		**MN% (SD)**		**MN% (SD)**	
Song #1						
Intonation	38	(22.9)	31	(20.0)		
Lyrics	10	(08.0)	13	(08.1)		
Song #2						
Intonation	28	(17.3)			33	(17.1)
Lyrics	07	(05.7)			16	(10.3)

IV. CONCLUSIONS

Drivers report they very often listen to music and sing along with the words in a karaoke-like fashion while driving in traffic. Nevertheless, there is disagreement in the literature concerning in-cabin music as to whether or not engagement facilitates driver performance or alters driving performance and impairs hazard perception. Furthermore, there is an ongoing debate if drivers self-implement strategies such as stopping music engagement at will with no ill-consequences or even block-out auditory distracters (concluding that in-car music does not impair driving performance), or if background music causes distraction and increased risk (concluding that in-car music prompts driver deficiencies and aggressiveness leading to increased incidents, events, and near-crashes). For a comprehensive review see Brodsky (2015). The current study found that vocal performances during low-demand driving were slightly better than when singing alone (baseline); perhaps such a find relates to a positive 'fun' experience drivers had when singing while freely cruising about – albeit the lyrics sung contained significantly more errors. Yet, vocal performances during high-demand driving were significantly more out-of-tune with significantly less rhythmic control, and the lyrics sung contained significantly more errors. Namely, vocal performances during high-demand driving were significantly more corrupted than during low-demand driving. These findings offer further evidence regarding the utility of in-car music: *Car-aoke* – as a secondary activity to driving – may deplete a portion of the mental resources required for safely driving a car. One can only wonder if such significant effects surfaced from a relatively small sample using PC-controlled simulated driving as in the current study, then how much more hazardous are the effects of *Car-aoke* in a real-world traffic road environment

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Effects of cognitive hypnotherapy and eye movement desensitisation and reprocessing on music performance anxiety in advanced pianists

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ABSTRACT

Many investigative studies have concluded that the cognitive behavioural approach to music performance anxiety (MPA) which focuses on the conscious mind may produce the best outcome; however little research has focused on implicit mental processes for the alleviation of this condition. This study investigated the effect of cognitive hypnotherapy (CH) and eye movement desensitisation and reprocessing (EMDR), therapies which target implicit processes. 52 pianists (Grade 8 and above) from the Universities of Leeds and Sheffield and Leeds College of Music were tested initially in a pilot study of six followed by a further study of 46. Participants were of mixed gender aged 18-26 (49), with three over 30. They were randomly assigned to a therapy or control group. The therapy groups received two hour-long interventions of either CH or EMDR during a two-week period between two concerts. Quantitative data was collected through: the Spielberger State-Trait Anxiety Inventory; a self-report questionnaire (SRQ); performance assessment; perception of therapies; and gender differences. Qualitative assessment was conducted through the SRQ and a subjective log of longitudinal performance experiences. The results showed that both therapy groups experienced a significant reduction in both state and trait levels of anxiety at the second performance and that performance was significantly improved in these groups but not in the control. Longitudinal testing of trait anxiety at four months and one year demonstrated that significant decreases from baseline were still maintained. This finding, using a large sample, has not been previously reported and is an important area for future research.

I. INTRODUCTION

Anxiety is a problem of some magnitude which can exert a negative effect on a variety of human behaviour including music performance; the research literature validates this extensively (Kenny, 2011; Kirchner, 2003, Osborne, Kenny & Cooksey, 2007; Wesner, Noyes, & Davis, 1990). The causes of anxiety can be deeply embedded in the mind (Alladin, 2010) and as a psychological condition, it may be posited that MPA can be successfully treated by psychotherapeutic interventions that target implicit processes no longer in conscious awareness.. This study explores an innovative approach to performance anxiety investigating the potential benefits of two psychotherapies (CH and EMDR), to determine the effect on music performance. To date there have been surprisingly few studies that have investigated MPA using these interventions. Only one large-scale study to date has assessed the effect of hypnotherapy on MPA and a significant pre- to post-therapy improvement was found in the treatment groups but not the control (Stanton, 1994). This research builds on Stanton's work and on studies using EMDR (Feener, 2005; Plummer, 2007). It extends current research by the use of innovative therapies testing MPA across three different domains: cognitive, physiological/somatic and behavioural.

This research tests the hypotheses that:

1. By lessening negative cognitions, both explicitly and implicitly, subjective performance is perceived as less threatening, resulting in a significant decrease in state anxiety.
2. Physiological/somatic symptoms of anxiety will also be reduced.
3. Performance will be enhanced post-therapy.
4. It further proposes that both therapies will be effective in achieving these outcomes.

Research questions in this study focus on the main hypotheses; however other emergent questions are considered including the mutability of trait anxiety (the general level of anxiety) and the effect that this exerts on performance. Although this was not the original aim of the study an unanticipated and potentially important effect was found regarding trait anxiety in the pilot study; therefore this was considered a valuable area of further exploration.

A. The Components of Anxiety

The concept of anxiety has been well documented in the psychological literature. Freud viewed anxiety as a signal to the ego of anticipated dangerous internal impulses that instigate external retaliation (1959). A model of anxiety based on the interrelationship of cognitions, physiology and behaviour was proposed by Lang, Miller and Levin (1988). They maintained that anxiety is the product of interactions of fearful thoughts, arousal of the autonomic nervous system, and overt behavioural responses to perceived threat. Anxiety was first categorized into a two-factor structure having both trait and state components (Cattell, 1956). Trait anxiety can be thought of as a person's normal level of anxiety when in a non-threatening situation (an aspect of personality). State anxiety however changes according to environmental situations and pressures and the degree of threat perceived by the individual (Spielberger, 1966). Differences in an individual's trait levels of anxiety affect the response to situations perceived as threatening, intensifying the state component of anxiety (ibid). Previous research has demonstrated that individuals with high trait anxiety do not perform as well as those with low trait anxiety when faced with a threatening situation (Spence & Spence, 1996). Anxiety where the individual is thought to be in the spotlight may originate from various cognitive processes:

- High levels of trait anxiety: pre-empting susceptibility to stress (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983).

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- External factors, historical or social, causing negative cognitions (Sloboda & Juslin, 2001).
- Aspects of behaviour which are pre-conscious. Every intention is assumed to be describable by a set of physical events (LeDoux, 1989).

- Explicit memories of past events (Wills, 2009).
- Implicit memories of past experiences which are no longer in conscious awareness but impact on present day performance (Damasio, 1989; Scherer, 1993).

Implicit memories are highly pertinent to performance. Negative memories of past experiences (both implicit and explicit) can trigger latent patterns of thoughts, emotions and behaviour, resulting in a cycle that maintains and exacerbates the non-helpful behaviour (Young, Klosko, & Weishaar, 2003). Emotional feelings and memories may exert a crucial role in instigating and exacerbating the anxiety experienced prior to and during a music performance.

B. The Impact of Anxiety on Music Performance

Anxiety has been described as overestimating the severity of a feared event in conjunction with underestimating the coping resources and rescue factors which could be adopted to aid the situation (Beck & Emery, 1985). Performance anxiety lies within the broad domain of social anxiety and occurs when psychological discomfort in situation-dependent states lead to anxiety (Crozier & Alden, 2005; Wilson, 1997). Self-focused negative attention to forthcoming events plays a key role in the conceptualization of social anxiety (Coles, Hart, & Heimberg, 2005). It is clear from the literature that MPA is a problem of some magnitude and has been documented as affecting over 60% of all performing musicians (Brodsky & Sloboda, 1997). Gender differences are apparent, with females generally exhibiting higher degrees of state anxiety than males (Osborne & Franklin, 2002; Wesner et al., 1990); their findings are supported by the current study. It has also been found that solo performance generates higher levels of MPA than ensembles (Brugués, 2011).

It has been suggested that there are three categories of MPA (Stein & Stein, 2008):

1) focal performance anxiety: a condition that exists in an otherwise healthy functioning musician and is domain-specific;
2) social anxiety/social phobia: described as negative connotations of a future performance causing mental anguish (Barlow, 2000);
3) panic disorder: fear masquerades as anxiety, terror or panic, the three degrees of the intensity of fear (Barnett, 1989).

C. Treatment of MPA: Current Interventions

A wide range of therapies have been offered for the management of MPA and are well documented in the literature:

- Cognitive interventions (assertiveness training, attentional focus techniques); cognitive-behaviour therapy which includes exposure therapy, systematic desensitisation and systematic rehearsal, coping skills training, imagery and goal setting.
- Physiological and physically-based interventions (Alexander technique, biofeedback, muscle relaxation training and music-enhanced relaxation techniques).
- Meditative interventions (meditation, yoga and autogenic training).

Although some positive effects have been found using cognitive-behavioural therapy, the drawback is the number of sessions required (Osborne et al., 2007; Tarrant & Leatham, 2007). There is a paucity of evidence for the physiologically/physically-based treatments and assertiveness training. However there is increasing evidence for the efficacy of psychodynamic-orientated therapies for the reduction of MPA (Kenny, 2011) with promising outcomes in the field of short-term dynamic psychotherapy (Kenny, Arthey, & Abbass, 2014). However, at the time of conducting the current study there is a paucity of research using therapies that target implicit or automated mental processes for the reduction of MPA; it is therefore more difficult to assess their effect. It can be posited however that by identifying and targeting the core issues relating to the presenting problem (the method adopted in the current research), an effective and permanent cure is achievable. Both interventions adopted in the current study, CH and EMDR, target both explicit and implicit cognitive processes. A brief explanation of each therapy is given by the author, an experienced pianist and qualified hypnotherapist and EMDR practitioner.

D. Therapies Adopted in this Study

1) Cognitive Hypnotherapy (CH). CH allows for deep relaxation so that a trance state can be reached. During this time the conscious mind (the critical part of the mind) has 'switched off' allowing the subconscious mind to be receptive to helpful positive suggestions to be passed to the conscious mind as post-hypnotic suggestions. The literature informs us that hypnosis is a technique that can be used to change the memory and meaning of distressing events by reducing the perception of threat, and also the somatic symptoms of anxiety associated with the event (Dozois & Westra, 2004). Hypnosis has been used since the time of Freud to bring about positive change for anxiety-based conditions.

2) Eye Movement Desensitisation and Reprocessing (EMDR). This is a relatively new psychotherapy having its inception through research conducted by Shapiro (1989). It was used initially for the treatment of post-traumatic stress disorder and found to be very effective for emotional conditions such as anxiety. Since 2002 it has been placed in the American Psychiatric Association category for 'A' trauma as being highly recommended, and more recently for 'small trauma' (2004). The theory of EMDR is that through guided eye movements (or other sources of bilateral movements), negative cognitions, emotional memories and beliefs are desensitised and reprocessed enabling positive change.

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II. METHOD

A. Purpose

The aim was to investigate the efficacy of two psychotherapeutic interventions, CH and EMDR, on MPA when applied to Grade 8 standard pianists performing in two small concerts. The pilot study (6 undergraduate participants) gave useful information into the phenomenon of MPA. It showed the potential of the two interventions, and highlighted the need for further investigations into both state and trait anxiety, particularly in the area of cognitive anxiety. In broad outline the pilot and the main study followed a similar methodology, procedure and a repeated measures design.

The main study tested:

- Trait and state levels of anxiety pre- and post-interventions
- Subjective measures of anxiety (including somatic symptoms) by self-report questionnaire
- Measures of anxiety through blood pressure monitoring
- Behavioural anxiety by an assessment in each performance, pre- and post-interventions
- Gender differences in cognitive anxiety
- Perceptions and ratings of therapy, effectiveness pre- and post-treatment
- The ongoing efficacy of the therapies through longitudinal investigations of trait anxiety and performance experiences.

B. Participants

Participants were Grade 8 pianists (or above) from the Universities of Leeds and Sheffield and Leeds College of Music. It was not a requirement that piano was their primary instrument; however a criterion was that they suffered from MPA to a greater or lesser degree. 46 pianists took part in the main study: 27 females and 16 males aged 18-26; and three (two female and one male) aged 33, 48 and 53 respectively. Eight held post-graduate diplomas in piano, the remainder were of Grade 8 standard of the Associated Board of the Royal Schools of Music (ABRSM) or the equivalent. Participants were recruited after presentations of the research at the three institutions, or through posters in music departments and across the campus. They were allocated an identification number to ensure anonymity, and were informed that they would receive two free therapy sessions during the main research period, or immediately afterwards should they be in the control group.

C. Procedure

The main study was conducted over a period of 18 months to enable recruitment of a large sample; in order to achieve this it was necessary to utilise two tranches (Tranche 1: 21; Tranche 2: 25). There were variations in the numbers of participants from each institution within each tranche. A multimodal largely quantitative procedure was adopted using four different measures to assess the impact that cognitive anxiety exerts on individuals in performance. Baseline measurements of cognitive and physiological anxiety were taken at recruitment. Assessment of anxiety was conducted in two concert performances. Participants performed an own choice piece appropriate to their standard (playing time two minutes) in two unpublicised concerts. They had the choice of using the score or playing from memory; audio and video recordings were made of each performance. The timescale between the two performances was approximately ten days. At the end of the first performance participants were randomly assigned to one of three groups: Control, CH or EMDR. In the intervening period between the concerts the therapy groups received two one-hour therapy sessions of their allotted therapy. At the end of the main data collection the Control group was also randomly assigned two sessions of either CH or EMDR; this would enable longitudinal monitoring of trait levels and performance experiences using the largest possible sample.

D. Tools and Data Collection

A Participant's Ratings of Therapy sheet was completed at the outset of the research before allocation of therapy, and a subsequent rating was given post-therapy. This allowed for comparisons which would ascertain if therapy perception impacted on therapy outcome. This was rated on a Likert scale of 1-10 where 1 was deemed to have the least effect and 10 the maximum; subjective comments regarding any aspect of the therapeutic intervention were also invited.

An assessment of both state and trait levels of anxiety was conducted using raw scores from the State-Trait Anxiety Inventory (STAI) (Spielberger et al., 1983). The STAI is the most widely used psychological test of cognitive anxiety; however to strengthen the findings from the STAI a self-report questionnaire (SRQ), designed by the author, was also used. This provided a more sensitive and broad idiographic account of MPA which was not possible from the STAI alone. It gave valuable information on cognitions, emotions and somatic/physiological symptoms experienced in the weeks/days before and during the performances. The rationale for not using a standardised instrument of testing was the need for detailed qualitative information regarding subjective cognitive anxiety (both trait and state), as well as somatic symptoms of anxiety. This was not wholly fulfilled by existing measurements in this area. The SRQ incorporated six questions and was completed by participants at the end of each performance allowing comparisons to be made; it reported on:

- Thoughts/feelings/emotions in the weeks/days prior to performances 1and 2
- Strength of feelings as performance approached
- Strength of any thoughts regarding possible withdrawal
- Feelings 15/30 minutes before performing
- Physical symptoms experienced before and during performance
- The effect of these symptoms on performance.

A Likert-type scale of 1-9 was used where 1 represented the lowest anxiety and 9 the highest (1-3 low anxiety, 4-6 medium, 7-9 high) enabling a more refined quantitative assessment. A random sample of the SRQs was independently assessed by a post-graduate musician affiliated to the City of Birmingham Symphony Orchestra (CBSO).

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A quantitative measurement of assessment of performance was applied across the two performances to determine the impact of anxiety on the quality of performance. Designed by the author (an experienced pianist) it was broadly based on the ABRSM criteria for performance assessment. It used the six criteria below, each calculated on a Likert scale of 1-10 where 1 represented the lowest mark and 10 the highest:

- Overall accuracy/technical security
- Instrumental control (including pedal)
- Fluency
- Sensitivity to tonal quality
- Musical interpretation
- Confidence in performance.

Two independent professional musicians (one a Guildhall examiner) assessed a blind selection of a random sample.

Physiological measurements of systolic and diastolic readings in blood pressure measurements pre- and post-therapies were tested using a standardised wrist monitor. However as the raw data readings showed no indication of significant heightened anxiety either in the pilot study or in Tranche 1, physiological measurements of blood pressure were not included in Tranche 2.

Longitudinal investigations of trait levels of anxiety were conducted, enabling comparisons with baseline measurements and performances 1 and 2. This ascertained the effect of the therapies on trait levels over time. All participants were contacted and asked to complete the trait portion of the STAI questionnaire (STAI Y-2) online at designated times. 34 participants from Tranches 1 and 2 responded at the four-month measuring point and 17 participants from Tranche 1 responded at one year.

The objective scores of the trait levels of anxiety were compared with subjective performance experiences at the same measurement points; this would establish whether a relationship exists between trait anxiety and MPA. A longitudinal assessment of performance outcome was completed online at four months and one year post-intervention through a log of experiences post-research (LEPR) completed after any subsequent performances. This allowed for comparisons with trait anxiety at these points in time and also with the comments on the SRQs completed during the main data collection. The LEPR comprised the following categories:

- Date and type of each performance (recital/concert/exam)
- Thoughts/emotions/feelings (positive/neutral/negative) pre- and during performance
- Somatic/physiological symptoms during performance
- Post-performance thoughts/feelings.

III. RESULTS

Given that participants in this research were affiliated to three different educational institutions (the Universities of Leeds and Sheffield and Leeds College of Music), it was necessary to ascertain whether there were significant differences in the levels of state anxiety between the groups from the three institutions. In order to establish cognitive levels of anxiety, the STAI Y-1 (the state portion of the questionnaire) was completed by all participants at baseline and 15 minutes prior to the first performance. An ANCOVA was calculated comparing cognitive anxiety between the two measurement points between institutions; this revealed that there were no significant differences in state anxiety at this point of measurement which suggests that the data were stable cross settings.

A. Cognitive Anxiety

The raw data from STAI Y-2 (trait anxiety) indicated that the trait baseline levels of anxiety of the 46 participants ranged from 31-68 and the scores were normally distributed: one participant was in the high trait category; 29 had scores of 41-56 (medium category, 76%); 16 had scores of 29-39 (low category, 24%).

A Pearson's Correlation test was applied at baseline across the sample using the STAI Y-1 and Y-2 questionnaires to establish whether a correlation existed between trait and state scores. This indicated a positive correlation ($r(46) = 0.403$, $N = 46$ $p = .005$). This finding supports Spielberger et al. (1983).

B. Perception of Therapies

A paired sample *t*-test was conducted at the two points of measurement pre- and post-therapy. A comparison of the means indicated that the therapy ratings (Likert scale 1-10) increased post-therapy (pre-therapy mean = 5.62, post-therapy mean = 7.02), and this is statistically significant ($t = -4.44$, $p < .001$). This finding demonstrates that subjective perceptions of the psychotherapies changed after treatment.

C. Gender Differences

In this study females exhibited marginally lower trait anxiety at baseline than males, as indicated by the means (females 43.48; males 45.06); however the baseline state anxiety mean of females was higher than males (females 40.97; males 35.12). An ANOVA was calculated at the two points of measurement, baseline and performance 1 across both gender groups, and a significant difference was found ($t = 2.89$, $p = .006$). Females were significantly more anxious than males at the first performance; these findings support Osborne and Franklin (2002) and Wesner et al. (1990). A large percentage of females suffered from high cognitive anxiety at performance 1 compared to males. At this measurement point, 16 females (55% of the total female participants) had scores of over 50 on STAI Y-1 compared to five males (29% of the total male participants). However the difference in high somatic symptoms of anxiety between the genders was negligible. The current findings only support in part the research of Miller and Chesky (2004), who found that males and females reported similar levels of somatic and cognitive anxiety.

D. State Anxiety

To establish whether anxiety decreased more in the intervention groups than the control, an ANCOVA was calculated comparing the raw data from STAI Y-1 (state anxiety) across the three groups (CH, EMDR and Control) at the first and second performances (before and after treatment): Figure 1. There was a main effect of condition ($F(2, 42) = 4.916$, $p = .012$) such that participants in the two treatment groups showed significantly lower state anxiety than the control and both treatment groups were equally effective in achieving this (Helmert contrasts, .005 significance level). This suggests that the therapies applied between the two performances significantly lowered state anxiety in both therapy groups prior to the second performance. This corroborates Stanton (1994) in his research with pianists who experienced significant decreases in MPA after two sessions of hypnotherapy. It should be noted however that anxiety decreased in all three groups at the second performance, but not significantly in the control (see Discussion: B. State Anxiety and Performance).

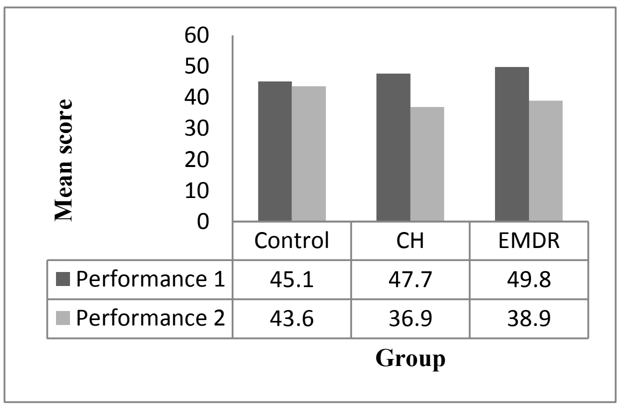

Figure 1. Mean change in state level of anxiety at performance 2 after CH and EMDR groups have received therapies.

E. Trait Anxiety

To establish whether trait levels decreased post-psychotherapeutic intervention, a further ANCOVA was applied across the groups at baseline and performance 2 (Figure 2). There was a main effect of condition ($F(2,42) = 5.71$, $p = .006$) such that participants in the two treatment groups showed significantly lowered trait levels of anxiety prior to the second performance than those in the control group, with the EMDR group being significantly less anxious than the CH group (Helmert contrasts, .032 significance level).

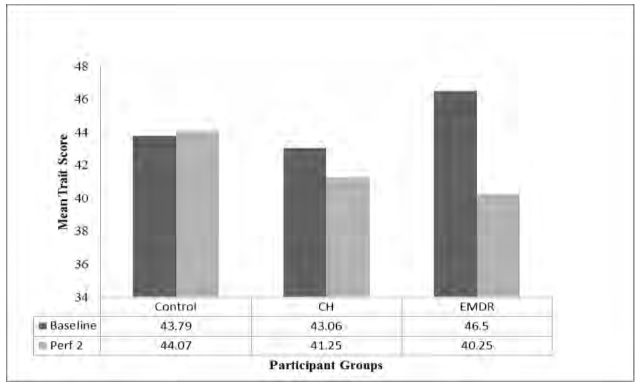

Figure 2. Mean change in trait level of anxiety at performance 2 after CH and EMDR groups have received therapies.

The results of the statistical findings demonstrate that trait levels of anxiety increased in the control group at the second performance however were significantly lowered post-intervention in the therapy groups. It was important to establish the effect of therapies on the control group. Therefore at the end of the main data collection period after the control group had also received two hours of therapy, the raw data from the STAI Y-2 was incorporated into the pre-existing data of the treatment groups. A repeated measure ANOVA across the whole sample (46) was conducted, comparing two levels of the time variable, baseline trait and trait post-intervention. It showed a significant main effect of time ($F(1, 43) = 18.435$, $p < .001$). This demonstrates that there was a significant decrease in trait anxiety at the second point of measurement when the whole sample had received treatment.

F. Self-Report Questionnaire (SRQ): Subjective Anxiety

Qualitative comments were coded and quantified allowing for statistical analysis of subjective anxiety which would supplement the findings from the STAI Y-1 questionnaire. Before statistical assessment of the quantified data was conducted, the scores of the main researcher and the independent assessor (an experienced pianist and violinist affiliated to the City of Birmingham Symphony Orchestra) were correlated. A Pearson's Correlation test was conducted giving the following results: performance 1, ($r(10) = 0.989$, $N = 10$ $p < 0.01$); performance 2, ($r(10) = 0.961$, $N = 10$ $p < 0.01$). This indicated a positive correlation and that the main researcher's ratings were in line with the independent assessment.

To determine whether a correlation exists between self-perceived and objective anxiety a Pearson's Correlation test was applied at performance 1 prior to therapy application. The results suggest that a positive correlation exists between subjective anxiety (SRQ) and the objective scores (STAI Y-1): ($r(46) = 0.582$, $N = 46$ $p < .001$).

An ANCOVA was calculated comparing perceived anxiety between the two performances across the three groups. There was a main effect of condition ($F(2, 42) = 4.11$, $p = .029$) such

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that the perceptions of anxiety in both treatment groups were significantly lower than those of the control group.

In the current study an ANCOVA showed no significant differences in somatic/physiological anxiety across the groups post-therapy. However somatic symptoms experienced immediately prior to and during the first performance (as stated by participants on the SRQ) were various, supporting Brooker (2009; 2012), Craske and Craig (1984); Shoup, (1995); and Steptoe (2001):

- feeling nervous and tense
- shaking all over
- hands/foot shaking
- sweaty hands
- no control over playing
- cloudy vision
- butterflies in stomach/empty feeling
- feeling sick

Cognitive symptoms overlapped with somatic symptoms in some cases:

- misreading the score
- feelings of unreality
- negative cognitions anticipating failure

A strong relationship between cognitive and somatic anxiety has been reported in the literature (Craske & Craig, 1984; Hardy & Parfitt, 1991). To determine whether a link exists between these areas of anxiety in the current study, a correlation of assessment of cognitive (STAI Y-1) and somatic anxiety (SRQ questionnaire) was calculated at measurement point performance 1. This showed the level of correlation as ($r(46) = 0.496$, N = 11, $p < 0.01$), demonstrating that levels of objective cognitive anxiety co-varied positively with somatic anxiety.

G. Assessment of Performance

This was conducted by two independent assessors and the main researcher. Before an assessment of the raw data was conducted it was important to conduct a correlation of the scores given by the two independent assessors and the main researcher. A Pearson's Correlation test was conducted at the two points of measurement, performance 1 and performance 2, ($r(11) = 0.948$, N=11 $p < 0.001$) which indicates that the ratings are in line with expert opinion, and that the level of agreement is good. An ANCOVA was calculated comparing the marks between the therapy groups and the control group across the two points of measurement. There was a main effect condition ($F(2, 42) = 4.07$, $p = .024$) such that the participants in both treatment groups displayed significant improvements at the second performance which were not evident in the non-treatment group.

H. Trait Anxiety Longitudinal: Four Months Post-Intervention

It was important to ascertain if a significant decrease in trait anxiety was maintained post-intervention. To assess the effect of the therapies longitudinally trait levels of anxiety were tested at different points in time by use of the STAI Y-2 questionnaire. At the four-month measuring point 34 of the 46 participants responded. A paired sample *t*-test was applied comparing baseline measurements and four months post-intervention. A comparison of the means (baseline = 45.85, post-intervention four months = 41.06, mean difference 4.79) indicated a significant decrease in trait anxiety ($t = 4.352$, $p < .001$) at the two points of measurement. To further support the data a repeated measures test was conducted at three points in time across the 34 respondents: baseline, performance 2 (Control group prior to therapy application) and four months post-intervention (Figure 3). It showed a significant main effect of time ($F(1.000, 31.00) = 17.304$, $p < .001$), which suggests the positive effects of the therapies over time.

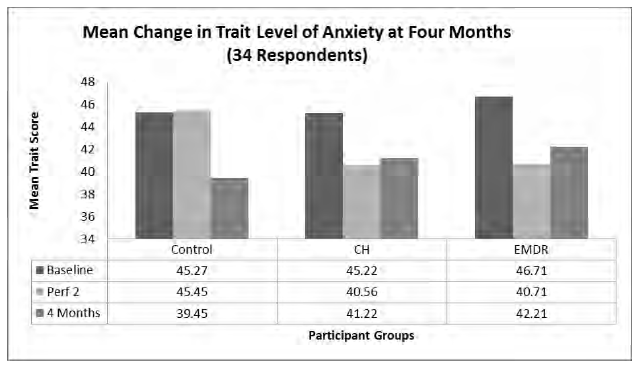

Figure 3. A repeated measures test showing the estimated marginal mean change in trait levels of anxiety (34 respondents, at three points in time: baseline, performance 2 and four months post-intervention.

I. Trait Anxiety Longitudinal: One Year Post-Intervention

At the one-year monitoring point 17 respondents from Tranche 1 further completed the STAI Y-2 questionnaire. A second paired sample *t*-test was conducted comparing levels of trait anxiety at baseline and one year post-intervention (Figure 4). A comparison of the means (baseline = 44.11, one year post-intervention = 39.05, mean difference 5.06) indicated a significant decrease in trait anxiety below baseline was still maintained ($t = 4.183$, $p = .001$). However at these two measurement points the sample is smaller and reduces the statistical power.

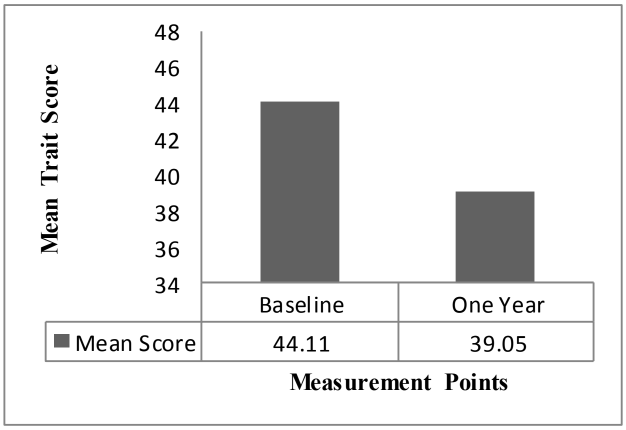

Figure 4. A paired sample *t*-test across 17 respondents showing the mean change from baseline to one year post-intervention.

A second repeated measures test was conducted at three points in time across the 17 respondents: baseline, performance 2 and one year post-intervention. It showed a significant main effect of time ($F(1.000, 16.00) = 16.940$, $p < .001$). This demonstrated that one year post-intervention the respondents still displayed significant decreases in trait anxiety scores from their baseline measurements. At this point of measurement:

- 15 respondents (88%) still showed decreases from baseline (two returned to baseline levels)
- ten of the 17 respondents (59%) experienced further decreases from the four-month measurement point
- two respondents had maintained a lowered trait category (STAI Y-2).

J. Longitudinal Evaluation of Performance (LEPR)

It was important to monitor the long-term effects of the therapies on performance. It was found from the LEPR that where a decreased trait level from baseline had been maintained at the longitudinal monitoring points, this exerted a positive effect on cognitive perceptions, somatic symptoms and performance outcome. The comments from the LEPRs highlighted that although a nervous apprehension could still be experienced, participants generally felt more confident, were calmer and more in control of the situation: some were excited at the thought of performing and little catastrophizing was experienced.

IV. DISCUSSION

This study set out with the primary aim of investigating cognitive anxiety across the main research period. State anxiety was found to be significantly reduced in the therapy groups after only two therapy sessions and performance was significantly improved, thus supporting the main hypotheses. An unanticipated and valuable finding was that trait anxiety also decreased significantly in the therapy groups but not in the control. Subsequent longitudinal investigations into trait levels demonstrated that at four months and one year post-intervention levels were still significantly lower than baseline. The current research demonstrated that when anxiety is decreased significantly the subjective experience of music performance is significantly enhanced and musicians are able to look forward to performance.

A. Perception of Therapies

In this empirical research it was not possible to conduct blind trials as the participants were fully aware of which treatment they would receive during the study. The practical implications of this might be that individuals have a bias toward a particular treatment which may affect the outcome; this is unavoidable in this type of research. Surprisingly there appears to be very little research reported in the literature on the relationship between perception of therapy and bias. The statistical tests in this study showed that participants' ratings pre-therapy did not reflect post-therapy ratings. However several participants were sceptical of the efficacy of the therapies which was demonstrated by low pre-therapy ratings. It would seem that scepticism towards hypnotherapy may inhibit a deeper trance state and affect the outcome of therapy. However, scepticism regarding EMDR, where participants gave low ratings pre-therapy was not reflected by post-therapy ratings. This is a most interesting finding and needs further investigation. It could be suggested that during EMDR sessions participants have concrete evidence of therapy effect, as they are aware of changed negative cognitions and emotions which are subjectively rated throughout the session; this enhances the perception of the beneficial effect of the therapy in the 'here and now'.

Previous research suggests that clients anticipate that change can be accomplished in a brief number of sessions, with three being the optimum number (Budman & Gurman, 1988; Garfield, 1989), and that this can be a key determinant of actual therapy outcome (Pekarik & Wierzbicki, 1986). Participants in the current research were informed at recruitment that two therapy sessions only would be given; this may have contributed to a positive therapeutic outcome. This is an interesting area for research and further studies which take the variables of perception and outcome of therapy into account should be undertaken.

B. State Anxiety and Performance

In the current study it was found that MPA was not evenly spread throughout the groups and that cognitive anxiety ranged across low, medium and high levels of state performance anxiety (STAI Y-1). State anxiety is primarily a result of faulty information which triggers affective negative responses (Beck & Clarke, 1997; Mandler, 1984); how events are perceived and interpreted may determine the type and intensity of the emotional response (Barlow, 2002a). Cognitive appraisal of the performance experience after two therapy sessions had changed perceptions positively in the treatment groups. An important finding was that both therapies were equally effective in achieving this in objective (STAI Y-1) and subjective anxiety (SRQ). The psychotherapies used in this

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study addressed implicit processes no longer in conscious awareness and desensitised past trauma; negative experiences and faulty cognitions and memories were reprocessed and changed.

The comments on the SRQs were enlightening and gave further insight into individual experiences of how the mind affects the body and the impact that this has on performance. The SRQs provided a rich source of idiographic information on the phenomenology of the performance experience. Previous research has noted the importance of both a nomothetic and idiographic investigative approach (Barlow & Nock, 2009). Seven participants in the current research (15%) had thought strongly of withdrawing to avoid performing. This indicates high levels of subjective negative perceptions of the forthcoming event. The comments indicated that cognitive anxiety could begin weeks before the performance and grow stronger as the performance approached; this supports previous research into the phenomenology of MPA (Kenny, 2011). Previous studies indicate that lack of concentration is a classic symptom of MPA (Craske & Craig, 1984; Steptoe 2001). In the current study it was found that audience distraction could affect concentration negatively and heighten anxiety. However a further finding was that audience support could enhance feelings of security, resulting in reduced state anxiety, supporting previous research by McPherson and Schubert (2004).

This study confirmed that cognitive anxiety co-varied positively with decreased somatic anxiety, showing the interrelationship of these two systems, and supports the findings of Landers and Lochbaum (1988). Participants in the high category of cognitive anxiety experienced significant decreases in performance anxiety post-therapy at the second performance and similarly experienced significant decreases in somatic symptoms of anxiety. However it should be noted that although there were decreases in somatic symptoms at the second performance overall in all three groups, no significant difference was found across the groups at the two measurement points. A possible explanation for this may be that those participants in the low, or the lower end of the medium category of cognitive anxiety (STAI Y-1) experienced fewer somatic symptoms in both performance 1 and 2 than participants in the high category; therefore a 'floor effect' may have operated here.

It was shown that a significant decrease in performance anxiety exerted a positive effect on performance outcome in the therapy groups but not in the control. This translated into more effective playing, obvious in both the audio and video recordings, relating to enhanced tonal quality, musical interpretation, overall accuracy, technical security and instrumental control. At the first performance lack of preparation was a factor which appeared to heighten anxiety, supporting Hardy, Beattie and Woodman (2007). It has been reported that maladaptive thought processes and behaviour are activated by a threatening performance and can be changed by therapeutic treatment (Kirchner, 2003); this is supported by the present study. However in the absence of therapies at performance 2, the control group also improved somewhat, but not to a significant degree. It has been found that second performances, where all aspects of the first performance were replicated, appeared to be less threatening (Connolly & Williamon, 2004). This could be a factor in enhancement of performance; however it could similarly be argued that non-therapy groups practise more between assessment points to demonstrate that they have improved without outside intervention. This is not straightforward and could be an area for future research.

C. Trait Anxiety

A valuable and unexpected outcome was that both therapies significantly reduced trait anxiety and a further interesting finding was that EMDR was significantly more effective in achieving this than CH. It is not surprising that EMDR was the more effective therapy in this instance; it is feasible that in a large group of musicians suffering from MPA a significant number may have deep-rooted psychological issues regarding performance. EMDR is a psychotherapy aimed at the pivotal event/trauma that caused the initial fear/reaction; by targeting past trauma the general anxiety level is decreased. This therapy also addresses the contemporary stimuli that might independently trigger the subjective fear.

Prior research informs us that an individual's trait levels of anxiety are relatively stable from baseline to the perception of a threatening situation (Spielberger, 1972). However the findings in this study demonstrate that trait anxiety levels are changeable on the application of the psychotherapies administered in this research.

D. Trait Anxiety Longitudinally

The current research demonstrated the importance of monitoring the trait component of anxiety to ascertain if decrements from baseline found post-therapy were still maintained longitudinally. Previous studies have monitored trait anxiety and have noted the mutability of the levels (Bernstein & Carmel, 1986; Carmel & Bernstein, 1990; Nagel, Himle, & Papsdorf, 1989). Research conducted by Brodsky and Sloboda (1997) using CBT as an intervention demonstrated that although trait levels reduced below baseline post-intervention during the research period, after a two-month monitoring period this was not maintained as all levels had returned to baseline. A pilot study conducted by Stern, Khalsa and Hofmann (2012) examined the effectiveness of a nine-week yoga practice on reducing MPA which still showed large decreases in trait anxiety from baseline at a one-year monitoring point. However only eight participants completed the Y-2 trait portion of the STAI questionnaire at this time, and therefore the data should be interpreted with caution. To the best of the author's knowledge the current research is the first large-scale study to examine the effects of interventions on trait anxiety longitudinally, at four months and one year, where significant decreases below baseline have been maintained.

The longitudinal reporting on trait anxiety at these measurement points demonstrates clearly the effectiveness of the psychotherapies used in this study after only two therapy sessions. At both measuring points significant decrements from baseline had been maintained and in some instances had decreased still further. In five cases reduced category levels (categorised from the Spielberger STAI questionnaire) had also been maintained. What is somewhat surprising is that in the absence of further therapy, at both the four-month and one-year monitoring period some participants not only maintained decreases below baseline but these decreased still further, showing the positive effect of the interventions over time. The literature suggests that positive perceptions of performance gained in therapy are continuous and that these perceptions may grow stronger over time. It further suggests that some variables are more positively affected over a longitudinal period than others (Steenbarger, 1994). It has been found that individual trait anxiety scores can increase systematically over time (Carmel & Bernstein, 1990); therefore it is feasible that they can also decrease systematically over time. In this research all participants were given the author's CD post-therapy and were advised to listen to this whenever they felt the need. It is difficult to ascertain whether the systematic decreases in trait anxiety were as a result of the benefits of listening to the CDs or whether this phenomenon would have occurred anyway.

The efficacy of the interventions in significantly reducing trait anxiety post-intervention and longitudinally has been demonstrated. 34 participants at the four-month monitoring point is a robust sample; however 17 respondents at the one-year monitoring point is a smaller sample and these results therefore need to be interpreted with caution as the findings might not be transferable to a larger sample. Further monitoring needs to be conducted at one year post-intervention with as large a sample as possible.

E. Performance Experiences Post-Intervention

In the current study there was strong evidence supporting the interrelationship of trait and state anxiety and the effect that these two factors exert on performance. However, as these states were assessed at the same time during the main research period, it is more difficult to ascertain the effect of trait anxiety alone on performance outcome. The LEPR however gave a subjective evaluation of performance experience alongside an assessment of trait anxiety. The longitudinal idiographic reports on cognitions and emotions in the weeks/days preceding and during performance highlighted that although a nervous apprehension could still be experienced, participants in general felt more confident. They were calmer, felt more in control of the situation, feelings of excitement were reported and there was little catastrophizing. A comparison of the LEPR with the longitudinal monitoring of trait anxiety showed that in general trait anxiety was related to performance outcome; it demonstrated that a noticeable reduction in trait anxiety levels exerted a positive effect on cognitions, resulting in an enhanced performance. These findings support Hamman (1985) in his supposition that a high trait level will have an adverse effect on state anxiety and performance.

F. Limitations

A weakness of this research which should be noted was that at the two longitudinal measuring points all groups (including the control) had received therapy; it is therefore more difficult to establish whether the significant decreases from baseline measurements to final time points are related to the presence or absence of therapy. It could be posited that a non-therapy group may have also experienced decreases in trait anxiety due to some uncontrolled variable. To make these findings more robust, future studies should extend this research by use of a control group throughout the whole period of research, including longitudinally.

It is also recognised by the author that the study was weakened in its design as the main researcher was also the therapist. Although independent assessment was adopted as far as possible, future studies could benefit from broadening the design by use of a therapist, or therapists, who are not involved in data collection; this would be a much more robust approach.

G. Conclusions

The aim of the study was to broaden the existing knowledge in this field by exploring the experience of MPA through the use of two psychotherapies which target implicit mental processes. The present research offers evidence for the effectiveness of both CH and EMDR for the significant reduction of cognitive anxiety (both state and trait) and significant enhancement of performance, after only two therapy sessions. Many writers and clinicians advocate the importance of using effective treatments for anxiety-based conditions; however there is little research which investigates the use of CH and EMDR for MPA and this study highlights that more research using these techniques is now required. The results suggest that the therapies have an important contribution to make to our understanding and treatment of the phenomenology of performance anxiety. The study has identified that further research is now required regarding the mutability of trait anxiety. The maintenance of significant reductions below baseline of trait levels of anxiety at four months and one year post-intervention makes a valuable contribution to research and extends current knowledge.

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Relationships between performers' intentions and observers' perception of embodied expression in collaborative classical music performance: A case study of a flute and marimba duo

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ABSTRACT

Background

Research indicates that musicians' bodily movements shape expressive intention and influence observer perception of performance (Broughton & Stevens, 2009; Davidson, 1993; Schutz & Lipscomb, 2007; Vines et al., 2006). Musicians working collaboratively must synchronise their performances, attuning their movements to achieve tightly coordinated performance (Davidson, 2012; Keller & Appel, 2010; Williamon & Davidson, 2002). Musicians also embed cues in memory during rehearsal to aid recall during performance (Chaffin & Imreh, 2002; Chaffin & Logan, 2006). These include expressive and technical elements, some of which may be shared in collaborative music making. There has been little examination of how musicians' embody their performance intentions, and how this relates to observer perception of performance.

Aims

The current study was designed to investigate how duo performers' intentions relate to observer perception of embodied audio-visual expression in classical music performance. We expected that performing musicians' shared performance intentions and individual expressive intentions would be reflected in observer perception of embodied expression witnessed in an audio-visual recording of a live duo performance.

Method

A live recording of an expert flute and marimba duo performance (1 min 33 s duration) served as the material for analysis. Two female expert classical musicians (one vocalist, one percussionist) independently analysed the audio-visual performance recording using Laban effort-shape analysis. The female duo performers reflected on their performance intentions and attentional foci (expression, coordination, or technique), using the performance recording as a prompt. Participants' effort-shape analyses and performance reflections were documented using ELAN (v.4.5.0) video-annotation software (Lausberg & Sloetjes, 2009; Sassenberg et al., 2011).

Results

The data were divided into one-second 'bins', which were examined for performer(s) intentions and observers' allied effort-shape analyses. Almost all intentions and cues were matched with observations of embodied expression; about one third by both observers. Observers documented effort-shape analyses in significantly more bins than performers reported intentions. Individual differences in the frequency and type of performer intention and observer effort-shape analyses were reported.

Conclusions

Accord was found between performers' individual and shared intentions and observer perception of embodied expression in collaborative music making. Results also suggest that expressive bodily movement in collaborative music making relates to sound production aspects particular to the score, and individual characteristics of performers, instruments, and observers. Performance training may be enhanced through a detailed understanding of how performers' individual and shared intentions are embodied in collaborative music making and perceived by observers.

Keywords

Bodily movement; music performance; collaborative performance; Laban effort-shape analysis; audio-visual perception

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Australian young children's musical engagement and development in family and community life

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ABSTRACT

Background

Across cultures, caregivers and infants communicate musically (Malloch & Trevarthen, 2009). As children grow, the particular socio-cultural context shapes individual musical engagement and development (Barrett, 2012). However, scant research has examined the musical engagement and development of young children at the cusp of infancy and toddlerhood. In a multicultural society, such as Australia, we consider how socio-cultural context might shape young children's musical engagement and development.

Aims

The current study is investigating the musical activities, uses and practices occurring in Australian young children's everyday lives. We seek to identify elements that might influence young children's pathways for musical engagement and development.

Method

A collective case study design involves primarily qualitative longitudinal data. Here we present data from the initial stage (six months) of this ongoing study. Fifteen Australian families, from a diversity of cultural backgrounds, with a young child (aged 0-12 months) are participants. The primary caregivers have participated in an initial interview, and completed a self-report questionnaire gathering demographic, family, music, health and wellbeing information. Families are capturing musical activities in their child's life through audio-visual recording, and "week-at-a-glance" diarising.

Results

Similarities exist across the case studies in the nature and use of musical activities between caregivers and young children, such as to moderate mood and emotion. Some activities are emphasised in, or unique to, particular families in accordance with differing beliefs, values, musical and cultural backgrounds, and family dynamics. Families use music to bond, to manage behaviour, and for a minority, physiological issues, such as low muscle tone. Young children demonstrate preference for rhythmic and interactive musical activities. Young children are listeners and active participants in informal and formalised contexts, such as library rhyme time. Some mothers express concern for how returning to work might negatively impact on the musical world created with their young children.

Conclusions

Australian young children's everyday lives are rich with musical engagement, the particulars of which are shaped by their individual socio-cultural context. This study contributes to the development of a cultural ecological model that identifies pathways and strategies to support musical engagement and development of Australian young children.

The research is funded by ARC Discovery grant led by Barrett and Welch, "Being and becoming musical: towards a cultural ecological model of early musical development" (DP130102488).

Keywords

Musical engagement, musical development, early childhood, home music activities, home music practices, socio-cultural context

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Myths, beliefs, and attitudes towards music piracy: Findings from qualitative research

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ABSTRACT

Background

Claims from industry bodies that music piracy harms the music industry tend to centre on the economic losses incurred from illegally sourcing copyrighted works, despite no readily observable evidence to support this. Individuals on either end of the debate who consider music piracy to be *good* or *bad* appear to demonstrate *confirmation bias*, favouring information which supports their beliefs. Where these beliefs come from remains largely unknown. A key theory stemming from criminology which has been widely used in relation to digital piracy is Sykes and Matza's (1957) techniques of neutralisation: the theory offers a framework in which to interpret the varied justifications individuals put forward to rationalise or neutralise their actions, in this case engagement in music piracy. The specific techniques are: *denial of responsibility, denial of injury, denial of victim, condemnation of condemners*, and *appeals to higher loyalties*. Research to date using this theory broadly reveals that music piracy is perceived as a victimless crime, lending to frequent use of 'denial' techniques.

Aims

This paper aims to advance knowledge on what beliefs and attitudes individuals engaging in music piracy hold and where they come from. Accordingly, qualitative methodology was utilised. In doing so, the research addresses a notable gap in the literature.

Method

Study One adopted online ethnographic observation, monitoring online discourse in three settings: Twitter, YouTube, and forums. Specifically, it sought to observe the various justifications people forward to rationalise engagement in music piracy in accordance with Sykes and Matza's (1957) techniques of neutralisation. Content analysis was used in a directed manner, given an existing coding scheme existed in the form of the techniques present in the theory used.

Study Two involved semi-structured interviews with four participants (two males and two females, aged 23 to 26), and aimed to complement and expand on the first study by more broadly exploring how music piracy fits within everyday music listening practices, including a consideration of the live music sector. Thematic analysis was used, in accordance with Braun and Clarke (2006).

Results

Study One.

Study One found ample evidence of the techniques of neutralization (Sykes & Matza, 1957) and, like the rest of the literature to date, an emphasis on the 'denial' techniques'. The *denial of injury* technique was notable, with many participants remarking on how rich musicians are and that music piracy cannot be affecting them negatively. For example:

Same way I just don't buy rap albums to listen to a guy tell me how many cars his buying and how he's throwing bills at strippers

The information put forward from participants did not appear to be designed to convince others but to reinforce their own beliefs; where they came from however, was unclear.

A new technique was also put forward: *denial of motives*. Many participants forwarded idealised notions of what it is like to be a musician and that it is a labour of love, of sorts; to want to be paid for creating music was viewed with skepticism. This rejects the commercial realities of being a musician.

I would be proud to see my album on #piratebay You can pay to be on itunes, you're only on pirate bay if people want your music

Importantly, those individuals engaging in music piracy were not found to share common beliefs and attitudes. In fact, a substantial volume of the activity on YouTube concerned self-confessed pirates exposing the rationalisation techniques of fellow pirates.

Again, as someone who pirates, NO, it's not sharing, it's fucking stealing. Don't pretend it's not. It's just stealing from rich people

One of the most striking (and unforeseen) observations during data collection was that users of all three online platforms discussed piracy behaviours so openly. Crucially, given many of the exchanges related to the protection of identities online, it cannot be inferred that participants were oblivious to their presence online as anonymous. Rather, it appears that the perception of being caught is so low that they simply did not worry about any negative consequences – one participant on YouTube reasoned that the chances of being caught are lower than that of being struck by lightning.

Additionally, participants were noted as frequently sharing links to pro-piracy news items and exchanging tips about overcoming technical circumventions to make piracy more difficult.

Hi, does anyone know or can anyone provide a list of mirrors that will help overcome the recently anounced Pirate Bay block in the UK?

Ultimately, findings supported Sykes and Matza's (1957) theory and corroborate Holt & Copes' (2009) observation that sub-cultural piracy knowledge is efficiently exchanged online. It was also shown that a variety of beliefs are prevalent amongst the sample explored and that these are often contradictory. Beyond uncovering rich data, this highlights the need for researchers to cease considering 'pirates' as one unified group: this important conclusion acts as a gentle reminder of how piracy operates in the real world and that academics ought to observe it in a more naturalistic manner, free from prejudice.

Study Two

Study Two identified three themes: *the role of digital music in everyday life; music piracy practices*; and *the live music experience and its relationship to music piracy*.

In terms of the first theme, *the role of digital music in everyday life*, interviewees revealed a multitude of different methods for listening to music, with different types of music-listening serving different functions. Subscription services were found to be particularly popular with all participants universally agreeing that they represent excellent value for money. With regards to music piracy, the price of music was argued by interviewees as a major driver in opting not to pay for music. Much discussion was utilitarian in nature, evaluating the different pros and cons of different recorded music formats, focused around cost.

Would 100% still go out and buy a CD rather than an mp3, because you then have the option of ripping it to mp3 and putting it on your i-Pod… Unless digital distribution got much cheaper (M, 24)

In the second theme, *music piracy practices*, participants echoed the sentiments from Study One concerning musicians' perceived wealth as a means to justify music piracy. However, distinctions were made between so-called 'smaller' bands and more successful ones where it was considered *wrong* to pirate music from upcoming bands. A conflict was evident when interviewees themselves introduced the moral dimension of music piracy and carefully reviewed the implications of their actions. One interviewee, for example, noted that:

Downloading illegally from artists who are a bit smaller, who are struggling to fill out some club or are playing really, really small tents at festivals, I think... I don't know, I can't be morally bothered that much, because I still do it (M, 24)

Where Spotify was observed as motivating legal purchases, music piracy was noted as similarly aiding music discovery for another.

In the third theme, *the live music experience and its relationship to music piracy*, interviewees revealed a variety of motivations behind choosing on whether or not go to a live concert. The social dimension of live music attendance was clear from interviewees. Additionally, money was less of an issue with live music than recorded music, despite live music having never been more expensive or with recorded music never having been cheaper. Discussing one concert which involved considerable travel and accommodation costs, one interviewee explained:

I just took it straight out of my savings, because I'm just like, I did not care about money. That was an experience (F, 26)

Ultimately, live music was found to satisfy different desires than recorded music and that when possible, interviewees would attend live concerts. There was also a general consensus that live music attendance is necessary to support your favourite artists live.

All participants discussed their behaviours openly and matter-of-factly, lending to their belief that music piracy was simply a matter of routine and was 'victimless'. Participants did not express any concern for being caught or punished for engaging in music piracy. This mirrors Study One.

Conclusions

The results of the studies offered unique insights into the decision-making of those engaged in music piracy, as well as highlighting the very different approaches to paying for recorded music and live music. Methodologically, the results confirm the usefulness of qualitative methods with individuals engaging in music piracy more than willing to simply talk about their attitudes and behaviours, generating rich and unexpected data in the process. Only with more research will the true origins of piracy attitudes be uncovered, but the current research defines an important starting point: so-called music pirates do not all share the same beliefs and attitudes.

Keywords

Music piracy, music industry, digital music, musical identities, qualitative.

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Exploring musical concepts for their relevance to primary school children's music preferences

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ABSTRACT

Background

Building on Behne's (1975) construct of musical concepts (beliefs, attitudes, information etc. hold by an individual concerning a musical object) the study explores the development of such concepts and their relevance for primary school children's music preferences. This ties in with the assumption of growing stylistic sensitivity being relevant to age-related changes in "open-earedness" (Hargreaves, 1982, i.a. Gembris & Schellberg, 2003). The framework of musical concepts seeks to extend the construct of attitudes by placing them into a broader associative network (cf. Bunte, 2014). Behne (1975) sees musical concepts as constructed of cognitive, evaluative, emotional and other associative elements (ibid, p. 36). This idea is compatible with the notions of social and cognitive schema. Building and extending Behne's construct of musical concepts, this study utilizes a music-specific social cognitive approach.

Aims

The study aims at investigating (1) what kind of musical concepts children already possess, (2) how concepts develop during primary school, and (3) what their role is in children's aesthetic judgment of music.

Method

In second (t1) and fourth grade (t2) children (n=31) were interviewed in small groups (boys only, girls only, and mixed groups) on their music preferences using guided interview technique. Being conducted in rooms of children's schools the interviews length ranged from 18 to 30 minutes at t1 and from 33 to 40 minutes at t2. Structuring and summarizing techniques of content analysis (Mayring, 2010) were used in order to develop a category system capturing musical concepts. Concept categories were analyzed with regards to the occurrence of musical concepts and their possible changes from t1 to t2. Additionally, differences between girls' and boys' statements were analyzed minding the discursive character of the interview situation by accounting for the order of statements.

The interviewed children form a sub-sample of a larger sample of primary school children (n=735) questioned in a longitudinal study with regard to the development of their music preferences measured by a sound questionnaire (Busch et al., 2014). Results of the interview study are triangulated with results of the quantitative study in order to explore the relevance of musical concepts for the evaluation of music.

Results

The interview analyses disclose musical concepts used by children to describe their music preferences already in second grade. In the interviews of both interview points nine concept categories, depicting certain kinds of music, could be differentiated: genre, gender, mood, country or language, musician, up-to-dateness and popularity, age, institution (cf. Bunte, 2014). In t1 the genre concept "rock music" is of importance particularly for boys showing a strong association with the gender concept of "boy's music". Gender-specific concepts have been detected at both interview points, but in t2 they remain relevant for boys' preferences only. Furthermore, the up-to-dateness and popularity oriented concept "charts music" appears as a new reference point in t2. The results also show that the occurrence and usage of genre concepts increase from t1 to t2.

Triangulation shows that musical concepts have explanatory potential for age- and gender-dependent differences in music preference development (Busch et al., 2014).

Conclusions

The results can be related to research on gender associations towards musical instruments and genres and on the development of musical style discrimination. This integrative potential of the framework of musical concepts makes it a beneficial perspective in understanding children's music preference development.

Keywords

Musical concepts, Music preference, Primary school children

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Predicting stimulus tempo and experiment instructions from music-induced movement

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ABSTRACT

Background

Full-body movements reveal complex patterns of sensorimotor coordination to music, in particular rhythmic structures. However, the ways humans move differently related to systematic changes in musical tempo have not been extensively studied.

Aims

This study investigates whether movement characteristics are altered when moving to the same music at different tempos. Furthermore, the effect of instructing participants to give a fast or a slow interpretation to music of the same tempo is examined.

Method

Thirty participants were presented with six Motown songs. First, each song reoccurred in two time-stretched versions at ±5 BPM of the original tempo, to which participants were asked to dance freely/spontaneously. Following this, each song was presented two times at the original tempo, with the participants being instructed to provide a "fast/vigorous" and a "slow/relaxed" interpretation. An optical motion capture system was used to record participants' movements, from which 16 movement features related to speed, acceleration, complexity, amount, and rotation were subsequently extracted.

Results

Two logistic regressions were conducted, one predicting the time-stretched trials, the other predicting the instructed trials, with the 16 movement features as predictors. A forward-stepwise approach was chosen, resulting in statistically significant models in both cases (time-stretched: $\chi^2(2)=31.67$, $p<.001$; instructed: $\chi^2(9)=395.12$, $p<.001$). In the time-stretched case, Foot Acceleration and Body Rotation were found to be significant predictors. Nagelkerke's R^2 of .11 indicated a rather low strength of association; however, the non-significant Hosmer and Lemeshow test ($\chi^2(8)=4.50$, $p=.81$) denoted an adequate fit, with the model correctly classifying 63.3% of cases. In the instructed condition, nine movement features, including Amount and Area of Movement, Hand and Foot Acceleration, Hip Wiggle, and Lower Body Complexity, were found significant predictors. Nagelkerke's R^2 of .89 indicated a strong association, with the non-significant Hosmer and Lemeshow test ($\chi^2(8)=4.36$, $p=.82$) implying an adequate fit, and correct classification of 93.6%.

Conclusions

This study suggests that participants embodied different tempos and different instructions for the same song with somewhat specific and coherent movement features. The effect of tempo was simpler, as it was related to only two movement features, whereas the effect of instruction affected a large number of features.

Keywords

Movement analysis, motion capture, tempo, logistic regression,

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Adaptive music recognition games for Dementia therapy

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ABSTRACT

Background

In partnership with the Manchester Museum of Science and Industry, the Wellcome Trust, and the Manchester City Council, Burgoyne et al. (2014) created Hooked on Music, a citizen-science experiment on long-term musical memory.[1] It takes the form of a timed music recognition game requiring no knowledge of music trivia, only an accurate auditory image. It is currently a static experiment, drawing uniformly for each participant from a sample of popular commercial recording fragments, but it relies on a similar game-scoring rule that powers recent developments in item-response theory for exploiting reaction times in computer-adaptive testing (Maris & Van der Maas, 2012).

Aims

We are investigating whether these developments could work to make Hooked on Music adaptive, predicting the most memorable fragments per participant and updating those predictions with every new play. If so, the game could be extended toward a therapeutic tool for dementia. Dementia patients benefit from personalised music therapy using familiar music (Gerdner, 2005; Sacks, 2007), but when these patients struggle to communicate verbally, it is difficult to identify what music best triggers memories. Because Hooked on Music is a strictly musical game, an adaptive version might be able to help caregivers overcome this verbal communication barrier. Before moving into the dementia community, however, it is important first to confirm that the adaptive approach can work in a healthy population and yield results comparable to the original experiment.

Main Contribution

The first Hooked on Music data have been analysed with linear ballistic accumulators (LBA), a variant of the classical drift-diffusion model (Brown & Heathcote, 2008). This model takes into account some differences between individuals and yields precise estimates of recognisability, but it is too computationally intensive to be practical for adaptive updating. The recognisability estimates from LBA correlate positively, however, with the difficulty estimates from two simpler item-response models – *signed residual time* (Maris & Van der Maas, 2012) and *item-response trees* (Partchev & De Boeck, 2012) – which are practical for on-line adaptation.

Moreover, Van Balen et al. (2015) have developed a technique for uncovering the relative effects of melody, harmony, and timbre on the LBA recognisablity results, a technique which can also provide vector-valued difficulty ratings for seeding multidimensional variants of the aforementioned item-response models. With multidimensional item-response models, Hooked on Music could make more refined matches between musical fragments and participants and provide explicit estimates of participants' preferred musical recall strategies (melodic, harmonic, or timbral).

Hooked on Music has been played over 2 million times by more than 120 000 participants and remains popular. In tandem with the Manchester Science Festival 2015, we will replace the back-end of Hooked on Music to incorporate item selection according to a multidimensional item-response model. Difficulty estimates will be fixed according to the LBA analysis of previous data and participants' abilities will be estimated adaptively as they play. With this new back end, we will be able to evaluate how effectively Hooked on Music could be used to personalise playlists for maximal recognition.

Implications

Although the drift-diffusion family is the traditional best-of-class approach for analysing reaction times, item-response models can recover the same underlying phenomenon with the added benefit of real-time adaptivity. Therapeutically, such adaptivity could identify personalised playlists, a particular advantage for dementia patients who struggle to communicate verbally.

Keywords

Dementia, memory, music therapy, item-response models, reaction times

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Exploring audiences at live coding events

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ABSTRACT

Background

As an arts practice, live coding has its roots in musical performance, and the fact that its 'liveness' requires the performer to write and modify algorithms in real time (Collins et al, 2003) means that it might be thought of as a kind of improvisation. 2014 saw the tenth anniversary of organized live coding (Magnusson, 2014), and during this decade it has been manifested in a variety of different contexts. Whilst there is a growing body of research addressing aspects of live coding from the performer's perspective, little is known about the audiences for these events. Therefore this paper seeks to explore the motivations, experiences, and responses of live coding audiences in a variety of performance contexts.

Aims

This paper aims to understand the experience of being a member of a live coding audience. In particular the research seeks to explore:

1) the role and impact of the source code (projected as part of the performance);

2) the impact of the audience on the development of that code; and

3) the audience's response to music being visibly created in the moment.

Method

Data were collected using a mixed-methods approach as follows:

1) Observations of two live coding events were carried out initially in order to provide a framework for the subsequent stages of data collection.

1) Audiences from a range of live performance events in the UK and Europe were invited to complete an online questionnaire which was designed to explore participants' motivations to attend live coding events, as well as their experiences and responses during those performances.

2) Some of the questionnaire respondents also participated in follow-up semi-structured interviews which provided a more detailed and contextually situated insight into their experiences during live coding events.

3) A small number of performers (coders and instrumental performers) also agreed to participate in a semi-structured interview which allowed a detailed exploration of the ways in which audiences and other performers directly impact upon their coding practices during a live performance.

Results

Initial findings suggest that there are similarities between live coding and free improvisation events (e.g. Burland & Windsor, 2014) – audiences enjoy the sense that they are contributing to the development of the music through their participation in the event – whether this is overt (i.e. dancing, cheering) or more subtle (i.e. standing, listening, appreciating (or not)). The physical presence of the performer(s) and any on-stage interaction enhances the experience of the event in much the same way as in more traditional performance contexts (cf. Burland & Pitts, 2014), and the presence of the projected code adds yet another dimension to the visual show. In many ways there are similarities between live coders and DJs who make context-dependent choices about the musical shape of the performance (Greasley & Prior, 2013), and these relate, in part, to the venues in which live coding events take place, but the fact that the music is created in real time adds a further dimension which will be considered within the paper.

Conclusions

In previously under-explored territory, this is an exciting area of research which may shed new light on the role of audiences, openness and technology in live musical performances.

Keywords

Audiences; technology; live coding; live performance

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Prominent cerebello-hippocampal connectivity in musicians during music listening

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ABSTRACT

Background

The acquisition of fine motor skills through intensive musical training can modify both function and structure of the brain. Previous research (Onuki et al., 2013) has found that the hippocampus and cerebellum interact during spatio-temporal prediction of motor sequences following preceding visual cues. This phenomenon has however not been studied and compared in the context of music with musically trained and untrained individuals as they listen to music.

Aims

We hypothesized that differences in functional connectivity of this network may exist between musicians and nonmusicians during continuous listening to music. In particular, we expected musicians to exhibit stronger cerebello-hippocampal connectivity than nonmusicians as they anticipated musical events.

Method

Participants' (18 musicians and 18 nonmusicians) brain responses were recorded using functional magnetic resonance imaging (fMRI) while they listened to three music pieces of different genres. For each participant, we computed the functional connectivity (temporal coactivation) between the averaged voxel time courses of the hippocampal area and all voxel time courses of the cerebellum. Following this, we performed t-tests between groups to assess whether differences in the cerebello-hippocampal functional connectivity exist.

Results

Preliminary statistical analyses supported our hypothesis: we found that the strength of the cerebello-hippocampal network was increased in musicians compared to nonmusicians during music listening.

Conclusions

The observed increased connectivity between hippocampus and cerebellum may be explained by musicians' anticipatory imagery in response to the musical flow, aiding in the prediction of subsequent musical events. From an embodied cognition perspective, musicians may be mentally simulating motor sequences needed to produce the music. This simulation is facilitated via strengthened coupling between produced and heard sounds through life long instrument practice. Thus, our findings may indicate that musicians' spatiotemporal prediction of fine motor actions, as observed in the cerebello-hippocampal connectivity, can also occur during music listening: during perception they perform action simulation.

Keywords

fMRI, music, neuroscience, functional connectivity, hippocampus, cerebellum, naturalistic paradigm.

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Structural blending of harmonic spaces: A computational approach

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ABSTRACT

This research focuses on concept invention processes and suggests that structural blending is a powerful mechanism that gives rise to novel musical concepts. Structural blending is omnipresent across several formal musical levels, from individual pieces harmoniously combining music characteristics of different pieces/styles, to entire musical styles having emerged as a result of blending between diverse music idioms. In this paper, we focus on conceptual blending in the domain of musical harmony and present primarily computational examples in the following harmonic domains: chord-level blending, chord sequence blending, scale blending, harmonic structure level blending, melody-harmony level blending. Structural blending can be used not only for music analysis and music understanding, but more so it may form the basis for creative / generative music systems; processes of conceptual blending can be incorporated in computational compositional systems, facilitating the creation of original music structures/pieces/styles and contributing to a richer comprehension / experience of music.

I. INTRODUCTION

New concepts may be invented by 'exploring' previously unexplored regions of a given conceptual space (exploratory creativity) or transforming in novel ways established concepts (transformational creativity) or by making associations between different conceptual spaces that are not directly linked (combinational creativity). Boden maintains that the latter, i.e., combinational creativity, has proved to be the hardest to describe formally (Boden 2009).

Conceptual blending is a cognitive theory developed by Fauconnier and Turner (2003; 2006) whereby elements from diverse, but structurally-related, mental spaces are 'blended' giving rise to new conceptual spaces that often possess new powerful interpretative properties allowing better understanding of known concepts or the emergence of novel concepts altogether. Conceptual blending is a process that allows the construction of meaning by correlating elements and structures of diverse conceptual spaces. It relates directly to Boden's notion of combinational creativity.

With regards to music, conceptual blending has been predominantly theorised as the cross-domain integration of musical & extra-musical domains such as text or image (e.g. Zbikowski 2002 & 2008; Cook 2001; Moore 2012), and primarily discussed from a musico-analytical perspective focusing on structural and semantic integration. Blending as a phenomenon involving 'intra-musical' elements (Spitzer 2003, Antovic 2011) is less straightforward. In principle, one of the main differences of blending theory from the theory of Conceptual Metaphor (CMT) is that it may involve mappings between incongruous spaces *within* a domain (e.g. conflicting tonalities in a musical composition). In this case, 'intra-musical' conceptual blending in music is often conflated with the notion of structural blending (Goguen & Harrell, 2012), and Fauconnier and Turner's theory is primarily applied to the integration of different or conflicting structural elements, such as chords, harmonic spaces, or even melodic-harmonic material from different idioms (e.g. Kaliakatsos-Papakostas et al. 2014; Ox 2012). A more extended discussion and critical examination of conceptual blending processes in music is presented in (Stefanou and Cambouropoulos, 2015).

In this paper it is maintained that the creative potential of conceptual blending (i.e., invention of new blends) in the domain of music is, probably, most powerfully manifest in processes that enable structural blending This study focuses on structural musical blending processes that are omnipresent across several formal musical levels, from individual pieces harmoniously combining music characteristics of different pieces/styles, to entire musical styles having emerged as a result of blending between diverse music idioms.

In the next section a succinct description of the core computational blending model is given, and, then, in section III, examples are given that illustrate the application of the theory of conceptual blending in the domain of music harmony.

II. FORMAL MODEL & HARMONY

In the context of the COINVENT project (Schorlemmer et al., 2014) a model is being developed that is based on Goguen's proposal of a Unified Concept Theory (Goguen, 2006), inspired by the category-theoretical formalisation of blending (Goguen, 1999) that employs the category-theoretical colimit operation to compute blends. This methodological framework incorporates important interdisciplinary research advances from cognitive science, artificial intelligence, formal methods and computational creativity. As an illustration of the model's potentialities, a proof-of-concept autonomous computational creative system that performs melodic harmonization is developed.

Different musical styles/idioms establish independent harmonic spaces that involve a network of inter-related constituent concepts such as chord, root, scale hierarchy, tonality, harmonic rhythm, harmonic progression, voice-leading, implied harmony, reduction, prolongation and so on. Conceptual blending is facilitated when a rich background of concepts is available and when these concepts are structured in such ways that creative mappings are supported. Thereby, the

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existence of a rich background that includes formal descriptions of diverse harmonic elements is required, which fosters the selection and combination of concepts that inject novelty and creativity to the melodic harmonization process. A rich idiom-independent representation of harmonic concepts is proposed: from the 'primitive' chord events (see General Chord Type representation – Cambouropoulos et al 2014) to a hierarchical multiple-viewpoint representation of harmonic structure that allows 'meaningful' blends at various hierarchic levels of harmony. Knowledge extracted from a large dataset of more than 400 harmonically annotated pieces from various diverse musical pieces (mainly in a statistical formalization) comprise the rich background required for interesting and creative blends.

A core-model for conceptual blending has been developed that is schematized in Figure 1. According to this model, conceptual blending is employed between two input spaces, I1 and I2, while it is based on generalizing some concepts that pertain either to I1 or I2, leading to the respective 'weakened' input spaces, I1' and I2', where I1'and I2' are more general than I1 and I2 respectively (Ontañón and Plaza 2012). The concepts that are common in both input spaces are preserved in the 'generic' space (denoted by G in Figure 1). It is expected that two conceptual spaces, I1 and I2, will most likely include concepts that are incompatible and/or contradicting. To this end, the generalisation operation is successively employed for the weakening the input spaces for as long as there are contradicting concepts between them. This process leads to the resolution of all incompatibilities and contradictions, allowing the compatible and non-contradicting parts of the input spaces to be combined/blended ('blend' denoted by B in Figure 1).

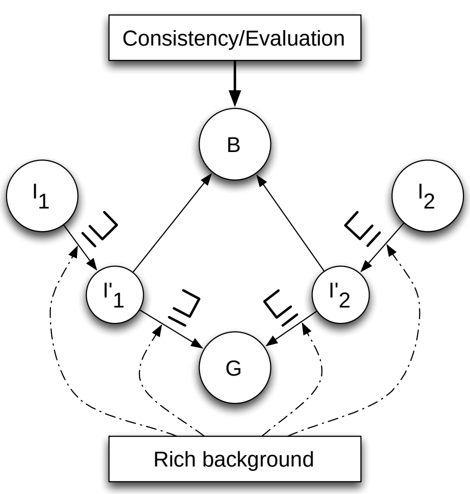

Figure 1. The COINVENT core model for conceptual blending between two input spaces (I1 and I2).

When considering, however, conceptual blending for input spaces that are grounded on rich knowledge repositories, there are numerous possibilities for generalisation, leading to questions about which generalisation scenario would yield a 'useful' or 'interesting' blend. Thereby, the utilisation of background knowledge is required for setting some domain-specific limitations to the generalisation possibilities that would potentially make sense, as well as a mechanism for consistency/evaluation check of the resulting-blended conceptual space.

An important part of a creative blending process is the evaluation of its output. Evaluating creativity - either human or computational - is a non-trivial task, especially when the assessment of aesthetic quality is also involved - a comprehensive discussion on aesthetic appreciation and aesthetic judgments is presented by Leder et al. (2004). The mere definition of creativity is problematic and not commonly accepted as many authors approach it from different perspectives (e.g. Boden, 2004; Wiggins, 2006; for a comprehensive discussion see Jordanous, 2012). Creativity is often approached by breaking it down into smaller constituent dimensions (e.g. novelty, value, surprise, problem solving ability, originality, divergence etc.). In terms of assessing a creative system, the two usual approaches are either to evaluate directly the product of the system or to evaluate the productive mechanism (Pearce, 2001). A preliminary empirical evaluation of the output of the chord blending module of the melodic harmonisation system is given in section III-A.

Aim of this paper is to provide an overview of the wide spectrum of creative applications that the development of the COINVENT blending model introduces in the context of a melodic harmoniser, and to present examples of conceptual blending in musical harmony, in the following harmonic domains:

- Chord-level blending: Individual chords that share common properties are blended giving rise to novel instances of chord functions (e.g., cadence blending)
- Chord sequence blending: sequences of chords from different idioms are blended creating sequences of different degrees of originality (sequence concatenation and sequence chord-to-chord bending
- Scale-blending: Scales are combined to create novel artificial scales.
- Melody-harmony level: a given melody with specific properties and implied harmonic space(s) is blended with features of a different harmonic space allowing the generation of novel melodic harmonisations.
- Harmonic structure level: different levels of harmonic structure from diverse harmonic spaces are combined generating 'coherent' new blended harmonies.

The presented examples aim to demonstrate the effectiveness of the computational model in 'inventing' novel concepts (like the 'invention' of the tritone substitution progression in the next section). Some of these examples are generated computationally, others are described theoretically in a systematic manner with the view to implementing them in the COINVENT melodic harmonisation system.

III. HARMONIC BLENDING EXAMPLES

A. Chord Level Blending

Chords can be seen not only as simple collections of co-sounding notes, but as richer concepts that embody several properties/relations: from roots, types and degrees of dissonance to voice leading characteristics and chord functionality. Is it possible to blend different chordal input spaces? As a first experiment, an attempt has been made to blend musical cadences (Eppe et al., 2015), and, more specifically, the pre-final chords of cadences that have well-established functional characteristics. For instance, conceptual blending may be applied to the input spaces of a perfect cadence and a phrygian cadence (Figure 2), these being represented as collections of notes in a tonal context with weights attached to each note based on functional properties (e.g. salience of leading note or tritone in the prefinal chord of the perfect cadence – see bold lines in Figure 2). This blending process gives rise to the Tritone Substitution progression (a cadential type that emerged in jazz, centuries after the main tonal/modal input cadences! – see Figure 2); many other blends are possible (e.g. backdoor progression/cadence – see Figure 2) some of which have been examined further in an empirical listening test (see below).

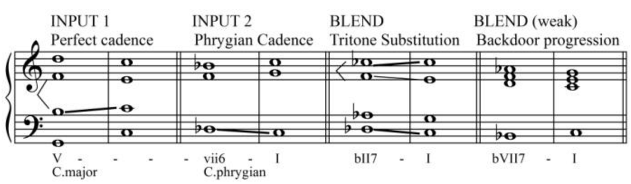

Figure 2. Conceptual blending between the basic perfect and phrygian cadences gives rise to the Tritone Substitution progression / cadence (the Backdoor progression can also be derived as a blend, even though a weaker blend).

A preliminary subjective evaluation of the proposed blending system has been conducted (Zacharakis et al., 2015). A pairwise dissimilarity listening test using as stimuli original and blended cadences (in total nine cadences) produced by the system was conducted. Multidimensional Scaling analysis provided spatial configurations for both behavioural data and the dissimilarity estimations by the algorithm. The aim of the study was to examine whether perceptual distances between pairs of cadences, as rated by the participants, were actually reflected by distance metrics that relate to the formalisation of cadences in the blending system. The comparative results show that the system is capable of making fair predictions of the perceived dissimilarities between the blended cadences and that the system can model the perceptual space quite accurately.

B. Chord Sequence Level Blending

Chord level blending can be employed for chord sequence concatenation (i.e. connecting sequences that cannot be 'naturally' connected within a certain idiom) or for original sequence blendings (e.g., blending of chord with similar functions in two sequences, or, even, full bending of every corresponding chord in two sequences).

Suppose we have trained a harmonic system on the basic major-minor harmonic idiom (without chromatic alterations). The system has learned basic chords (e.g., major, major seventh, minor, diminished, diminished seventh) and chord progressions (e.g. first-order transition matrices) for the major and minor scales separately, and, can use these to generate new chord sequences (Kaliakatsos-Papakostas et al., 2014). Such a system works fine within a certain key, but may reach an impasse if a transition to a new distant key is required. For instance, let us suppose that a chord sequence starts in C major and at some point it is forced to proceed into a chord progression starting with chords G#7-C# (remote modulation from C major to C# major). The system will not find any transition from the available diatonic chords in C major to the G#7 chord and will terminate or give an arbitrary continuation. Could chord blending give a solution to overcome this impasse creating an acceptable transition to bridge these two remote key areas?

Let us assume that the system has generated a sequence of chords in C major such as C-Dm-G7-C-(F) and then encounters the G#7-C# modulation chords. The C major chord can be followed by a number of chords (e.g. F, Fm, G etc.) but not G#7. Is it possible to blend, for instance, F with G#7 to create a new transitional chord that bridges the two key regions? F is [5,9,0] and G#7 is [8,0,3,6] in pitch class (pc) notation. If we blend these two chords and constrain the resulting chord to belong to one of the basic chord types (e.g., 4-note tertian chords such as major seventh, diminished seventh), we get [0,3,6,9] which contains two notes from the first chord and three from the second; this resultant chord is the diminished seventh chord that is well-known to be very versatile and useful for modulations to various keys. The blending mechanism 'invents' a new chord state that bridges the two key regions. This chord can then be used as an ending constraint to the C major (first) tonality and, at the same time, as a beginning constraint to the C# major (second) tonality, allowing the chord sequence generator of the melodic harmoniser (Kaliakatsos-Papakostas et al., 2014) to construct a chord sequence that covers both tonality areas.

Chord blending may be employed not only to connect different chord sequences, but to blend in a chord-to-chord fashion two different sequences. Such experiments are currently performed and are part of ongoing research.

C. Scale Blending

Using a similar strategy as the one employed for chord blending, it is possible to create new scales. Especially in jazz a variety of non-diatonic scales are used, many of which can be seen as blends between standard established scales. Aspects of the scale ontologies that may enter the blending process are individual scale degrees, whole tetrachords, and/or tonic degrees. The examples presented in Figure 3 are some interesting cases – these have been assembled manually for the scope of this paper and are part of ongoing research in computational music blending.

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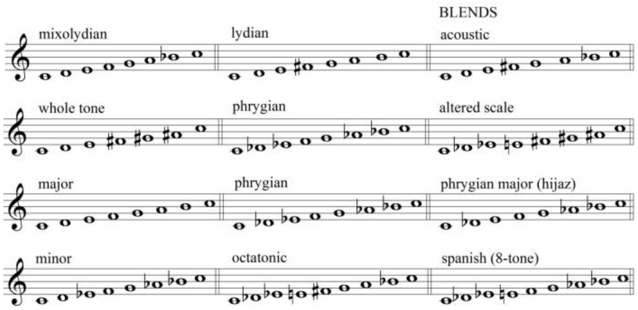


Figure 3. Scale blending - the last scale in each staff may be seen as a blend between degrees of the two previous scales.

Scale blending may be used in the context of the proposed harmoniser as a means to alleviate inconsistencies between the scale upon which a given melody is built and the scale(s) associated with a proposed harmonic space.

D. Melody – Harmony Level Blending

The friction between musical styles and potential incompatibilities can prompt creative processes that allow new concepts to emerge. Musical creativity often arises when radically different musical idioms/styles intersect. Attempting to harmonise given melodies in foreign harmonic styles is a domain which allows different musical concepts to meet, or even clash, making it an appropriate field to explore musical blending and concept invention (for instance, in the context of the movement of musical nationalism that emerged in the 19th century, composers *blended* local musical elements such as folk melodies with aspects of established western musical idioms such as classical tonality or post-tonal harmony, giving rise to new harmonic musical styles).

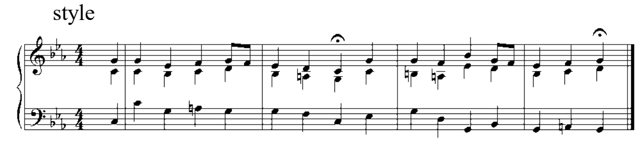
A melody embodies a rich set of musical concepts that relate to scales, tonal centres, motives, cadential patterns, phrase structure, rhythmic characteristics, implied harmony, and so on. Harmonising a given melody within its implied 'natural' harmonic space involves primarily exploratory creative processes, whereas a foreign harmonic language triggers the need to combine different musical spaces leading to novel harmonic concepts (combinational creativity). A number of different harmonisations of a single melody are given in Figures 4 & 5; the harmonisations are created automatically by the COINVENT melodic harmoniser (see next subsection; at this stage, chord types are computer-generated - voice leading is added manually). The creative system is expected to be able to adapt/adjust existing harmonic systems to foreign (possibly incompatible) melodic structures by means of transformation and/or invention of new harmonic concepts; in this phase, however, the alignment of two distinct musical spaces is assisted by the user (e.g. which notes should be harmonised, harmonic rhythm, selection of 'appropriate' harmonic idiom for selected melody).

a. Michelle (Beatles) harmonised in Bach chorale style

b. Michelle (Beatles) harmonised in traditional jazz style

Figure 4. Two different harmonisations of *Michelle* by The Beatles (chord types generated by melodic harmoniser).

a. Bach Chorale melody harmonised in medieval Fauxbourdon style



b. Bach Chorale melody harmonised in Renaissance modal style

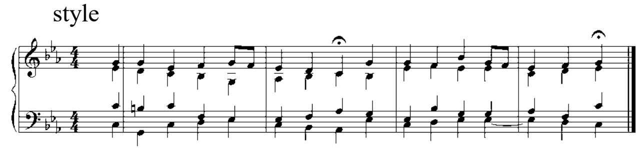


Figure 5. Two different harmonisations of a Bach Chorale melody (chord types generated by melodic harmoniser).

E. Harmonic Structure Level Blending

Conceptual invention and blending is facilitated when a rich background of diverse concepts is available and when these concepts are structured in such ways that creative mappings are supported. When concept invention takes place, the rich structural networks that often lie dormant under 'seemingly' simple concepts, get activated enabling meaningful mappings and productive blends. A computational system of (musical) creativity must have access to such rich underlying structural representations on various hierarchic levels.

It is maintained that a melodic harmonisation assistant that facilitates conceptual blending should allow a modular highly structured representation of harmonic concepts in an explicit manner at various hierarchic levels and parametric viewpoints. In this study, five constituent structural components of harmony are explicitly represented:

- Harmonic pitch space: scales, pitch hierarchies in scales, consonance/dissonance, chord types.
- Chord transitions: Learning of chord transitions from corpus data in one or more idioms/styles (e.g. dominant is followed most commonly by tonic chord).
- Cadences: Learning of chord transitions that end phrases at various hierarchic levels (e.g. for tonal music, perfect cadence for the highest level cadence, other types of cadences at various lower level structural boundaries).

- Modulations: Changes of harmonic pitch spaces that characterise a certain style (e.g. neighbouring/distant tonalities, density of modulations, etc.).
- Voice leading: general characteristics of the way chords are realised and connected in a given idiom (e.g. parallel/similar/oblique/contrary motion, drone tones, repetition or 'compulsory' motion of certain pitches, preparation/resolution of dissonance, etc.).

In the current study, at the lowest level the General Chord Type (GCT) representation (Cambouropoulos et al 2014) has been utilised for automatically encoding chords in the context of a given pitch space and consonance/dissonance ordering of intervals. Then this extracted encoding is used for harmonic learning at various levels. Kaliakatsos-Papakostas et al. (2014) introduce a constrained HMM (cHMM) that combines a well–studied probabilistic methodology, namely, the hidden Markov model (HMM), with constraints that incorporate fixed beginning and/or ending chords and/or intermediate anchor chords. Beginning or ending chords (cadences) and intermediate chords (e.g. relating to tonicisations/modulations/phrase endings) are represented using simple probabilistic grammars that capture harmonic dependencies among distant events. The application of efficient voice leading is also tackled through a statistical learning technique, which encapsulates statistical information about pitch height contour relations between the constituent pitches of successive chords. The phrase structure and the voice-leading statistical learning methodology are parts of ongoing research.

Once structural characteristics of diverse harmonic idioms are induced in an explicit modular fashion, then blends can be created that combine different harmonic aspects from different harmonic spaces. For instance, modal chord transitions may be combined with tonal cadences (see example in Figure 6), or, more 'adventurous' arbitrary blends may be generated that combine, say, atonal chord transitions with tonal voice leading and jazz cadences. Such harmonic blending can be found in music by composers of different periods (most notably in the 20th century).

Figure 6. Bach Chorale melody harmonised in medieval Fauxbourdon style with inserted tonal cadences (cf. Figure 5a).

IV. CONCLUSION

Structural conceptual blending in music is a powerful mechanism that gives rise to novel musical concepts. In this study, a number of computational examples have been presented in the domain of harmony; these examples highlight the potential of the proposed formal conceptual blending strategy. More specifically, examples were presented in harmonic blending at the level of chords (cadences), chord sequences, scales, harmonic structure modules, and melodic harmonisation. Structural blending can be used for understanding musical structures, but, additionally, it may form the basis for creative / generative music systems. It is suggested that formal blending processes can be incorporated in computational compositional systems, in order to invent new harmonic concepts and to create original music structures/styles. It is suggested that conceptual blending may contribute to a richer comprehension/experience of music and to the development of more creative compositional systems.

ACKNOWLEDGMENTS

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Relationship between extraversion, agreeableness, and spontaneous motor tempo

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ABSTRACT

Background

There is already more than 100 years worth of research regarding spontaneous motor tempo (SMT) in tapping and gait, however most of this research has focused on general tendencies, such as defining the average preferred rate for SMT as around 2hz, though individual differences exist and may partially be explained by such factors and age and physical fitness level. There is, however, a lack of research investigating how individual differences such as personality might be related to SMT. Neuroticism, a trait related to anxiety, has been shown to relate to increased motor cortex excitability (Wassermann, Greenberg, Nguyen & Murphy, 2001). Differences in movement features related to personality have previously been found in dance studies, with Extraversion, Agreeableness and Conscientiousness relating to higher levels of global movement and Neuroticism to higher levels of local movement (Luck, Saarikallio, Burger, Thompson, Toiviainen, 2010), suggesting that personality may indeed be evident in motor responses.

Aims

This research seeks to explore the manifestations of personality in SMT, with the goal of providing insight into personality differences in more general music-related movements. We expected that personality traits would correlate to variables such as tapping rate and variability, perhaps along similar lines as they relate to dance movements.

Method

Thirty participants of 15 different nationalities (15 female, mean age: 28.2, SD of age: 4.4) were recruited from the University of Jyväskylä, Four participants had received professional music education. Participants were instructed to "tap at a comfortable rate" using the spacebar of a keyboard. A Max interface was used to record inter-onset-intervals (IOIs) for two 15-second trials. Means and standards deviations of IOIs were quantified form this data. Big Five personality traits were measured using the Ten-Item Personality Inventory.

Results

Participants rating higher in Extraversion tended to have a faster SMT than less extroverted participants during the first trial (r = .39, p<.05), to slow down during the second trial (r = .51, p = <.01), and to display higher overall IOI variability (r = .47, p = <.01). Participants rating high on the Agreeableness scale tended to tap more slowly overall (r = .51, p = <.01).

Conclusions

These results suggest that personality traits may be evident in SMT. The IOI variability, and inconsistency between trials, in more extraverted participants supports previous studies that have associated extraversion with lower levels of self-monitoring, as well as being more motivated by sensory input. These results could have implications, for example, for studies of personality and dance, suggesting that different mechanisms may drive increased movement in extraverted compared to agreeable participants. Further study using a larger and more varied sample could provide further insight into these relationships.

Keywords

Spontaneous Motor Tempo, Personality, Extraversion, Agreeableness, Tapping

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Emotional development in guitar instrumentalists of advanced level in cultures of classical, flamenco and jazz

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ABSTRACT

Background

We are based on the theoretical framework of different realms of learning (music): From Informal to Formal, and in between Non-formal spheres. We can establish a two poles of the Formal and Informal contexts in (musical) education (Folkestad, 2006; Green, 2001/02; Trilla, 1997), where conditions, processes and results of learning are varying. In the Conditions we consider learning sources, participants, locations, music community and music in everyday life. In the Processes we observe goals, planning, motivation, emotion and intentionality, and as Results, type of audition, type of practice and evaluation.

We situated three Music Learning Cultures from informal to formal learning. **Classical Learning Culture** comes from Central Europe, which core rules were encoded between 16th and 20th centurias, located mainly in conservatories, and regulated by state and autonomic curriculum. This learning culture uses traditional scores, testing and formal accreditation. **Jazz Learning Culture** is a Popular urban music from EEUU, which core rules were encoded in the late 19th and the early 20th centuries. It is located mainly in independent schools, regulated by state /autonomic or independent curriculum, and it uses charts and scores, testing with formal and non-formal accreditation. **Flamenco Learning Culture** is a Popular urban music from Spain, which core rules were encoded in the late 19th and the early 20th centuries. It is located mainly in families-friends practices and personal projects, and therefore they don't use formal evaluation and accreditation.

Finally, we have taken into account the Implicit Theories about learners' minds (Olson and Bruner, 1996; and Pérez Echeverría *et al.,* 2001): in the **Traditional** conception learner is seen as doer who acquires a skill or ability, ability to do, and therefore the role of the teacher corresponds as demonstrator, craftsperson, focuses on imitation. In the **Constructive** conception the learner is seen as an expert, who develops critical knowledge and the ability to contribute to cultural storage. Then, the teacher corresponds as information manager, consultant who helps knowledge construction.

Aims

Considering these three different musical learning cultures (Classical, Flamenco, and Jazz), are there relationships between CULTURES with Learning CONCEPTIONS? And, how do both relations to Musical Learning PRACTICES (External Representations, Processes and Results)?

Method

Participants

Thirty-one guitarists meeting the conditions of being in a semi-professional stage of learning and having educational and semi-professional experience in only one of the cultures of musical learning considered in this study took part in this study. Ten of the participants belong to the Classical culture of learning (5 male, 5 female), are aged 19 to 29 years (M=24.9; SD=3.48). Eleven of the participants belong to the Flamenco culture of learning (11 male)[1], and are aged 15 to 25 years (M = 16.82; SD = 2.96). They are all of Roma ethnicity. Ten of the participants belong to the Jazz culture of learning (9 male, 1 female)[2], and are aged 26 to 42 years (M = 29.6; SD = 4.93). Later, in a second study, in order to observe their musical practices two Learners were selected within each of the three cultures for showing opposite conceptions (the most direct and the most constructive). Choice based on the interview of dilemmas and Automatic Selection of Modal Responses ASMR analysis (first study).

Material and Procedure

We have developed a Discourse analysis on practice from Initial Interview and three Pos-practice Interviews. Compared with the three Practice Sessions and their respective Reflection on Practice Interviews (watching the videos of practices with the learners). We applied a Constant Comparison Analysis, through Categories of an Analysis System (Casas-Mas, 2013), part of Funded Project EDU2010-21995-C02-01 at UAM and the Research Group on Acquisition of Musical Knowledge (GIACM).

Results

Firstly we observe the frequency of occurrence of musical speech and gesture, where flamenco participants are who integrate gesture, playing the guitar and the speech in a unique discourse. But nevertheless, jazz and classical learners have dissociated speech from gesture, and even classical learners didn't play the guitar during interviews, even when they were invited.

1 & 2. The fact that the sample has many more male than female participants is not a matter of bias, but reality. In popular urban music, women rarely participate in any group as instrumentalists (Green, 1997), especially at these levels of learning.

Regarding the verbal content and musical practice related to orectic processes (emotion and motivation), Classical learners used Attributions while popular cultures didn't activate, either positive or negative. Contrast by negative Evaluations of the classical learners, against an excess of positive evaluations in flamenco learners. And more negative evaluations in traditional learners than in constructive learners. Finally, about Emotions, a great perception of positive emotions in flamenco learners vs. classical and jazz, but a consciousness of this perception more developed in the more academic cultures. We have observed a great perseverance in musical practices of jazz and classical learners. In classical even when the emotions perceived were negative.

Intrinsic motivation appeared associated to constructive learners as well as a better management of negative emotions.

Conclusions

Regarding orectic processes, the Learning Culture set an emotional pattern. Flamenco participants show an integration of body, speech and verbal music, as embodied minds linked to communicative situations. The discourse of academic cultures expressed analytically and away from the body so. Performance Anxiety also appeared linked to academic spheres. But, conceptions also show a better emotional management in construction apprentices (Casas-Mas, Montero & Pozo, 2015).

About collective practice, the learning community is related to the popular cultures (flamenco and jazz). In flamenco gestural communication, and face to face with the teacher are crucial and necessary for musical learning. Flamenco has more expression of emotion linked to collective situations where music plays a truly communicative function.

Keywords

Learning Culture, Classical, Flamenco, Jazz, Musical Practice, Conceptions, Traditional, Constructive

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Note-by-note melodic expectation: Hymns vs. rock

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ABSTRACT

Melodic expectation is influenced by a number of factors, including music style. While empirical research on style-related expectations often compares Western and non-Western music, we explored differences between expectations in two distinct Western styles. The question of interest is to what degree the listener's expectation will conform to style-specific rules, as opposed to the more general rules of melodic expectation, such as tonality or proximity. Corpus analysis (note-to-note transition probabilities) was performed to identify main differences between a corpus of hymns and a corpus of rock songs. In a subsequent probe-tone task, listeners were asked to rate on a 1 to 7 scale how well the continuation tone fit into the given style. Every test sample offered two continuations, each frequent in one style but less common in the other. For example, in minor-key melodies, the third scale degree is most often followed by the second scale degree in hymns, but in rock songs, it is most often followed by the tonic. The pattern of responses for the hymn samples displayed a better fit to the style-specific transitions of the corpus than to Krumhansl's tonal hierarchy model. The opposite was true for the rock songs. We assume that in cohesive, well-defined styles, the listeners might be more likely to reflect style-specific knowledge in their expectations. In varied, broadly defined styles, however, they will adhere to a general tonal model.

I. INTRODUCTION

Major theories of sound perception (Bregman, 1990; Narmour, 1991) divide melodic expectation into two subsystems: top-down, which is learned and schema-based, and bottom-up, which is innate and operates on Gestalt principles. In his seminal work on musical emotion, Meyer defined expectation as "a product of the habit responses developed in connection with particular musical styles" (Meyer, 1956, p. 30). According to Meyer, style equals "a replication of patterning... that results from a series of choices made within some set of constraints" (Meyer, 1989, p. 3).

The evidence that listeners pick up patterns in perceived structures and use them as basis for expectations comes from various research traditions. Firstly, experiments with artificial language and music grammars, such as those by Saffran and collaborators, have shown that both adults and children can identify borders of "tone words" based on transition probabilities between tones (Saffran, Aslin, & Newport, 1996; Saffran, Johnson, Aslin, & Newport, 1999). Secondly, studies of artificial tonalities suggest that listeners quickly adapt to shifts in tonal hierarchies. Krumhansl's experiments with perception of tonality (Krumhansl, 1990) have established that a typical Western listener develops, over the course of their life, a fairly stable mental representation of a tonal hierarchy reflective of the Western tonal system (i.e. with the first, third and fifth scale degrees perceived as the most stable tones). However, the tonal schema is flexible. Oram and Cuddy (1995) created pure-tone sequences, assigning higher frequency of occurrence to some chromatic tones. After listening to a series of these sequences, participants were asked to rate how well a given tone matched the tonal context. Frequently repeated chromatic tones were assigned higher ratings, which suggests that the listeners changed their tonal hierarchy schema. The third source of evidence for statistical learning of style comes from comparative ethnomusicology studies. Listeners who were asked to rate continuation tones in unfamiliar melodies from music cultures different from their own tended to rate the most frequently appearing tones as the best continuations (Castellano, Bharucha, & Krumhansl, 1984; Kessler, Hansen, & Shepard, 1984). Rating frequently-appearing tones as tonally important is a useful strategy, as it roughly corresponds with the reality of most music traditions. However, in some instances, this strategy can prove unhelpful, such as in twelve-tone serial music. Krumhansl, Sandell, and Sergeant (1987) have found, in their experiment with twelve-tone samples, that only experts in serial music have rated tones not previously heard as better continuations, in accordance with the rules of strict dodecaphony. Most listeners assigned highest ratings to tones they already heard, using the strategy suitable for tonal music.

While the studies above investigate learning of novel music structures or unfamiliar tonal systems, our study aims to investigate differences between expectations regarding two Western styles, both well-known by the subjects. We are interested in answering the following questions: (1) Are there any differences in expectations for distinct Western styles listeners are familiar with, or will listeners use a common expectation strategy for both styles? (2) If differences exist, can they be traced back to style-specific characteristics of the respective music corpora?

We expect to find some strategies common to both styles. For example, proximity is a strong tendency in expectation. As pointed out by Narmour (1991) and repeatedly confirmed in expectation studies (Cuddy & Lunney, 1995; Krumhansl, 1995; Krumhansl, Louhivuori, Toiviainen, Järvinen, & Eerola, 1999; Schellenberg, 1997; Schellenberg, Adachi, Purdy, & McKinnon, 2002; Thompson, Cuddy, & Plaus, 1997), listeners expect the continuation tone to be close to the preceding tone; interval steps are perceived as better continuations than interval leaps. Preference of tonally stable tones is another tendency we expect to find in both styles. Krumhansl's (1990) tonal hierarchies model, while not a model of expectations in itself, correlates highly with scale degree distributions of real Western music corpora. As the positive correlation between frequency of occurence and expectation has been established (Aarden, 2003), we consider Krumhansl's model a fair representation of tonal expectations in Western music.

Despite the assumed commonalities, we hypothesize that participants' expectation strategy will not be identical for both styles, and that note-to-note probabilities of the corpora will reflect on their continuations rating.

To test our assumptions, statistical analysis of two corpora was conducted: a corpus of hymns and a corpus of rock songs. Scale degree frequency of occurrence and note-to-note transitional probabilities were calculated to identify the most notable differences between the two styles. Four specific style-differentiating criteria were chosen, and an experiment was designed to test whether listeners' expectations conformed to the stylistic differences.

II. CORPUS ANALYSIS

We compared two corpora of songs composed in distinct styles, both chosen under the assumption that they would be sufficiently familiar to our subjects (an assumption later confirmed by participants). Analysis of scale degree distributions and transitional probabilities served to discover their distinguishing characteristics. Brief descriptions of the corpora, as well as results of the statistical comparison are presented in the following sections.

A. Hymns

Jednotný katolícky spevník (Unified Catholic Hymnal), first printed in 1936, is the most popular hymn collection with Roman Catholics in Slovakia. Compiled by composer Mikuláš Schneider-Trnavský (1881 - 1958), it contains hymns from older collections, often based on folk melodies, as well as Trnavský's own compositions. The songs are strictly diatonic, simple major/minor melodies, with occasional modality (mostly Dorian or Lydian). Hymns with transposing parts were eliminated from the analysis. In total, 546 songs (29,514 tones) were analyzed; 71% were major and 29% minor. To simplify comparison, Dorian songs were included in the "minor" category, Lydian songs in the "major" category.

Scale degree frequency-of-occurrence analysis confirmed strict diatonicity of the corpus (Fig. 1, 2). Chromatic tones are largely absent, with the exception of the raised fourth in major songs (due to the few Lydian samples) and raised sixth and seventh scale degrees in minor songs (due to various forms of minor scales, and a few Dorian samples). The most frequent scale degrees were the mediant, the dominant and the tonic, followed by the second and fouth scale degrees. The predominance of the mediant in major-key songs is a particularity of our hymn corpus; in tonal Western corpora, it is usually the dominant that holds the highest occurrence rank (cf. e.g. Aarden, 2003; Knopoff & Hutchinson, 1983; Youngblood, 1958). The reason for the overrepresentation of the mediant is not clear; it might derive from the local folk influences, or possibly reflect the collector/composer's individual style. The analysis of transitional note-to-note probabilities showed that the corpus displays a strong preference for small intervals: 90% of the intervals were smaller or equal to 4 semitones in both major and minor songs.

B. Rock

We used deClerq and Temperley's rock corpus (deClerq & Temperley, 2011) available from Temperley's home page (http://theory.esm.rochester.edu/rock_corpus/). While the original corpus is based on Rolling Stone Magazine's chart "500 Greatest Songs of All Time" and totals 200 songs, we analyzed only 95 songs (28,117 tones) that did not include transposing parts (eliminating e.g. "Bohemian Rhapsody" by Queen or "I Walk the Line" by Johnny Cash).

Transcription of rock songs into standardized 12-tone notation is problematic at times due to the performers' ambiguous intonation, which is often an artistic intention (e.g. the use of "blue notes"). In this sense, the transcriptions used are a necessary oversimplification required by the need for standardized comparison. The same limitation holds for the major/minor classification. While the majority of samples fit comfortably in one of the two traditional tonal categories, a portion of the songs were modal. Furthermore, the corpus included songs where the third scale degree was absent, or both the major and minor third were present in the vocal part, or the vocal part used a minor third, while the harmonization included a major third. For the sake of standardization, we included Mixolydian songs into the "major" category, and treated Dorian songs as "minor". In the absence of the third scale degree, or if both the major and minor thirds were present, the major/minor classification was based on the harmonic accompaniment, which was mostly major, thus the songs were treated as major. In this way we obtained 79% major and 21% minor songs.

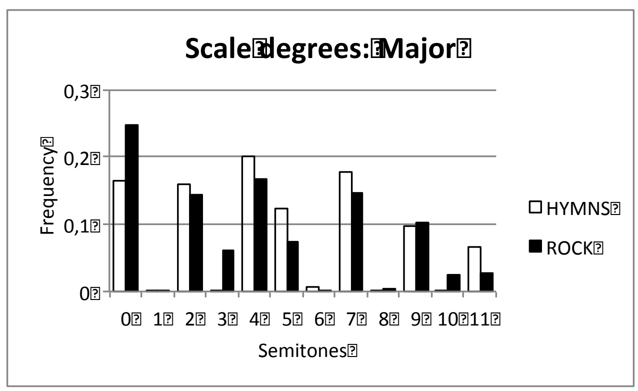

Figure 1. Frequencies of occurrence of scale degrees (in semitones) in major hymns and rock songs.

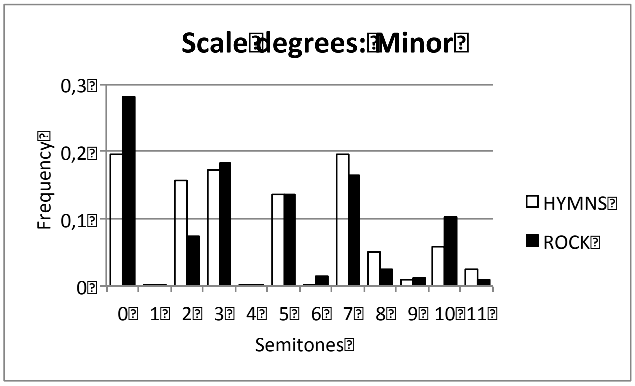

Figure 2. Frequencies of occurrence of scale degrees (in semitones) in minor hymns and rock songs.

Scale degree distribution analysis shows a predominance of the tonic (Fig. 1, 2), which, as discussed in Section A, is unusual for tonal Western corpora. The rock corpus appears to be more tonic-centralized than other Western styles. There is a strong representation of the minor third in major songs, a result of "blue notes" as well as our decision to categorize ambiguous vocal lines with underlying major harmonies as "major". Other notable chromatic tones include the Mixolydian seventh in major songs and the raised fourth, sixth and seventh scale degrees in minor songs. The five most frequent scale degrees form a pentatonic scale in both major (first, second, third, fifth and sixth) and minor (first, third, fourth, fifth and seventh) rock songs. Transitional note-to-note probabilities analysis discovered a high proportion of unison intervals (31% compared to only 15% in hymns). This is probably a result of the rhythmic function in rock, where long phrases of rhythmic singing on a single pitch are common. Another special characteristic of rock is the relative scarcity of minor seconds (10% compared to 21% in hymns), reflective of pentatonic tendencies. The avoidance of minor seconds results in underrepresentation of the second scale degree in minor songs.

C. Stylistic Differences

Figures 1 and 2 illustrate the distribution of scale degrees for major and minor hymns and rock songs.

Using the information from the statistical analysis, the following four style-differentiating criteria were used for experimental testing:

- Frequent minor thirds in major rock songs.
- Frequent mixolydian sevenths in major rock songs.
- Infrequent second scale degrees in minor rock songs.
- Comparatively frequent Dorian sixths in minor rock songs.

While the criteria are defined by the rock style, they describe both styles, as their opposite is true for hymns. Minor thirds in major songs are, for example, frequent in rock but very rare in hymns. Therefore, we expect listeners to rate them higher in rock than in hymns, although not as high as the major third, which is the most natural and frequent type of third in both styles. The fourth criterion is arguably the weakest, as the Dorian sixth is relatively rare in both corpora. Nevertheless, the probability of a Dorian sixth in minor rock songs is roughly double compared to hymns, which gives us an opportunity to test if listeners' mental representation of style includes infrequently-appearing scale degrees.

The chosen criteria allow us to specify our hypotheses:

- Minor thirds in major rock songs will be rated higher than minor thirds in major hymns.
- Mixolydian sevenths in major rock songs will be rated higher than Mixolydian sevenths in major hymns.
- Second scale degrees will be rated lower in minor rock songs than in minor hymns.
- Dorian sixths will be rated higher in minor rock songs than in minor hymns.

Note that all four criteria are deviations from the norm which occur more often in rock than in hymns. This does not mean that we expect the deviation to be rated higher than the norm (e.g. minor thirds in major songs over the more natural major thirds). What we expect is listeners to be more tolerant of deviations in rock, where they occur statistically more often.

III. METHOD

A. Subjects

Participants ($N = 26$, 11 women, age $M = 23$) were recruited from the pool of undergraduate musicology students at Comenius University Bratislava. They were asked to participate in the experiment as part of their music theory course. Their formal music education averaged 11 years and their music theory education 9 years.

Participants rated their knowledge of the hymn and rock styles on a 1 to 5 scale (1 - Don't know any songs; 5 - Know more than 30 songs) with an average of 4 for rock songs and 3 for hymns. None of the participants answered with 1 (Don't know any songs) for either of the two styles.

B. Stimuli

Participants were asked to listen to short melodies of 8-12 tones followed by a probe tone and indicate on a Likert scale how good a continuation the probe tone constituted within the given music style. The scale was marked from 1 (very fitting continuation) to 7 (very unfitting continuation). Eight melodies were used for each style (8 hymns, 8 rock songs); two hymns and two rock songs for each hypothesis. Each melody played twice, with a different continuation tone: one typical of hymns, the other a deviation common in rock. Sample melodies are shown in Fig. 3-6.

Figure 3. Creedence Clearwater Revival, *Fortunate Son* (top) and JKS 382, *Tisíc ráz buď pozdravená* (bottom).

Figure 4. Nirvana, *All Apologies* (top) and JKS 170, *Rozmýšľajme dnes* (bottom).

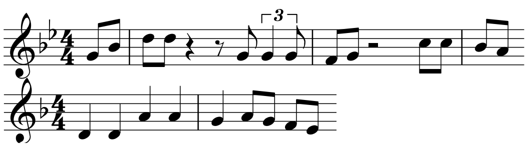

Figure 5. 2Pac feat. Dr. Dre, *California Love* (top) and JKS 139, *Iní Krista opustili* (bottom).

Figure 6. The Beatles, *Eleanor Rigby* (top) and JKS 93, *Veselým hlasom spievajme* (bottom).

Note that the figures only display one of the two possible continuation tones: for example, the *Fortunate Son* fragment (Fig. 3 top) was heard again during the experiment ending on a major third, and the *Tisíc ráz buď pozdravená* fragment appeared again ending on a minor third. Analogically, the fragments in Fig. 4 were heard ending both on the Mixolydian and natural sevenths. The Fig. 5 samples were played ending both on the mediant-to-second-scale degree step and the mediant-tonic step (the mediant-to-second-scale degree step is the most frequent interval movement starting on the mediant in hymns, while the rock style largely avoids semitone intervals) and the Fig. 6 samples ended either on the Dorian or the natural sixth. The last scale degree of the melody before the probe tone was held constant for all four melodies testing a hypothesis. For example, note that in both melodies in Fig. 3 the tonic appears before the probe tone (major/minor third).

The samples were created in Finale 2011 (piano sound) and stored as 16-bit .wav files with a sampling rate of 44,100 kHz. All fragments were in played in their original keys. No additional pause was added between the last tone of the melody and the probe tone. The listeners had, theoretically, an unlimited amount of time to enter their ratings, but were encouraged to do so quickly and spontaneously.

C. Procedure

The testing was conducted individually, using PsychoPy2 (v1.74.00) for instructions, trial presentation and data collection (Peirce, 2007). Subjects wore headphones and were asked to adjust volume to a comfortable level. The experiment began with a few practice trials to ensure the participant had understood the instructions. Two blocks of trials followed, first the hymn block, then the rock block. At the beginning of each block, listeners heard five short (30-second) fragments of songs of the respective style in order to "tune into" the style. The testing samples were heard in random order. Participants were asked to write down any samples they might recognize.

IV. RESULTS

Using the probe-tone method, we explored listeners' expectations in two music styles. Based on statistical corpus analysis, we chose four specific melodic situations in which we had reason to believe the participants would answer differently for each style.

Our experiment aimed to investigate expectations in music samples that were unfamiliar to listeners, although composed in a familiar style. As the rock samples used come from famous songs, we asked listeners to let us know if they explicitly recognized a piece. However, only in one case did a listener name a melody she recognized (*Eleanor Rigby*, Fig. 6 top). A second listener described *California Love* (Fig. 5 top) as sounding very familiar but was unable to name it. While implicit knowledge cannot be ruled out, we consider the samples sufficiently unfamiliar to subjects.

Our first hypothesis was that listeners would be more tolerant of minor thirds in major rock songs than in major hymns. This was partially confirmed; minor thirds were rated lower than major ones in hymns, although the difference was significant only in one of the two hymn samples (U = 115.5, p < .001), while the differences between major and minor third ratings in the rock samples were not significant. The second hypothesis predicted higher tolerance of Mixolydian sevenths in major rock songs than in hymns, but our findings did not support the assumption. The natural major seventh was preferred over the Mixolydian seventh in both hymn and rock samples (hymns: U = 221.5, p < .05; U = 107, p < .001; rock: U = 115, p < .001; U = 163, p < .001). The average ratings of the Mixolydian sevenths were not higher in rock than in hymns. The third melodic situation investigated the semitone movement from the third to the second scale degree versus the three-semitone movement from the third scale degree to the tonic in minor samples. As the second scale degree is underrepresented and semitones largely avoided in rock, we expected lower ratings of the movement ending on the second scale degree in rock compared to hymns. Our subjects indeed rated the 3-1 progression consistently higher than the 3-2 progression in rock samples (U = 175.5, p < .005; U = 117.5, p < .001). In contrast, both hymn samples received higher ratings of the 3-2 progression, but the difference was only significant for one of the two samples (U = 235.5, p < .05). The last hypothesis predicted higher tolerance of Dorian sixths in minor rock songs than in minor hymns. However, no significant differences were found between ratings of Dorian and natural minor sixths in any of the samples or between hymn and rock samples.

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Table 1. Spearman's correlations of listeners' ratings in hymn samples with 0th- and 1st-order transition probabilities of the hymn corpus, 0th- and 1st-order transition probabilities of the tonal hierarchy (TH) model and with the proximity criterion.

	Rating hymns	P 0th hymns	P 1st hymns	P 0th TH	P 1st TH	Prox.
Rating hymns	**1**					
P 0th hymns	**.24****	1				
P 1st hymns	**.30****	.64**	1			
P 0th TH	**.24****	.88**	.52**	1		
P 1st TH	**.20****	.67**	.79**	.71**	1	
Prox.	**-.16****	.22**	-.43**	.36**	n.s.	1

***p<.01*, n.s.-not significant

Table 2. Spearman's correlations of listeners' ratings in rock samples with 0th- and 1st-order transition probabilities of the rock corpus, 0th- and 1st-order transition probabilities of the tonal hierarchy (TH) model and with the proximity criterion.

	Rating rock	P 0th rock	P 1st rock	P 0th TH	P 1st TH	Prox.
Rating rock	**1**					
P 0th rock	**.16****	1				
P 1st rock	**n.s.**	.84**	1			
P 0th TH	**.29****	.60**	.43**	1		
P 1st TH	**n.s.**	.29**	.16**	.71**	1	
Prox.	**n.s.**	.53**	.21**	.27**	n.s.	1

***p<.01*, n.s.-not significant

A central question of the study is if participants' expectations reflect stylistic differences between the corpora, or if they are in fact a result of a common strategy, such as preferring tonally stable tones or small interval movements over large ones. To investigate this, listeners' ratings were correlated with scale degree transitional probabilities of the 0th and 1st orders (scale degree frequencies of occurrence and scale-degree-to-scale-degree transition probabilities) of the respective corpora as well as with Krumhansl's (1990) tonal hierarchies model and a simple proximity preference model based on probe-interval size in semitones. The results are shown in Tables 1 and 2.The hymn ratings correlate with both style-specific and general criteria; the highest correlation is with the 1st-order corpus probabilities, the lowest (negative) with interval size (smaller intervals received higher ratings). The rock song ratings only correlate with 0th-order probabilities of the rock corpus and of the tonal hierarchies model.

Table 3. Spearman's correlations of listeners' ratings in tonally unambiguous hymn samples with 0th- and 1st-order transition probabilities of the hymn corpus, 0th- and 1st-order transition probabilities of the tonal hierarchy (TH) model and with the proximity criterion.

	Rating hymns	P 0th hymns	P 1st hymns	P 0th TH	P 1st TH	Prox.
Rating hymns	**1**					
P 0th hymns	**.37****	1				
P 1st hymns	**.46****	.48**	1			
P 0th TH	**.35****	.93**	.40**	1		
P 1st TH	**.43****	.81**	.81**	.74**	1	
Prox.	**-.17****	.31**	-.64**	.32**	-.17	1

***p<.01*

Table 4. Spearman's correlations of listeners' ratings in tonally unambiguous rock samples with 0th- and 1st-order transition probabilities of the hymn corpus, 0th- and 1st-order transition probabilities of the tonal hierarchy (TH) model and with the proximity criterion.

	Rating rock	P 0th rock	P 1st rock	P 0th TH	P 1st TH	Prox.
Rating rock	**1**					
P 0th rock	**.21****	1				
P 1st rock	**.12****	.80**	1			
P 0th TH	**.33****	.57**	.37**	1		
P 1st TH	**n.s.**	.35**	.15**	.73**	1	
Prox.	**n.s.**	.45**	.12**	.30**	n.s.	1

***p<.01*, n.s.-not significant

The model used in this experiment relies on the separation of major and minor songs. As discussed in Section II.B., this is a necessary oversimplification of music reality. Furthermore, a portion of the samples are tonally ambiguous. Without cues enabling major/minor categorisation, such as the absence of the third scale degree in the sample melody, the listeners might become confused and base their predictions on the wrong schema. Consider the hymn *Tisíc ráz buď pozdravená* (Fig. 3 bottom), without the probe tone (A) at the end. As it does not include the third scale degree, it could be in F major as well as in F dorian. Also, the *Fortunate Son* sample (Fig. 3 top) without the probe tone (B♭) only consists of four tones around the central G and could be interpreted as either Dorian or Mixolydian.

Tonal ambiguity is an integral part of expectation. However, for better understanding of which expectation schemas listeners apply when the major/minor character of the melody is unambiguous, we eliminated the ratings of four ambiguous samples (3 hymns, 1 rock) that did not include third scale degrees. This improved the correlations with both style-specific and general data (Tables 3 and 4) but not their ranking. Ratings of melodic continuations in hymns still correlate best with scale-degree-to-scale-degree transition probabilities of the corpus, and rock ratings still correlate best with scale degree distributions of the tonal hierarchy model.

V. DISCUSSION

The results suggest that while expectations are far from carbon copies of statistical note-to-note frequency of occurrence tables, differences between style-related expectations exist and can be partially attributed to the statistical differences between corpora. We were able to find support for two out of four hypotheses that predicted listeners' expectations based on scale degree distributions and note-to-note probabilities of the two corpora: the tolerance for minor thirds in major rock songs and the avoidance of the second scale degrees and semitone movements in minor rock songs. However, we did not find support for increased tolerance of Mixolydian sevenths in major rock songs or for Dorian sixths in minor rock songs. This may be caused by the fact that both natural major and Mixolydian sevenths are relatively rare in rock, as are natural minor and Dorian sixths. Limited exposure to these scale degrees might be insufficient to form a schema of their statistical significance within the style. On the other hand, Dorian sixths in minor hymns were rated higher than their frequency of occurrence in the corpus would account for. A possible explanation is a false mental image of the Slovak hymn corpus as a "collection of archaic songs", reinforced by the outdated lyrics, which might lead to overestimation of the percentage of modal songs included.

Listeners' ratings of continuation tones in hymn samples correlated with both corpus-specific statistical data and data from Krumhansl's (1990) tonal hierarchy model. The best fit was with scale-degree-to-scale-degree corpus probabilities. Interestingly, Krumhansl and her collaborators found, in their study exploring expectations in Finnish hymns, that listeners who were experts in the hymn style were, in their expectations, more sensitive to 1st-order transition probabilities than to scale degree distributions (Krumhansl et al., 1999). Thus, this finding might indicate a level of expertise in the hymn style. However, the subjects rated their knowledge of rock higher than their knowledge of hymns, and no correlation was found between their ratings of continuation tones in rock and 1st-order transition probabilities of the rock corpus. Listeners' ratings in hymns correlate equally well with scale degree distributions of the corpus as with those of the tonal hierarchy model. This is natural, as the hymn corpus essentially represents a "typical Western" corpus, representative of tonal norms rather than of deviations. High correlations of corpus-specific transition probabilities with matching transition probabilities of the tonal hierarchy model are proof of this (0th-order: .88, 1st-order: .79; see Table 1). Interval size correlated weakly with listeners' ratings. While pitch proximity has been established as a strong component of melodic expectations, the intervals preceding the probe tone in this study were all small (4 semitones maximum), which prevented this factor from displaying its full distinguishing power.

Ratings of continuation tones in rock samples correlated only with scale degree distribution probabilities of both the rock corpus and the tonal hierarchy model; the fit with the general tonal model was significantly better. No correlation was found between probe-tone ratings and the size of the last interval, as rock melodies prefer two- and three-semitone intervallic movements over semitones, due to frequent use of pentatonic scales.

There are several possible explanations of the rock ratings' poor fit with style-specific data. The first is insufficient familiarity. While the participants rated their knowledge of rock as above-average, they might have overrated their level of expertise. However, this seems unlikely; given the omnipresence of rock music in everyday environments (media, concerts, cafés, malls), students almost certainly had sufficient exposure to the style. Secondly, the subjects might have had difficulties "tuning into" the rock style, as the samples lacked cues that would normally help them identify a piece of music as "rock": the right timbre, vocals, or overall sound. The most probable explanation, however, is the inherent variability of the rock style. Rock is a broad category, spanning decades and comprising numerous subgenres with their own distinctive music language, which makes predicting melodic continuations more difficult. For example, expectations for melodic continuation of an art rock song might differ from expectations in a punk rock song. The high degree of variability makes it hard to be an expert in the style. While with the hymns, it is enough to know a few songs to have a fair understanding of the style, in rock, much more experience is needed to reach the same expertise level. That explains why the listeners were able to incorporate style-specific information from the hymn corpus, even though they rated their familiarity with it as lower. Furthermore, the rock style, with its frequent use of blue notes, pentatonics, and modality deviates from the typical Baroque-to-Romanticism Western tonal schema. Even with knowledge of its particularities, listeners might be unable to "let go" of the general tonal expectations they would normally rely on. To sum up, it appears that in a variable style with high uncertainty and lack of data regarding specific subgenre rules, listeners decided that the best strategy is to base their expectations on a general tonal schema. Style-specific information might have been unavailable to them, or they could have been unsure about its suitability for the particular samples.

Based on these findings, we conclude that listeners' expectation reflect higher-order style-specific probabilities in styles that are cohesive, conform to tonal norms, and are well-known to the listeners. However, in highly variable styles with higher demands on expertise, listeners' expectations rely on low-order general tonal schemata rather than on style-specific data.

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The role of embodied simulation in emotional contagion with music

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ABSTRACT

Background

According to grounded theories of emotion, emotional experiences involve "simulation", i.e. the partial re-enacting of past sensory-motor and introspective states (e.g. Barrett, 2006; Damasio, 1994). In the case of music, authors such as Molnar-Szakacs & Overy (2006) and Cochrane (2010) have suggested that the perception of musical emotions is based on simulation (internal mimicry) of the actions that musicians make. In the case of the induction of musical emotions, both Scherer et al. (Scherer & Coutinho, 2013; Scherer & Zentner, 2001), and Juslin et al. (Juslin, Liljeström, & Västfjäll, 2010; Juslin & Västfjäll, 2008; Juslin, 2013) have proposed that internal embodied simulation plays a critical role in the phenomenon of musical emotional contagion. However, these authors disagree on the type of simulation involved. For Scherer, the mere observation of the performers' motor expressions and gestures can elicit internal mimicking, which leads to experiencing similar emotions to the observed models. For Juslin, music works as a super-expressive voice, so that mimicking the sonic aspect of music via subvocalization leads to emotional contagion.

Aims

To investigate which type of simulation (vocal vs. motor) is more effective in eliciting emotional contagion with music.

Method

Twenty-five participants recruited from the city and the University of Sheffield (Mean age = 25.75; S.D.= 3) have participated in the experiment so far.

The stimuli consisted of extended versions (Mean duration = 2:17 sec.) of three stimuli taken from the Film Soundtrack Stimuli for Music Studies Database (Eerola & Vuoskoski, 2010), which express three different emotional contents, correspondingly (Sadness, Fear, Joy).

Participants in the *vocal simulation condition* were asked to listen to the pieces while singing or humming along to the melody; participants in the *motor simulation condition* were asked to listen to the pieces while pretending to play the instruments themselves (i.e. doing "air-guitar"-like movements); and participants in the *non-simulation condition* were asked to listen to the music while engaging in a simple task involving moving their arms and counting out loud.

After listening to each stimulus the participants affective state was measured with an implicit technique based on Niedenthal and colleagues' (2001), and with questionnaires including adjectives taken from the GEMS (Zentner et al. 2008) and from Juslin et al. (2013). Participants were also asked to report their perceived emotion by using self-report.

Results

Data collection and analysis is currently under way. However, preliminary analysis suggest that in all groups experienced participants experienced the same perceived and induced emotions, (i.e. they experienced emotional contagion of the emotion expressed by the music), and that the participants in the two simulation groups (motor and vocal) experienced more intense emotions than the participants in the non-simulation group.

Conclusions

The preliminary results of this study suggest that the phenomenon of emotional contagion with music is moderated by the extent to which the listener engages in embodied simulation of the melodic aspect of the music and of the movements performed by the musicians.

Keywords

Emotion, Simulation, Emotional Contagion.

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Biases in the perception of dynamics in harpsichord performance

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ABSTRACT

It is widely claimed that it is not possible to vary dynamics on the harpsichord through touch; however, recent studies on single tones show that small dynamic differentiation can be obtained depending on the type of keypress. These differences are perceived accurately in comparisons of single tones; within a musical excerpt, they may be harder to detect, especially if biases exist. This study explores whether preconceptions regarding the ability of the harpsichord to produce dynamics influences perception of such differences. Two experiments are detailed: Experiment 1 uses two participant groups to test the effect of a bias (factor "cover story") in the perception of two types of musical excerpt (factor "stimulus set": dynamic variation performed/no dynamic variation performed). Experiment 2 adds a set of artificially manipulated excerpts to the stimuli, and presents all trials to participants in a fully within-groups design. Results of experiment 1 show a main effect of stimulus set (F (1, 30) = 24.01, p < .001). Experiment 2 results show a main effect of cover story (F (1,81) = 80.67, p < .001), and of stimulus set (F (2.30, 186.41) = 24.60, p < .001), with no interaction. The main effect of the stimulus set in both experiments demonstrates that it is possible to effect the perception of dynamics in musical excerpts. These results have implications for the understanding of historical performance practices.

I. INTRODUCTION

It is a generally received view that the harpsichord cannot produce any appreciable change in loudness (see, for example, the definition of harpsichord in the New Grove Dictionary of Music and Musicians: Ripin, Schott, & Koster, 2001).

Like all generally received views, it holds true, at least at some level; the harpsichord cannot indeed match the dynamic range of the lute, theorbo or harp. Furthermore, the desire to make the instrument capable of great dynamic contrast was already evident in the eighteenth century, with instrument makers inventing such devices as the "venetian swell", or the *peau de buffle* register, which endowed the harpsichord with the capacity specifically to play crescendo and decrescendo (Hubbard, 1965).

However, it is possible to obtain small changes in volume between single tones on the harpsichord (Penttinen, 2006); recent studies have found evidence of intensity differences of up to 11 dB in the production of single tones on an anonymous historical instrument re-built by Taskin (MacRitchie & Nuti, 2015). The acoustic differences between single tones found in both Penttinen (2006) and MacRitchie and Nuti's (2015) studies were accurately perceived by audiences.

Historical treatises (Couperin, 1717; Rameau, 1724; C. Ph. E. Bach, 1759, etc.) explain how to use an extensive and sophisticated range of performance techniques including varying timing between the hands, articulation, phrasing, arpeggiation, the speed of the spread of a chord and the overholding of notes, in order to enhance the listener's experience of changes in loudness. The use of registration, on harpsichords with more than one register, further contributes to the variety of timbres and dynamics available on the instrument. Yet still, when asked directly, many listeners will say that the harpsichord is incapable of dynamic changes, even though it has been demonstrated how these techniques are able to effect such changes (Leonhardt, 2001).

Twentieth century schools of piano playing continue to contribute to this misunderstanding of an inability to realise the harpsichord's capacities. Towards the end of the nineteenth century concern was already being expressed over an asserted limited responsiveness of the harpsichord: "Le son du clavecin n'était susceptible d'aucune modification de force ou de douceur par la pression des doigts" (Marmontel, 1885), "What we call *nuances* was unknown at the time of the harpsichord" (Saint-Saëns, 1895). This view of the instrument's resources is understandable before the historical performance practice movement of the twentieth century; today, our increased knowledge of instrument construction, performance styles and performing techniques allows us to play the instrument, and its music, in a manner which is, arguably, closer to the performance intentions of the composers who wrote for the instruments they knew (Haynes, 2007).

Yet the belief that the harpsichord was somehow unsatisfactory took hold, with some performers going as far as to state – without much further explanation - that the composers that wrote for the harpsichord were also unhappy with the instrument: "It is common knowledge that the harpsichord, with its plucked tone, was regarded by musicians of that time as lacking in expressiveness" (Tureck, c. 1960).

The idea that the harpsichord cannot produce or create dynamics is still embraced by some modern pianists: "on the harpsichord…it's all uniform" (Hewitt, 2008), "you simply cannot do that [play one note softer than another]" (Schiff, 2012). That harpsichord touch is unconnected to sound production is also sustained in contemporary literature: "No matter how hard a harpsichord's keys are struck, the instrument's quills pluck their assigned strings at a single, consistent volume, unleashing an unchanging, biting sonority" (Isacoff, 2001, p.9).

With such widespread conviction about the dynamic inability of the harpsichord, it is not surprising that it can be hard to convince people otherwise. It is well known that stereotypes or biases can influence people's perception. For

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example, scholars in a wide range of scientific domains have shown that a given information can be perceived in different ways depending on its context (e. g. Bertrand & Mullainathan, 2004; Fichter & Jonas, 2008; Fernandez-Duque, Evans, Colton & Hodges, 2015). In the context of music it seems likely that the belief about an instrument can influence the way its sound is perceived. The question arises whether physically measurable dynamic differences in harpsichord music – such as produced on the Taskin harpsichord (MacRitchie & Nuti, 2015) – can be perceived when under the impression such differences do not exist. This set of experiments aimed to test the perception of dynamics in a context that allowed control of listeners' beliefs regarding the harpsichord's capacity to play dynamics.

II. Experiment 1

A. Method

1) Participants. Thirty-two participants (16 female, 16 male; age $M = 21.97$, $SD = 2.42$ years) from the Conservatorio della Svizzera Italiana took part in this study. Participants had $M = 12.97$, $SD = 4.68$ years of musical experience. Participants were in two groups, assigned by music class.

Group 1 comprised 15 participants (undergraduate students of a history of music class; 5 female, 10 male; age: $M = 20.73$, $SD = 2.63$; experience: $M = 9.87$ years, $SD = 3.72$) and group 2 comprised 17 participants (undergraduate and postgraduate students of a seminar on historical performance practice; 11 female, 6 male; age: $M = 23.13$, $SD = 1.58$; experience: $M = 15.88$ years, $SD = 3.50$). The two groups significantly differed in terms of age ($t(29) = 3.04$, $p = .005$) and musical experience ($t(29) = 4.63$, $p < .001$), group 2 being older and more experienced. They did not differ in their practical experience with harpsichords, $\chi^2(1, N = 32) = 0.23$, $p = .29$.

2) Materials. Twelve excerpts of harpsichord music of approximately 10-12 seconds duration were selected from recordings of full pieces of music (Nuti, 2014). These excerpts were performed by co-author Giulia Nuti, on an anonymous 18th century harpsichord, extensively revised by Pascal Taskin in 1788. At recordings, the microphone was at a distance of approximately 1m from the harpsichord's quills. Six of the excerpts were performed using differences in touch and techniques intended to create dynamic variation (set B), the other six were performed without intention of producing dynamic variety, so techniques normally used to produce dynamic variation were not used specifically (set A). In order to check if the two sets were comparable in terms of overall dynamic structure (i. e. dynamic variation due to high vs. low notes, number of notes per time unit, etc.), intensity measures were calculated for each excerpt using Praat (http://praat.org), with the coefficient of variation used to compare variation in intensity between each set of excerpts. An independent samples t-test confirmed no significant differences between the variations in intensity of set A versus B, indicating that the two sets were comparable. However, the dynamic variation achieved between single notes through the use of touch technique alone could not be objectively measured from the audio recordings in isolation from other simultaneous notes.

3) Design and Procedure. For each group, data collection took place in the students' regular classrooms in one session, at the end of a lecture. Participants gave their consent and were advised they could abort the experiment at any time, discarding their data. The excerpts were played through a central state-of-the-art loudspeaker system.

The two groups were tested in a between-subjects design for the factor of bias (hereafter referred to as cover story): Group 1 ($n = 15$) was told that it is possible to measure dynamic variation on single tones, the *peau de buffle* register of French harpsichords being particularly sensitive to touch (cover story "Expect Variation"); group 2 ($n = 17$) was told that it is not possible to achieve dynamic variation through touch, and that any change of loudness they might perceive was not because of actual physical decibel changes, but due to techniques employed by harpsichordists to convey the impression of dynamic variety, such as timing, articulation, etc. (cover story "Expect Uniformity"). After instruction, each group was presented the 12 excerpts of harpsichord music in a pre-defined, randomised order. This order was the same for both groups. Using a 2-alternative forced choice paradigm, participants were asked if they could hear dynamic variety. Participants indicated their responses on paper for each excerpt.

B. Results and Discussion

Data was analysed based on the rate of "dynamics present" answers for each set of musical excerpt. Results are displayed in Figure 1. A two-way ANOVA (factors "cover story" and "stimulus set") revealed a significant effect of stimulus set, $F(1, 30) = 24.01$, $p < .001$, $\eta^2 = .44$. No effect of cover story was found, $F(1, 30) = 0.005$, $p = .94$, $\eta^2 = .00$, and no interaction, $F(1, 30) = 1.47$, $p = .23$, $\eta^2 = .04$. The cover story had no significant effect on the signal detection measure d', $t(30) = 1.21$, $p = .24$, which is in line with the ANOVA. Neither did the cover story significantly influence the criterion C, $t(30) = 0.64$, $p = .52$.

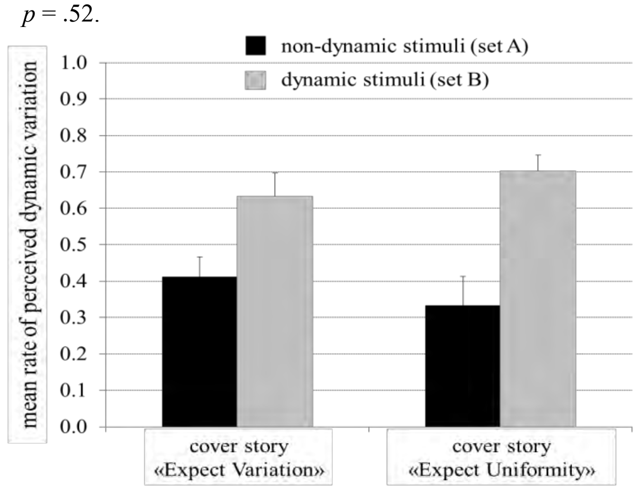

Figure 1. Rate of perceived dynamic variation in Experiment 1. Error bars represent standard errors of means.

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These results indicate that it is possible to perceive intended dynamic variation on a harpsichord. Participants could significantly distinguish between excerpts that included dynamic variation and those that did not. However, there is a possible methodological caveat: The stimuli of sets A and B were chosen by the artist on the basis of how she had intended to perform them (i. e., using touch variation for set B, none for set A), and not based on the measurement of any physical parameters. As stated in the introduction section, there are a variety of performance techniques that enhance the listener's experience of changes in loudness, by varying the timing of note onsets and offsets (e. g., spreading of chords, articulation, phrasing etc.). As there is no way of accurately determining the intensity of each single note performed within a polyphonic excerpt, it remains unclear whether the dynamic variation perceived in set B derived from an actual physical change of decibels, or whether the performance techniques simply influenced loudness perception. Data from the single tones studies (Penttinen, 2006; MacRitchie and Nuti, 2015) would suggest that physical differences may exist.

No main effect of cover story was found in the rates of perceived dynamic variation. This is unexpected when considering the literature on the effect of biases and stereotypes. One explanation for this lack of effect may be that the cover stories were not convincing enough. Cover story "Expect Uniformity" was intended to evoke expectations of hearing music that was completely free of dynamics. Although it was mentioned in this story that no dynamic variation was possible on a harpsichord, the story still included a remark on those alternative techniques used to convey the impression of dynamic variety. This may have spoiled the expectation of hearing music without dynamics. Furthermore, although the two groups' reported experience with the harpsichord instrument was equivalent, the two participant groups differed significantly in terms of age and musical experience. We cannot be sure that the difference between groups was not effected by these variables.

Experiment 2 was thus conducted with three modifications: First, a within-subjects design was used rather than a between-subjects design. Second, the cover story "Expect Uniformity" was modified to be more effective. Third, in addition to the A and B stimuli, a new set of artificial stimuli was created to allow a more detailed analysis of the nature of dynamical variance within the full stimuli set.

III. Experiment 2

C. Method

1) Participants. Ninety-one participants (62 female, 29 male; age M = 26.81, SD = 6.66 years) of the University of Zürich, including both post-graduate students and academics took part in this experiment. Nine participants were excluded from data analysis due to missing data, leaving a total of 82 participants for data analysis. Out of those, six considered themselves not interested in music at all; 53 as interested and not playing an instrument; 20 as interested and playing an instrument (M = 13.75, SD = 9.02 years of experience), and three as professional musicians (M = 24.67, SD = 9.07 years of experience).

2) Materials. The sets of stimuli used in experiment 1 (sets A and B) were also used in experiment 2. In addition, two parallel sets were created, adding dynamic variability artificially (sets A' and B'). The sets were created using Audacity software (http://web.audacityteam.org). Three types of variation were added, according to the dynamic variations reported by the performer as occurring in the B set. Crescendo and decrescendo were applied one per excerpt. These were created by modifying the original volume by +/- 3 dB (which is the approximately the degree of intensity variation obtainable on all registers by using different touches, measured on single tones on this instrument, see MacRitchie & Nuti, 2015). Sforzandi were applied where musically plausible, by augmenting the volume by 1.5 dB in the accented sforzando notes, and reducing by 1.5dB in the unaccented notes immediately following the sforzandi. In the B-set, the modifications were applied in such a way as to enhance the dynamics reported as already present in the excerpt; in the A-set, dynamic contrast was added where it was most musically appropriate.

Due to the increased number of stimulus sets (four instead of two), the number of excerpts per set was reduced from six to four. For this, the ratio of correct answers in experiment 1 was calculated for sets A and B, and the two stimuli with least discriminability were excluded from each set (also from sets A' and B', accordingly), resulting in a total of 16 stimuli used in experiment 2.

3) Design and Procedure. Data collection took place in a classroom in one session, as part of a regular colloquium (within-subjects design). The excerpts were played through a central state-of-the-art loudspeaker system. As the room was large, audibility was tested at various locations of the room prior to the experiment.

The cover story condition "Expect Variation" was followed by the "Expect Uniformity" condition. Each block was preceded by verbal instruction and data was collected from participants' responses on paper. The text of cover story "Expect Variation" was the same as in experiment 1. Since cover story "Expect Uniformity" was considered unsuitable to evoke expectations of non-dynamics, it was modified for experiment 2: After having completed the first condition, the participants were told that the previous experiments were actually part of a larger study on the perception of harpsichord music. One experiment asked for the use of completely non-dynamic stimuli as a baseline. For this, the same stimuli they had just heard were modified artificially to be bare of any dynamic variation. But since, as they surely knew, human perception did not always match the underlying physical parameters, it was necessary to pre-test these stimuli for their impression of dynamic flatness before using them in the actual experiment. The class was therefore asked to listen to the excerpts in order to check if all the stimuli were now truly without dynamics.

The stimuli were presented in a pre-defined randomised order (the order was kept the same for both cover story

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conditions), with the restriction that the corresponding excerpts of any set could not be presented consecutively (e.g. excerpt 1 from set B' could not be presented following excerpt 1 from set B).

D. Results and discussion

The participants' musical experience (professional, interested and playing an instrument, interested without playing, not interested in music at all) had no significant effect on *d'*, $F(3, 78) = 2.45$, $p = .07$ (one-way ANOVA). Also, for those who did play an instrument, there was no significant correlation between *d'* and years of experience, $r(17) = .17$, $p = .40$. The sample is therefore considered homogenous.

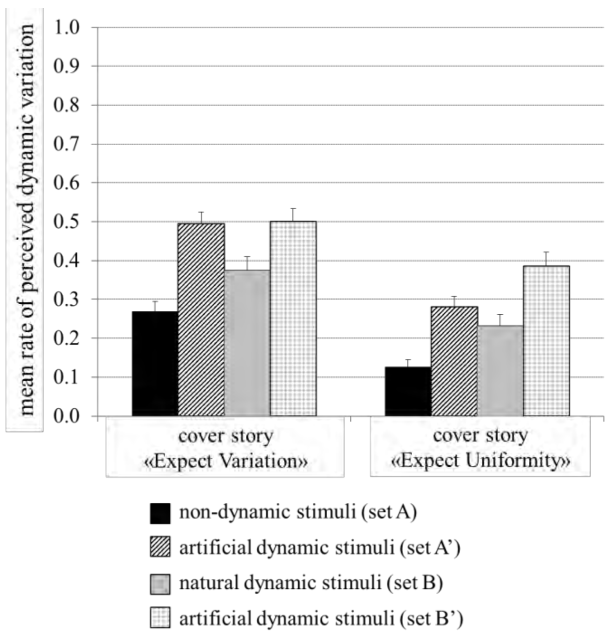

Figure 2. Mean rate of perceived dynamic variation in Experiment 2. Error bars represent standard errors of means.

Results are shown in Figure 2. As in experiment 1, data analysis was based on the rate of "dynamics present" answers for each stimulus set. Generally, the mean rates are lower in experiment 2 than experiment 1, which may be explained by differences in musical experience between the two samples. A two-way ANOVA (factors "cover story" and "stimulus set") revealed a significant effect of stimulus set, $F(2.30, 186.41) = 24.60$, $p < .001$, $\eta^2 = .23$; and of cover story, $F(1, 81) = 80.67$, $p < .001$, $\eta^2 = .50$. The interaction was not significant, $F(2.79, 266.45) = 1.81$, $p = .15$, $\eta^2 = .02$.

Table 1. Results of t test comparisons conducted on the mean rate of perceived dynamic variation between stimuli sets, separated by cover story. Holm corrections are applied to the results. Holm corrections are applied to the results.

cover story "Expect Variation"		
sets compared	***t* value (*df* = 81)**	***p* value**
A – B	6.00	= .049
A – A'	3.03	< .001
A – B'	6.15	< .001
A' – B	2.58	n.s.
A' – B'	0.14	n.s.
B – B'	3.43	= .01

cover story "Expect Uniformity"		
sets compared	***t* value (*df* = 81)**	***p* value**
A – B	3.50	= .007
A – A'	4.74	< .001
A – B'	6.75	< .001
A' – B	1.20	n.s.
A' – B'	2.46	n.s.
B – B'	5.23	< .001

Effects of stimulus sets: Single comparisons are displayed in Table 1. For both cover stories, set B was perceived as containing significantly more dynamic variation than set A, confirming the results of experiment 1. This finding indicates that volume changes in harpsichord music due to the use of different touches can be heard. The difference in responses to the natural and artificial sets (A versus A', and B versus B') was also significant for both cover stories. For both cover stories, the artificial set A' did not differ from the natural set B, indicating that the artificial manipulations administered in set A' were comparable to the natural dynamic variations achieved through touch in set B. The largest difference in response between two sets was found between sets A and B', set B' receiving the highest ratings of "dynamics present". This confirms the internal logic of the four stimulus sets, as B' contained both natural (achieved through touch) and artificial changes of loudness.

Table 2. Results of t test comparisons conducted on the mean rate of perceived dynamic variation between cover story conditions, separated by stimulus sets. Holm corrections are applied to the results.

cover story "Expect Variation" versus "Expect Uniformity"		
sets compared	***t* value (*df* = 81)**	***p* value**
A	4.70	< .001
B	7.60	< .001
A'	3.31	< .001
B'	3.99	= .001

Effects of cover story: Single comparisons are displayed in Table 2. For all stimulus sets, the two cover stories had a significant influence on perceived dynamic variation, cover story "Expect Variation" evoking higher rates of perceived dynamic variation than cover story "Expect Uniformity".

IV. CONCLUSION

The set of experiments presented in this paper demonstrate that the harpsichord is capable of producing perceivable changes in dynamics through differences in touch technique. That those changes can be perceived within musical excerpts suggests that acoustic differences achieved through touch technique on single tones may have an application in the performance of polyphonic music. It was also shown in this study that perception is influenced by bias: When under the impression to hear non-dynamic music, the rate of perceived changes of loudness was lower than when expecting to hear dynamic variation. How these touch techniques are used by harpsichordists to effect physical and perceived dynamic variation, and how these biases can be eventually reduced, warrants further investigation.

There are methodological restrictions to be considered in this study: First, the classical research paradigm for perceptual studies would have been to do single testing under controlled conditions, and not, as was done here, collective testing in a classroom. However, while results obtained from single testing might be more significant from the point of view of perception, the setting chosen here was of higher ecological validity. Second, in both experiments, musical experience of the participants was not controlled. Even though musical experience did not significantly influence *d'* in experiment 2, such effects cannot be ruled out generally, as sample sizes for each category (professional, interested and playing an instrument, interested without playing, not interested in music at all) were far from homogenous. The results obtained in this study suggest that the ability for dynamic perception rises with increased expertise (mean rates of perceived dynamic variation being higher in experiment 1 than 2). More research is needed to assess the role of expertise on dynamic perception and possible biases. Third, as the presentation order of stimuli (experiments 1 and 2) and of cover story (experiment 2) was held constant, effects of presentation order cannot be ruled out. Finally, the sets of stimuli used in this study were small, and the dynamic manipulations administered to sets A' and B' (crescendo, decrescendo, sforzando) were not varied systematically across stimulus sets, but rather placed where musically plausible. To confirm the effects found in this study, more research is needed controlling for artificial manipulation across excerpts.

Despite these restrictions, this study suggests two principal effects: that dynamic variation in harpsichord music is perceptible to the human ear, and that this perception is subject to biases. These findings indicate that widespread beliefs about the harpsichord's capabilities have been playing a part in dampening perception of this particular performance trait. Although it is acknowledged that these dynamic differences are far from being on a par with those of other plucked string instruments such as the harp, or indeed other keyboard instruments such as the piano to which it is invariably compared, it is still vital to performance practice to understand the full capabilities of an instrument long regarded to only be able to afford the performer a uniform response.

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Influence of *a priori* information on music performance assessment

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ABSTRACT

Each year over 350 international piano competitions are held, in which the main task of the jury is to assess the 'here and now' participants' piano performances, without taking into account any other information concerning them, such as their earlier competition accomplishments. However, vast evidence shows that many factors influence the jury's assessment. The topic of the present study is the influence of the *a priori* information about the performer/performance on the music performance assessment. Such information/prior knowledge (e.g. the participant's other achievements, the name of the pedagogue, the name of the conservatory, as well as the non-verbal suggestions of another juror) cannot be eliminated or controlled by the organizers.

I. INTRODUCTION

The music performance assessment (MPA) by the music experts constitutes one of the most important indicators of the music performance achievements – during music education, in the performance competitions, as well as at the professional music events. Each year over 350 international piano competitions are held, in which the main task of the jury is to assess the 'here and now' participants' piano performances, without taking into account any other information concerning them, such as their earlier competition accomplishments. However, vast evidence shows that many factors – apart from the characteristics and quality of the performance itself – influence the jury's assessment. The present study is focused on the influence of the *a priori* information about the performer/performance, available to the jury. Such information/prior knowledge cannot be eliminated or controlled by the competition organizers and can prompt the halo effect.

II. PREVIOUS RESEARCH

The first significant Polish research into the MPA was carried out by Manturzewska after the 6th International Fryderyk Chopin Piano Competition (IFCPC), held in Warsaw in 1960. This study is not widely known as it was only reported in the Polish language in 1970 in *Ruch Muzyczny*, a music journal with a very limited circulation (a revised and re-edited version of the report has been published in: Chmurzynska, Kaminska, 2006). In the first stage the assessments of the 28 jurors were subject to a quantitative statistical analysis. In the 6th IFCPC for the first time a separate scoring was introduced for the performance of a polonaise – which was performed, together with the other pieces, in the first stage of the competition. The majority of the 77 participants chose *Polonaise-Fantaisie in A flat major*, Op. 61 and it was the scores for the performance of this polonaise that were subject to analysis. Manturzewska (2006) found a wide range of the scores assigned to a single pianist participant. The jurors assessed on a scale of 1-25 points (this is the scale commonly used in the Polish music schools and music universities, as well as in the competitions). The scores for the best performances ranged from 4 to 25 points, and for the poorest performances from 1 to 22 points.

Although the selection of the candidates was (and still is) based on the arithmetic means of all the jurors' scores, the author found intriguing the question why the jurors, highly competent in the piano performance, assessed so differently the performance of a single, well known piece at the competition of old tradition and with relatively stable performance standards. A second question was whether, and to which extent, the assessments assigned by the jury during the competition would be consistent with the assessments of these same performances made by the music experts based on the recordings.

In her experiment Manturzewska used the recordings of the *Polonaise-Fantaisie in A flat major* Op. 61 made during the competition, including two highly assessed by the jury (A and B, where A, as it turned out later, was awarded the prize for the best performance of a polonaise), one average (C), and two poor ones (D and E). These performances were compiled into a set in which the performances A and C were repeated. This set was subsequently presented to the music experts, including two 6th IFCPC jurors, one 6th IFCPC participant, as well as several outstanding pianists – performers, academic teachers and music critics.

The experts, unlike the jurors, couldn't see the performers, neither they had any information of them. They only were asked to assess the performances on a scale of 1-25 points and to provide a brief description of them. The distribution of the average scores from the competition and from the experiment is shown in Table 1.

Table 1. Average scores of live competition and recorded performances respectively by 6th IFCPC jurors and music experts in Manturzewska study.

Performance	C	A	E	B	D	A	C
6th IFCPC jurors	15.1	21.5	8.4	19.4	10.4	21.5	15.1
Music experts	17.8	14.7	8.5	19.9	16.9	21.6	20.9

Source: Elaborated by the author from Manturzewska, 1970

Table 2 contains a comparison of the most significant properties, specified by the experts, of the performance A assessed in two experimental conditions: preceded by C (average according to the jurors) and preceded by D (very poor according to the jurors).

As a result of this research the author found that:

1. Both the jurors and the experts largely differ in their assessment of the same performance (lack of the intersubjective conformity).

Table 2. Properties of performance A as specified by experts in two listening conditions.

Performance A preceded by C	Performance A preceded by D
Expert No 1	
technically poor, lacking vigour, slow movements too slow, tries to play out every note, learned errors – misses F-sharp, makes no lasting impression, previous performance [C] was much better,	one of the best performances, full of vigour and temperament, logically ordered, minor errors,
Score 12 points	**Score 20 points**
Expert No 2	
C was better, slow, lacking vigour, irresolute, lengthy, timid but meticulous, phrasing was incoherent, one fragment didn't follow from another, it didn't constitute a consistent whole, it fell apart as the pianist wished to emphasize some minor detail in a part of little significance, hardly any performance value,	very good performance, quiet, transparent as a whole, premeditated construction, nicely phrased, every note played deliberately, not thoughtlessly,
Score 15 points	**Score 20 points**
Expert No 3	
a lot of emotional exaggeration, theatricality, artificiality, outdated performance concept, technically worse than C, insufficient right hand skill, dullish timbre, it seems the piece is too long.	a good concert concept, brilliant in a concert sense, a stage type performer, good left hand skill, great subtlety and energy at a time.
Score 17 points	**Score 24 points**

Source: Elaborated by the author from Manturzewska, 1970

2. The experts, listening to the same performance twice, assess and characterize them differently (lack of the intrasubjective conformity).

3. The experts do not recognize the same performance.

4. The individual assessments by the particular jurors and experts cannot be regarded as reliable indicators of the performance level.

The author proposed also several hypotheses explaining both forms of discrepancy between the assessments (lack of an intersubjective and intrasubjective conformity):

1. The effect of position in a sequence of performances. During the 6th IFCPC later performances were assessed more leniently than the earlier ones (e.g. the performance A was at the beginning of the hearings and C was the 74th). A similar trend was observed in the experiment.

2. The halo effect. During the 6th IFCPC it was observed that the jurors tended to assign higher scores to the performances of the polonaise by those pianists who earned higher scores for the whole 1st stage and who were positively valued in the professional environment.

3. The influence of context. The different assessments of a repeated performance A in the experiment could be affected by the preceding fast and dynamic performance C (on one occasion) and a slow and poor in quality performance D (on another occasion). It is worth adding that during the competition the performance A was preceded by two performances which were scored very low.

The conclusions and hypotheses by Manturzewska were subsequently confirmed in a number of studies, e. g. the influence of the halo effect (Duerksen, 1972; Hunter & Russ, 1996; Radocy, 1976), the influence of the position in a sequence (Ginsburgh & Ours, 2003; Flores & Ginsburgh, 1996), not recognizing the same performances (Fiske, 1977, 1979), large differences between the assessments (Wapnick, Flowers, Alegant, & Jasinskas, 1993). On the other hand, Manturzewska – contrary to the study of Ryan & Costa–Giomi (2004), Ryan, Wapnick, Lacaille & Darrow (2006), Wapnick, Mazza, & Darrow, (1998, 2000), Wapnick, Ryan, Lacaille, & Darrow (2004) – didn't found that the audio-visual reception (in this case of a live performance during the competition) determined higher scores than the auditory–only reception, and – contrary to the study of Iusca (2014) – didn't conclude that the scores were similar. The relationship discovered was that with the audio–visual perception higher scores were assigned to those pianists who were better valued in the professional environment and whose behaviour complied with the accepted standards. Lower scores at the competition (and higher ones in the experiment) went to less known pianists, the students of less renowned teachers.

The topic of the present study is the influence of the *a priori* information on the music performance assessment. Such information can generate the evaluative hypothesis and therefore modify the listening process. The results of the research by Noizet & Caverini (1978) into the assessment of school essays confirmed that the *a priori* information prompts the discrepancy of marks – when the examiners had different information on the same essay, they evaluated it differently, according to the expectations generated by the information (good student – better mark). It was also confirmed that the *a priori* information determines the perception of object – the examiners relativized the incoming information according to their prior knowledge and interpreted it in favour of this knowledge.

III. METHOD

Twenty professional music school students assessed twice, with a 2 week break, a set of 8 professional performances of Chopin's *Waltz in A flat major*, Op. 34, No 1, each time in a different experimental condition, A or B. In the condition A the students were secretly given a false *a priori* information that the performances had been ordered from the best to the poorest, and in the condition B no *a priori* information was given. The assessed performances had been audio recorded at the various IFCPCs and their level ranged from rather high to very high.

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They are similar with respect to a general technical correctness, i.e. they don't contain any errors or sound impurities which could be easily noticed by a less skillful listener. One performance – the poorest – was presented in the sequence twice: as the second and the eighth (the last one).

The subjects were aged 15-22 (M =17.46; SD = 1.42). They specialized in various instruments and had had a background of at least 9-10 years of intensive music education, including, apart from the main instrument, the ear training, listening to music, music theory, analysis of musical forms and others. They were therefore familiar with classical music and knew which aspects of music performance should be included in the assessment. They were asked to assess the performances on a scale of 1-25 points.

IV. RESULTS AND DISCUSSION

The mean scores and standard deviations for each assessed performance are shown in Table 3.

Table 3. Assessments of piano performances (means, standard deviations) in two experimental conditions.

Position	Assessment in A N=20		Assessment in B N=20	
	M	SD	M	SD
1	22.75	1.71	22.10	2.05
2	21.80	1.71	19.30	1.98
3	22.10	1.72	21.95	2.61
4	21.15	1.73	21.58	2.26
5	20.58	2.48	20.80	1.53
6	20.63	1.44	22.00	2.45
7	20.45	2.10	22.00	1.43
8	17.90	1.86	20.35	2.13

A two-way ANOVA with repeated measures was performed. A significant main effect was observed [$F(7, 133) = 10.4$; $p < 0.001$], which showed that regardless of the situation of assessment, the assessments of the performances are differentiated. In accordance with the expectations, the interaction effect was significant [$F(7, 133) = 9.27$; $p < 0.001$]. It turned out, therefore, that the position of a performance in a sequence influences its assessment depending on whether the assessment is made in the condition A (with a false *a priori* information) or B (without any *a priori* information). The post-hoc multiple comparisons according to the Bonferroni procedure were made to find out which performances and in which conditions were assessed differently. The following differences were revealed (Figure 1):

1. In the condition A the performance presented as the first was assessed higher than the performances from the second part of the sequence, i.e. according to the *a priori* information that the performances from the beginning of the sequence were better than those towards the end of the sequence. In the condition B these differences were statistically not significant.

2. In the condition B the performance presented as the first was assessed higher than the performance presented as the second (which is the appropriate assessment as the latter performance is a poorer one), but in condition A, with the *a priori* information available, the difference in question is statistically not significant.

3. In the condition B the performance presented as the second was assessed (in accordance with the expectations) lower than the performances presented as the first, third, sixth and seventh, while there were no differences between the assessments of the performances presented as the second and eighth (it was the same performance). However, the latter were assessed differently in the condition A (assessment in accordance with the *a priori* information).

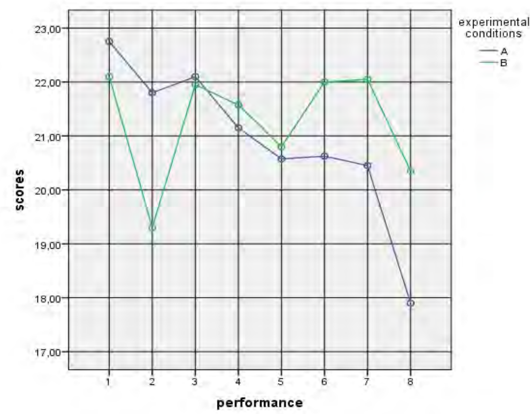

Figure 1. Assessments of piano performances in two experimental conditions.

4. In the condition A the performance presented as the third was assessed higher (in accordance with the *a priori* information) than the performances from the second half of the sequence, i.e. A5, A6, A7, A8. In the condition B there are no significant differences between the performance presented as the third and the remaining ones (and these assessments are more appropriate).

5. In the condition A all the performances were assessed higher than the performance presented as the eighth (here all the assessments are both appropriate and consistent with the *a priori* information). In the condition B no statistically significant differences were observed between the performance presented as the eight and the remaining performances.

The assessments of the same performances, made by the same individuals but in different conditions reveal the influence of the *a priori* information suggesting the declining level of the successive performances. It was also observed that in the condition A the students tended to make more courageous, differentiated but also absurd assessments. In the condition B the assessments were much more homogenous but also definitely more appropriate.

The results of the present study confirmed the significant influence of the *a priori* information on the music performance assessment.

A conspicuous example of the influence of the *a priori* information on the real life decisions of the IFCPC jury is the third prize awarded in 2000 to the pianist A.K., a former prize-winner of several prestigious competitions. He was assessed very highly in the first stage, but in the next stages he did really poorly. One of the jurors, asked in a private conversation (personal communication) why that pianist wasn't rejected – as it should have been expected – after the second stage, answered: 'Because we *knew* he was an excellent pianist – we *knew him from the other competitions*'.

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Intra-judge reliability of music performance assessment

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ABSTRACT

Background

The bias does not omit any field, in which the judgments are formulated, even if it is experts who assess. Polish experimental research into music performance assessment (Manturzewska, 1970; Jordan-Szymanska, 1980) showed that adjudicators (competitions' jury, musical experts, musical critics): (a) significantly differ from each other in assessment of the same performance (lack of intersubjective consistency); (b) do not recognize the same performance (lack of intra-subjective consistency); (c) while listening to the same performance twice at different time and in different context, perceive, characterize and assess them in a different way. It is assumed that one of the reasons for the differences can be influence of the halo effect in the form of previous knowledge about the assessed subject and/or the context in which the assessed performance is presented.

Aims

To investigate how the same performance located twice in different places of set will be assessed by students from professional music schools in the situation of providing them with biased information about performance quality; if the investigated recognize similarity of the repeated performance if their attention was drawn to it.

Method

Two groups of the investigated (N–40) evaluated the set of eight recorded piano performances of Chopin's *Waltz in A flat major*, Op. 34, No 1 (seven different, and the one repeated), each group in different situations. The first group (N–20) were suggested that "performances are ordered from the best to the poorest" (situation A), the second group (N–20) assessed without being given biased information. Additionally both groups were asked to indicate those performances which were similar to each other.

Results

The assessments of the repeated performance of the first group (situation A) were significantly different, but in the second group (situation B) they were not. In the second group the percentage of the people who rightly indicated the similarity between performance 2 and 8 amounted to 45%; however, in the first group – only 5%.

Conclusions

The repeated performance was assessed with intra-judge reliability (with consistency and repeatability) if no biased information was introduced. The investigated are able to recognize the repeated performance, if their attention is directed to indicating similarities. In natural conditions (exams, competitions) such situations do not take place. The influence of effect halo was confirmed.

Keywords

Bias information, halo effect, music performance assessment, piano performance.

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Metacognitive strategies and pianists' achievement

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ABSTRACT

Background

Metacognitive strategies are concerned with the planning, monitoring and evaluation of learning and performance. A number of studies into the musicians practice have explored the issue of metacognitive strategies adopted and used in the process of becoming a professional musician/performer (e.g. Hallam, 1995, 1997, 2001a, 2001b; Jørgensen, 2002, 2004; Jørgensen & Hallam, 2009; McPherson & McCormick, 1999; 2001; Nielsen, 2001, 2008).

Aims

To compare the metacognitive strategies used by two groups advanced in piano playing with different levels of expertise.

Method

40 foreign participants of international piano competitions (including the prize-winners) and 40 piano students from Polish music universities filled out questionnaires (both pen-and-paper and via the Internet) designed to investigate the planning of strategies, setting goals, monitoring their own progress, the identification of particular difficulties, the selection of the appropriate strategies for tackling the difficulties, the ingenuity in applying many forms of practice, styles of explanation of one's own success or failure, a sense of self-efficacy and competence in the instrumental performances.

Results

In almost all dimensions the participants of the piano competitions (the high achievers in piano performance) obtained significantly higher scores than piano students from Polish music universities. The former more often and more consequently plan and set the specific goals for themselves, are more engaged in self-observation and self-monitoring, demonstrate a higher level of optimism, ingenuity in the choice of practice strategies, and higher self-evaluation in terms of various music competences. Both groups do not differ in general self-efficacy – both scored very high in this dimension, but again, in the self-efficacy in piano performance the first group obtained higher scores. The piano competition participants demonstrated higher self-awareness of their strengths and weaknesses, while the majority of piano students were not able to assess their competence.

Keywords

Metacognition, piano performance, practice strategies.

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Why are violin concertos more popular than bassoon concertos? Predicting the popularity of solo instruments in concertos as a function of pitch height and performer pool size

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ABSTRACT

Background

In Western classical music, some instruments are more popular for solo roles than others. What accounts for the differences in popularity? A number of factors might be expected to influence the choice of a solo instrument. Acoustical factors might include the loudness capability of an instrument. Also, in light of the high-voice superiority effect (Marie & Trainor, 2012), instrument tessitura may be important. Some instruments may have a more salient or prominent timbre (Chon, 2013), which could make them preferred for a solo role as they might better attract listeners' attention. Some instruments are rarer than others, so the ease of access to an instrument might also have an impact. In this paper, we test two of these many possible factors; specifically, we predict that the popularity of solo use is related to pitch range and performer pool size.

Aims

In the current study, we seek to predict how frequently various instruments are used in a solo capacity. We hypothesize that an instrument will be attractive for a solo role when it can play a high pitch and when there are many skillful performers available.

Method

Of the many possible ways in which an instrument can be featured in a solo capacity, perhaps the most unambiguous can be found in the case of solo instruments in concertos. Therefore, we endeavor to predict the distribution of instruments used in classical concertos using the two factors identified above.

A simple query of "concerto" on allmusic.com returned several thousand compositions. Many of these pieces have a single solo instrument, some have more than one, and some others do not mention any in the title. After excluding concerto titles that did not specify a solo instrument, such as *Concerto for Orchestra* by Béla Bartók (1943), we ended up with a list of 6,559 concertos. The instruments specified as solo instruments in titles were all tallied.

We narrowed the list to the 18 most popular solo instruments. A multiple regression was carried out on these instruments' popularity in concertos with regard to the highest pitch as an acoustic factor and performer pool size as a social factor. Each instrument's highest playing pitch was obtained from Read (2004). The highest pitch information was converted to midi numbers for numerical analysis. In terms of the performer pool size, we counted the number of teachers listed in the directory of music faculties in colleges and universities, U.S. and Canada 1992-94. These numbers will not perfectly reflect the number of skilled musicians available, especially when they are restricted to the two North American countries. However, we still elected to use these numbers in the absence of better estimates.

Results

From the 6,559 concertos, 138 unique solo instruments were identified. These solo instruments included some exotic instruments such as didgeridoo, Theremin and zither. Among these 138 instruments were some period instruments, which were ancestors or relatives of a modern instrument, such as chalumeau (related to clarinet) or posthorn (related to French horn). The number of concertos for these related instruments was combined with the number of concertos for more typical modern instruments.

Table 1. 18 most popular solo instruments and the corresponding number of concertos

Instrument	Number of concertos	Highest pitch	Performer pool size
Violin	1894	D8	1191
Piano	1169	C8	4337
Flute	606	D7	976
Cello	597	E6	682
Oboe	436	$G^{\#}6$	557
Clarinet	330	$B^{b}6$	817
Harpsichord	270	F6	413
Trumpet	263	D6	885
French horn	214	F5	685
Viola	212	A6	670
Organ	175	C7	1127
Bassoon	170	E5	499
Guitar	138	A5	1354
Harp	101	$G^{\#}7$	220
Recorder	96	G6	102
Trombone	95	D5	631
Saxophone (alto)	84	B6	702
Contrabass	58	G4	545

Table 1 lists the target 18 instruments and the corresponding number of concertos featuring each instrument, as well as the highest pitch and the performer pool size. The number of concertos for an instrument (for example, a piano) means that there were 1,894 concertos found featuring a piano as a solo

instrument and not necessarily that these concertos had a solo piano and no other solo instruments. As we can see from Table 1, the most popular solo instruments were violin and piano, which account for 45.9% of the sampled concertos [(1894+1169-52) / 6559; 52 concertos were subtracted because they featured both a violin and a piano as solo instruments].

One might argue that harpsichord is an ancestor of piano, hence the two numbers should have been combined for *piano*, which would be more general of the two instruments, or recorder should have been combined with flute. However, we decided to keep them separate, as harpsichord and recorder are becoming more popular as solo instruments in contemporary concertos.

Multiple regression analysis has been carried out with the dependent variable (DV) of the number of concertos and independent variables (IV) of the highest pitch in midi number and the performer pool size. The model came out to be significant, $F(2, 15) = 7.917$, $p = .004$. However, when the effect of individual factors was compared, only the highest pitch was significant, $\beta = .531$, $p = .017$. When combined with the highest pitch, the performer pool size failed to achieve a significant effect, $\beta = .306$, $p = .144$, even though it was significant when it was the only regression factor, $F(1, 16) = 6.275$, $p = .023$, $\beta = .531$.

The reason why the effect of the performer pool size failed to reach significance might come from different assumptions reflected in the numbers. The numbers of concertos for 18 instruments are the numbers of compositions in the genre of classical music. On the other hand, the number of university-level teachers includes both the teachers in classical music as well as those in other genres such as jazz or marching band, which are more popular in U.S. than in any other country. This inclusion of music teachers in other genres might explain why there are so many saxophone teachers, for example, even though it is not considered as one of the traditional orchestral instruments.

Conclusions

In this paper, we aimed to predict the popularity of an instrument for a solo role in concertos in terms of an acoustic factor (highest pitch) and a social factor (performer pool size). The numbers of concertos written for 18 most popular instruments were analyzed using multiple regression with the two factors. Even though the performer pool size alone could explain 28% of the variance in the number of concertos, it was not significant when combined with the highest pitch, which by itself explained 43.7% of the variance. The results are mostly consistent with our hypothesis that an instrument is popular for a solo in concertos when it can play a high pitch and when there are many skilled musicians on it.

There must be other important factors that may explain the solo popularity in concertos that have not been considered in this analysis. For example, we did not consider the historical factor of the instrument age. The violin has been available for a much longer period than a clarinet, for example; hence it is natural to see more concertos featuring a violin solo than a clarinet solo. There also could be the factor of "traditional practice" that can be summed up as "because that's the way it's been done." This might be related to why the viola was not as popular as the violin although it can play pretty high, its timbre is similar to the violin timbre, and it has been around for as long as the violin has been. It just could have been the standard practice to put a violin in the foreground and the viola in the background that led to less number of viola concertos.

There could be other acoustic factors, such as the loudness capacity or timbre salience of an instrument. An instrument capable of playing loudly will be heard more easily with a polyphonic orchestral texture, which could make it more popular for a solo role. An instrument with a more salient timbre might be preferred for a solo capacity because it tends to stand out of the mixture of concurrent instrument sounds. These factors will be considered in a follow-up study.

The popularity of high-pitch instruments for solo use suggests the importance of the high-voice superiority effect that the auditory stream of higher pitch tends to carry more cognitive importance. Perhaps the human auditory cognition system assigned more importance on higher pitches to begin with, which might have led to a more foreground role for high-pitched instruments that was evident in many concertos written for high-pitched instruments.

Keywords

Concerto, solo popularity, timbre, pitch height, performer pool size.

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Exploratory study of instrument combinations in orchestral music

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ABSTRACT

Background

There exist a number of classic treatises in orchestration (Adler, 2012; Berlioz, 1855; Piston, 1955; Rimsky-Korsakov, 1922). Although they may recommend certain instrument combinations, there is surprisingly little theorizing concerning the implicit principles that might inform how to combine instruments.

Aims

In this study we examine patterns of orchestration within a historical context. Specifically, we trace changes in instrumentation patterns over the period of 1701 to 2000. In addition, in examining the instrumental combinations, we include information regarding specific pitches and dynamics played in various sonorities. This is a bottom-up data-driven exploratory study; hence there is no preset hypothesis to test.

Method

In brief, the method involved sampling 10 random vertical moments (hereafter sonorities) from each of 300 orchestral works composed between 1701 and 2000. Each sonority was coded according to the instruments present, as well as their pitches, dynamic levels, tempo, and date of composition.

In creating a longitudinal set of samples, we aimed to sample 50 works in each 50-year period from 1701 to 2000. In order to maintain high data independence, no more than three works by any given composer were sampled.

We will employ for analysis the instrumentation clustering methods used by Johnson (2011) with the additional factors of tempo and dynamics (see also Horn and Huron, 2012).

Results

Data collection remains in progress. Although premature, several predictable patterns are already evident. These include, for example, the high popularity of the harpsichord during the 18th century, its decline in the 19th century, and its resurrection among new music composers in the late 20th century. Similarly, the use of more “exotic” instruments (especially percussion instruments) is a notable trend in the 20th century. Not surprisingly, the ensemble size for orchestral works can be observed to have increased through the 300-year period.

We expect to observe some interesting interactions from the longitudinal data, such as for the correlation between pitch and loudness of an instrument or that between pitch and tempo. The data are also expected to reveal different patterns in instrument doubling across the three centuries considered.

Conclusions

This is our first effort to examine possible latent patterns in orchestral scores through the last 300 years. Apart from the rather obvious informal observations mentioned above, we are yet uncertain of what patterns will surface from the collected data. We presume that our analysis will replicate the instrument combination patterns in Romantic orchestral music observed by Johnson (2011), as well as replicate the musical expression clusters found by Horn and Huron (2012).

Keywords

Orchestration, historical patterns, instrument combinations

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The relationship between music performance anxiety and flow amongst professional classical musicians, and its clinical implications

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ABSTRACT

Background

For many classical musicians, music performance anxiety (MPA) is a debilitating phenomenon. Despite the high prevalence of MPA and evidence indicating that MPA tends to be persistent over time, little help is generally given in the treatment of early symptoms of MPA or in the development of music performance skills in most educational establishments. In contrast to the field of MPA, research into peak musical performance and "flow" (the subjective state often associated with optimal performance) is still in its early stages. There are a handful of studies showing that student musicians experience flow (Sinnamon et al, 2012), however the flow experiences of professional musicians have not yet been investigated. Recent studies with students (Fullager et al, 2013), have shown that flow and MPA are antithetical experiences, implying that facilitating flow may provide a useful tool for alleviating MPA, as well as encouraging optimal music performance. Cognitive-Behaviour Therapy based interventions have been found to be most effective in reducing MPA (Bruges, 2011) and it has been proposed that music-enhanced interventions maybe particularly effective for treating musicians (Brodsky & Sloboda, 1995), however no such interventions for facilitating flow and reducing MPA are currently available. This paper presents the results of a preliminary study investigating the relationship between MPA and flow amongst professional classical musicians. The clinical implications of the findings are discussed. The study is part of a PhD research project.

Aims

The aims of the study are:

i) To provide quantitative data for professional musicians' flow experiences
ii) To investigate the relationship between MPA and flow amongst professional musicians
iii) To propose a music-enhanced intervention for facilitating flow and reducing MPA.

Method

Questionnaires to measure flow (the Dispositional Flow Scale (DFS-2 (short), Martin & Jackson, 2008) and MPA (the Performance Anxiety Inventory, PAI, Nagel, Himle & Papsdorf, 1989) MPA were distributed to orchestral players in two professional Israeli orchestras at the start of the orchestral rehearsal break, and collected at the end of the rehearsal.

Results

98 questionnaires were distributed, of which 57 were returned (58%). Global flow scores showed that 58.2% of subjects reported experiencing flow often, very often or always. Flow negatively correlated with MPA [$r[53]= -0.458$, $p <.001$]. Hierarchical regression analysis examining the contribution of flow to MPA in step 2, and controlling for demographic data in Step 1, showed a significant negative association between flow and MPA. [$\beta= -0.405$, $SE = 0.164$, $\Delta R^2 = .154$, $p = .003$].

Conclusions

The study provides evidence of a strong negative association between flow and MPA amongst professional musicians. Based on these findings, a music-enhanced CBT-based group intervention to reduce MPA and facilitate flow is proposed.

Keywords

Music performance anxiety, flow, music therapy.

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What do you listen to to calm down? Age-related differences in the selection of music when experiencing different affective states

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ABSTRACT

Background

The age of the listener has been assumed to be one central factor leading to differences in the preference for music and in the way music is used to regulate one's current affect (Saarikallio & Erkkilä, 2007; Saarikallio, 2011). Previous studies showed that compared to younger adults, older adults are motivated to enhance positive and low arousing affective states (Riediger et al., 2009; Charles, 2010) and to increase their well-being while listening to music in everyday life (Laukka, 2007). Hence, older adults tend to select and listen to music differently than younger adults while sharing the aim to regulate their current affect in a desirable direction.

Aims

This study employed a novel music selection paradigm to investigate age-related differences in the motivation and efficiency to regulate one's affect when experiencing different states of arousal and valence. We extent previous research by including a continuous behavioural measure of music selection and by taking the age of the listener as well as their regulation motivation into account.

Method

In a 2 (arousal) x 2 (valence) x 4 (age group) experimental design, 225 participants ranging from adolescents to old age (12-75 years) completed a complex task with or without time pressure and with a bogus feedback of either above-average, or below-average to induce various levels of arousal and valence. Following that, for a period of ten minutes participants freely browsed a music selection of 128 songs from various decades and genres, and their listening behaviour was recorded continuously. The music selection included the most distinct songs according to the perceived level of arousal and valence as a result of a pilot study with 50 different age listeners. Self-reported current affect was rated before and after the mood induction as well as after the music browsing. Furthermore, participants completed 26 items indicating their music-related affect regulation motivation.

Results

Results show age differences in the preference for music with divergent levels of valence and arousal as well as in the course of the regulatory process leading to a change in affect after music browsing associated with the affect regulation motivation. Older participants preferred to listen to positive and low arousing music in general and independent of the affect induction (incongruent mood regulation) while younger participants chose to listen to different music related to the induced level of arousal and valence (congruent mood regulation). Overall age groups, self-reported mood changed significantly in the assumed direction after mood induction and again after the ten minutes of music browsing.

Conclusions

Results emphasize the diversity as well as the efficiency of music listening behaviour as a process to regulate affect in various age groups and with regard to motivational aspects. Affect regulation via music as a regulatory strategy in comparison to other functions and motivations of music listening behaviour in different age groups will be discussed.

Keywords

Affect regulation via music, age differences, music browsing paradigm

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The influence of tempo on expressive timing: A multimodal approach

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ABSTRACT

In playing music, each individual performance is characterized by specific timing patterns. This variability, often referred to as expressive timing, is known to be interconnected with tempo, as timing patterns appeared to be tempo-dependent. Moreover, our sense of musical time and rhythm is bound up with the sensorimotor system that controls our body movements. Therefore, an embodied approach could offer interesting perspectives on the interplay between timing and tempo and provide evidence for the tempo-specific timing hypothesis in music performance. In the current study, we investigated how tempo shapes timing in a duet performance, taking into account audio, body movement and the performer's experience. Eight duos (piano – violin) played two pieces at a pre-defined tempo, after which the start tempo was gradually increased and decreased. An audio recording of the performance was made and the body movements of the violinist were recorded using motion capture. Additionally, feedback of the musicians on their performance was collected by means of short questionnaires. Changing the performance tempo altered the temporal patterning of tone onsets. Transitions in tempo could be observed in rhythmic patterns, the spatiotemporal patterning of the body movements of the violinists and their individual performance strategies. Approaching tempo in terms of movement dynamics and performance strategies seems to offer an alternative to understand the different expressions we experience in fast and slow music. The results provide support for the tempo-specific hypothesis but connect it to a broader, embodied perspective and the performer's experience.

I. INTRODUCTION

The role of timing in expressive music performance has been studied for many years and comprises a variety of topics. Scholars from different research domains have addressed expressive timing, going from music perception (Clarke, 1989; Parncutt, 1994), neuroscience (Large, 2010) and performance studies (Goebl & Palmer, 2009; Loehr & Palmer, 2009; Palmer, 2012) to computer music (Grachten, Arcos, & Mántaras, 2006) and movement science (Dahl, 2005; London, 2006; Repp & Su, 2013). These studies explore different aspects of musical structure as rhythm (Honing, 2013), phrasing (Cheng & Chew, 2009) and tonality (Todd, 1985) across a variety of musical styles (Bauer, 2014; Moelants, 2011).

The concept of musical timing comprises different dimensions and levels. On a micro-level, the rhythmic grouping of notes and fluctuations in tone onsets or articulation can be studied. In jazz music for example, a soloist who performs with a jazz combo can take the 'melody lead' and play ahead from the rhythm section (Friberg & Sundström, 2002). On a higher level, deviations in (local) tempo and musical entrainment can be taken into account. Variations in both of these levels can be characteristic of expressive music performance.

On the one hand, those variations can evolve out of a conscious, intended expression. This includes expressively motivated deviations in local tempo, for example when musicians play *tempo rubato* (Hudson, 1994), or when they implement a specific style as in funk or jazz (Ashley, 2014; Friberg & Sundström, 2002). On the other hand, fluctuations in timing may be unintended. Temporal variations are inherent to human movement production, and this motor variability can induce small fluctuations in timing dimension when performing music (Repp & Su, 2013). This causes small irregularities in each individual performance, which gives rise to a particular movement 'signature' that may reflect unique movement patterns, leading to a personal, idiosyncratic sound (Dalla Bella & Palmer, 2011; Keller & Appel, 2010) and small difference in the performance of particular rhythms (Penel & Drake, 2004). In terms of ensemble performance, a musician then would adapt against a varying timing pattern generated by other ensemble members, who may in turn be adapting to each other's timing pattern (Wing, Endo, Bradbury, & Vorberg, 2014).

Moreover, musical structure can influence the timing of musicians as well. Goebl & Palmer (2009) found that pianists playing a part with a higher note ratio in a duet performance preceded the other pianist in timing. In addition, empirical evidence showed that the duration of certain notes, as in *tempo rubato*, could be generated from the musical structure (Todd, 1985). Expressive timing therefor concerns the performance of time-critical musical structures, whether or not in agreement with an (intended) expression.

In the performance of such time-critical musical structures, tempo is an important musical parameter. Repp (1994) argued that the expressive timing patterns of a performance remain relationally invariant across moderate (musically acceptable) changes in tempo. In other words, the ratio between rhythmic intervals and the total duration of a rhythmical pattern remains equal, even when the tempo changes. Desain and Honing (1994) challenged these findings with a similar study, in which they did find significant interactions between tempo and timing. Other evidence that supports this tempo-specific timing hypothesis (Honing, 2007) was found in studies on the performance of swing-ratio's (Friberg & Sundström, 2002) and *notes inégales* (Moelants, 2011). Additionally, Repp, Windsor, and Desain (2002) found that the timing of simple two-note rhythms was equal across tempo changes, in contrast to some three-note rhythms, in which note ratio's appeared to be tempo-dependent.

This raises questions on how tempo has an influence on expressiveness in music performance. Up to now, studies

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that relate expressive timing with tempo have only included solo performances and a comparison of a limited range of tempi. In-depth research on the limits and thresholds of tempo in music performance with regard to changes in expressive timing are scarce and moreover, these studies mainly rely on cognitive theories of music performance, though embodied research approaches have proved to offer interesting perspectives on timing.

The sense of motion in music has been closely associated with rhythm and tempo (Clarke, 2005). Todd (1992) argued that the performance and perception of tempo and dynamics is based on an internal sense of motion. On the one hand, our sense of musical time and rhythm is bound up with the sensorimotor system that controls our body movements (London, 2006). On the other hand, Todd (1999) has argued for a vestibular component within the sense of musical motion, complementary to the sensorimotor system. The latter would then account for smaller-scale gestures, as the former would map onto lager-scale, whole body movements (Clarke, 2005). According to the Dynamic Attending Theory (Jones & Boltz, 1989), human movement dynamics will change when performing periodic movement in different tempi. An obvious example can be found in the transition between walking and running. This intimate connection between movement kinematics and periodicity is also present in the performance and perception of musical rhythm (Burger, Thompson, Luck, Saarikallio, & Toiviainen, 2013; Dahl, 2005). As a consequence, different tempi will give rise to different movement dynamics, causing a difference in how musical time and rhythm is experienced. Such insights can help us answer the difficult question of why we experience different musical expressions in slow and fast tempi, and where we can find the transitions from one tempo to another. To grasp this aspect of music performance, we propose a multimodal approach, taking into account different levels of timing, but also performance gestures, entrainment dynamics and the performer's experience.

In this study, two pieces of music are performed in a wide range of tempi by piano-violin duos. We hypothesise that musicians will entrain on different metrical levels when the tempo of the performance changes and that this will be traceable in the production of sound and movement by the musicians. By means of short questionnaires, the experience of the performer was taken into account, adding a top-down perspective to the analysis of low-level features.

II. METHODS

A. Participants

In total, 8 duos participated in the experiment. All the musicians were young adults between 18 and 30 years old, had obtained their final degree in the music academy and played their instrument on a regular basis.

B. Stimuli

The music the musicians were asked to perform comprised two short compositions, which were selected from a corpus of French baroque dances. The first piece, a *canaries* by Jean-Baptiste Lully, is a lively dance, notated in 6/8. The main characteristics are the dotted figure in the solo part of the violin and a quarter + eight note figure in the piano (Fig. 1). The second piece, a *courante* by an anonymous French composer is notated in 3/2 and has a more complex rhythmical structure. The dotted quarter note followed by an eight note is distinctive here, as is the slow and dignified

Fig. 1 Excerpt from the canaries (left) and courante

character of the dance. Both pieces have an anacrusis in the piano part, before the violin starts. Bowings were indicated in the two scores and the violinists were instructed to follow them strictly. They were asked to study the courante at 70 bpm for a half note, and the canaries at 80 bpm for a dotted quarter note. Yet, they were free to add some expressive tempo-changes and articulations in their playing as no other suggestions for articulation were given in the score. The musicians received the music in advance, so they had the opportunity to study it individually before the experiment.

C. Procedure

The duos were individually invited to the laboratory. The procedure consisted of a preparing rehearsal, a series of duet performances with the pianist accompanying the violinist and a series of solo performances by the violinist.

During the first part of the rehearsal, the violinist and the pianist worked alone. The pianist had the opportunity to practice on the keyboard used for the recordings, while the

Table 1: Log2 transformation of tempo (canaries)

TEMPO	Log2-scale factor	BPM
10	3.174802104	253.9841683
9	2.828427125	226.27417
8	2.5198421	201.587368
7	2.244924097	179.5939278
6	2	160
5	1.781797436	142.5437949
4	1.587401052	126.9920842
3	1.414213562	113.137085
2	1.25992105	100.793684
1	1.122462048	89.79696384
0	1	80
-1	0.890898718	71.27189744
-2	0.793700526	63.49604208
-3	0.707106781	56.56854248
-4	0.629960525	50.396842
-5	0.561231024	44.89848192
-6	0.5	40
-7	0.445449359	35.63594872
-8	0.396850263	31.74802104
-9	0.353553391	28.28427128
-10	0.314980262	25.19842096

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violinist could get used to playing in a motion-capture suit. After they indicated feeling comfortable with the equipment and music, they rehearsed the music together. The violinist had to perform with his back turned to the pianist, so they could not make eye contact while playing.

When both musicians felt ready, the first piece was performed and recorded. A pick-up microphone was used to record the sound of the violin, while the piano accompaniment was performed on a Yamaha Clavinova and recorded via MIDI-output. During the performance, the movements of the violinist's body and instrument were measured using the motion capture system Optitrack. All data streams were synchronized using Max/MSP. The performance was repeated until the pianist and violinist felt mutually satisfied with the recording and the performance tempo approached the imposed 70 bpm for the courante and 80 bpm for the canaries with a maximum difference of 2 bpm.

After this recording, a series of duo performances started where the tempo of the piece was varied. For each new performance, a faster or slower tempo was calculated relative to the original performance and based on a log2-scale division (Table 1). First, the tempo was gradually speeded up or slowed down and then the other way around, separated by a performance in the original tempo. Each performance started with four bars of metronome ticks in the new tempo. After four bars, the pianist started to play and the metronome stopped. For each new tempo, the musicians filled out a questionnaire to compare the new tempo with the one of the performance before. The topics that were evaluated included ensemble playing, the character of the music, articulation and fluency of the performance, the metrical level of the pulse and the overall quality of the performance.

The ratings were done on a semi-continuous scale. As such, we did not limit their answers to a discrete point scale and got a more nuanced view on the musician's performance ideas. The speeding up and slowing down of the tempo continued until one of the musicians reported that it was impossible to play the piece in the given tempo. At best, up to 10 levels slower and faster could be reached.

The next step of the experiment comprised the same procedure, but now a computer-generated piano accompaniment was used instead of a live performance. The piano part was rendered by the computer in each tempo, based on the original performance by artificially increasing and decreasing it in tempo, following the same log2-scale as in the duo performance. Again, each time the piece was performed in a new, faster or slower tempo until the violinist had reached his or her performance limit or, in the best case, the maximum of 10 levels. After a break, the whole procedure was repeated for the second piece.

III. ANALYSIS

Different methods were used to analyse the data streams collected during the performances. A full description of all levels of analysis goes beyond the scope of this paper and therefore we will focus on the individual timing patterns of the violinists, their body movements and individual performance strategies in one of the two pieces, the *canaries*.

A. Timing

From the audio recordings, the onsets of the violin were extracted using 'Praat' (Boersma & Weenink, 2014). This program gives an automatic analysis of pitch and intensity as well as spectrogram visualization, with parallel audio feedback. The use of this program makes it relatively easy to locate the onsets with a precision of a few milliseconds when using recordings made with contact microphones. Expressive timing as found in the proportions of note values in rhythmic patterns was derived from the audio of the violin. The characteristic 3:1:2-pattern was played 14 times in each performance of the canaries. In the analysis we expressed the duration of each note as a percentage of the duration of the whole pattern (with 50:16.7:33.3 as a 'perfect' ratio). This allows us to compare the ratios independent from the local tempo. The evolution of this ratio was then compared between tempo categories in duo and solo conditions.

B. Movement Features

The head is found to be a body part that can convey and communicate musical meaning by violinists (Glowinski, Mancini, Cowie, & Camurri, 2013). As acceleration has proven to be a relevant movement feature in the study of musical performance, (Luck & Sloboda, 2008) this kinematic variable was calculated form the positional data of the head (sampled at 100 Hz), using a Savitzky-Golay smoothing filter with a window length of 11. To relate the recorded head movements of the violinist with the musical structure as found in the pieces, elements of timing as extracted from the audio were used to create meaningful movement units. The mean acceleration within strong beats (the first note of each bar) and weak beats (the first note of the second beat of the bar in the canaries), were calculated and compared among the different tempi.

C. Clustering of Tempi

In order to classify and identify similar behaviour in tempi and differentiate it from tempi in other groups, hierarchical cluster analysis was used. The clustering was applied twice, once based on the timing data (contribution of duration in % of a note value in a rhythmic pattern) and once based on the acceleration of the head (acceleration peaks on strong and weak beats), to separate variables that were measured on different scales. The 'average linkage within groups' method combines clusters so that the average distance between all cases (here the different tempi) in the resulting cluster is as small as possible. As a first exploration of the data showed distinctive individual behaviour, the clustering was done within subjects. The Agglomeration Coefficients (distance statistic) were used as reference to decide which number of clusters was representative for the data. The resulting cluster numbering for the tempi was than applied as a grouping variable to test in an ANOVA whether the clusters differed significantly on the variables used to create them.

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D. Questionnaires

Finally, the features extracted from the movement and audio data were interpreted by means of the answers reported in the questionnaires. The question is whether the transitions found in the analysis of sound and movement, are equally reported by the musicians. Here, major changes in articulation and the sense of the metrical pulse of the music are considered in the comparison of different tempi.

IV. RESULTS

A. Tempo and Timing

Differences between ensemble performances with a real pianist and the computer accompaniment were found in the maintenance of the implied tempo. The duet performance takes a faster speed from tempo -2 on, where average tempo is 1.1 bpm (1.8%) faster, rising to 5.6 bpm (22.3%) at the slowest tempo. In the other direction the ensemble performance plays slower than the indicated tempo going from a 1.6 bpm (2.2%) decrease at tempo -1 to 16.4 bpm (11.5%) at tempo +5.

When we consider the individual timing of the violinists, changes in expressive timing, or ratio of note values, can be observed in the three-note pattern of the canaries (Fig. 2). The triangles represent the ‘performance space’ of the rhythmical pattern, in which the rhythm ‘moves’ as the tempo changes (Fig. 3). The ratios of note values within the rhythmic pattern are grouped according to the results of the hierarchical clustering method, summarized in Table 2. Three clusters appeared to be relevant to represent the changes in rhythmic timing for all participants except participant 4, where only 2 clusters were distinctive. Note that clusters sometimes comprise non-adjacent tempi (like cluster 2 in participant 8 and 9). It is clear that tempo seems to have an effect on the performance of the violinists, but that this effect differs from individual to individual.

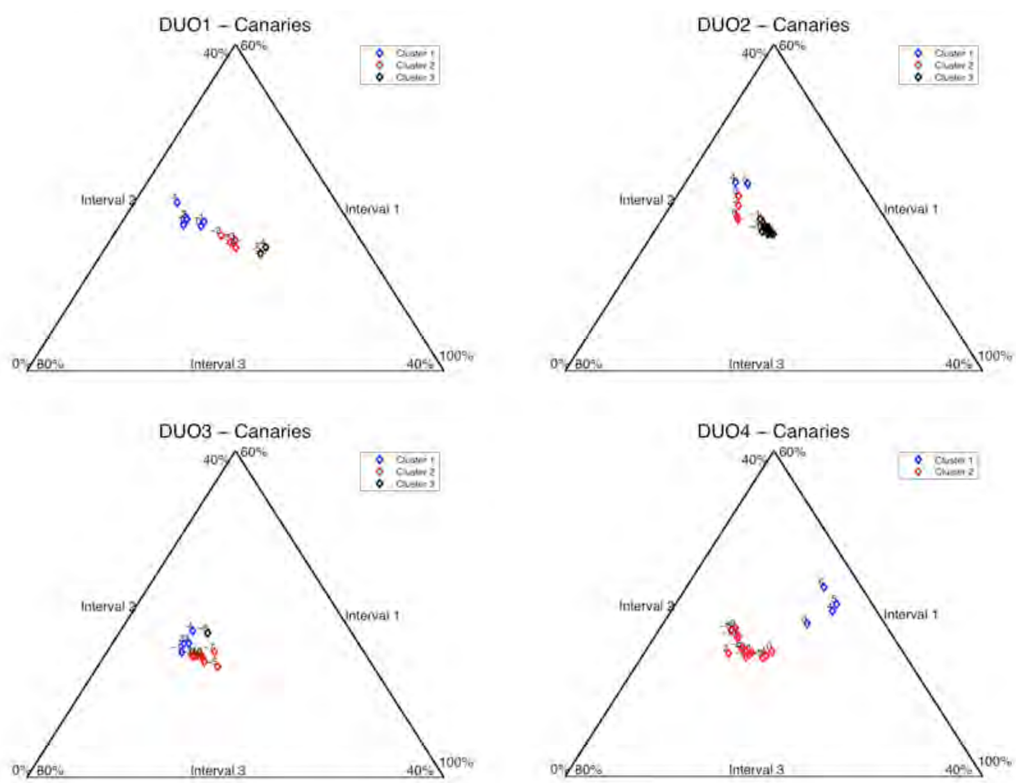

Fig. 2a: Averaged rhythmic timing per tempo for the first four violinists, displayed in the “performance space”. Each side represents the duration (in %) of one note interval, relative to the duration of the complete rhythmic pattern (100 %). The colors show the grouping of the rhythmic timing patterns per tempo, as obtained from the hierarchical cluster analysis.

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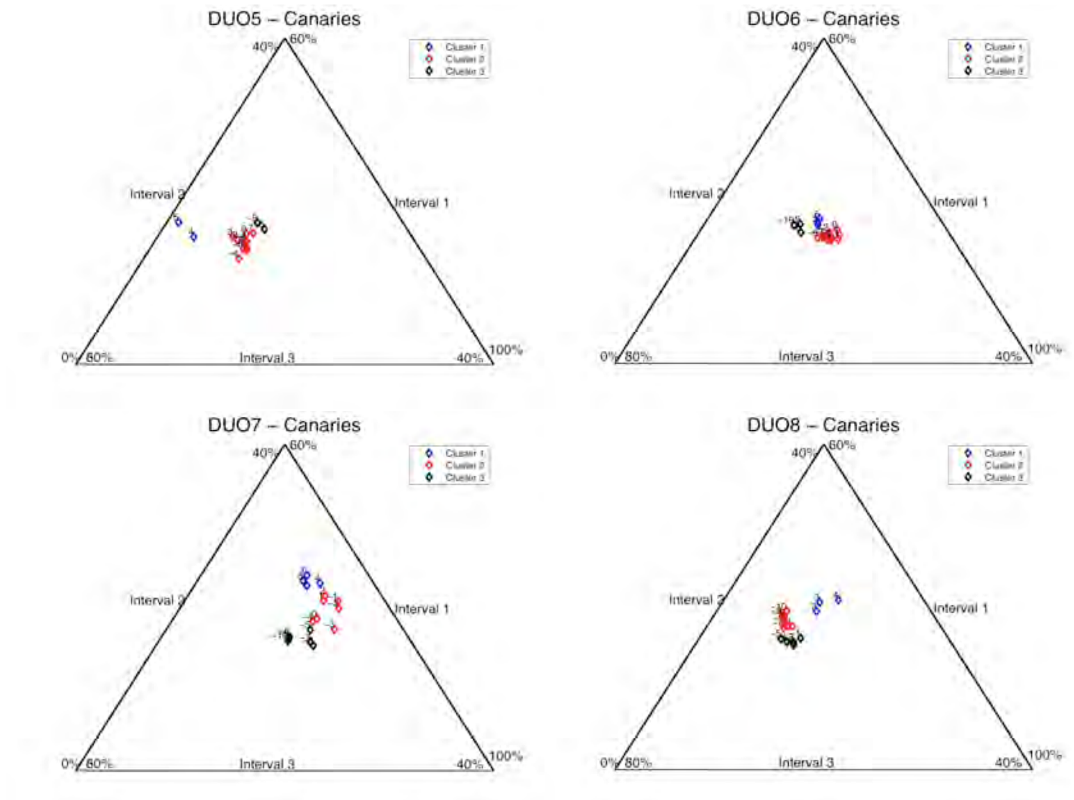

Fig. 2b: Averaged rhythmic timing per tempo for the last four violinists, displayed in the "performance space".

Comparing the evolution of the ratios by the different duo's we see some general trends but also remarkable differences. At the starting tempo, the general tendency is to make the first note slightly shorter and the second a bit longer (49.2:17.3:33.5). Participants 6 & 7, however make the first note about 4% longer and play the last note shorter. Moving to slower tempi, the average ratio stays similar (49.4:17.2:33.4 taking the slowest tempo played by each duo), though changes occur in individual performances. Participant 6, for example, moves from the initial lengthening of the first note to a shortening and an elongation of the second and third note. Stronger differences can be found moving to faster tempi. The average (47.9:20.6:31.5) shows a tendency to more equality, lengthening the short second note relative to the other two. However, looking at individual duos, large differences are found. Participant 5 plays the first note about 3% longer at the fastest tempo and makes the two other notes equal. This tendency to play a 2:1:1 ratio note - pattern is also found in participants 8 and 9. Most remarkable, participant 6 evolves to a 41.1:17.5:41.4-ratio at the fastest tempo, making the first and last note almost equal.

B. Movement

To observe whether tempo also has an effect on the gestures of the violinists, the canaries were analysed in terms of movement. Figure 4 show the mean acceleration of the head of all participants on strong and weak beats over

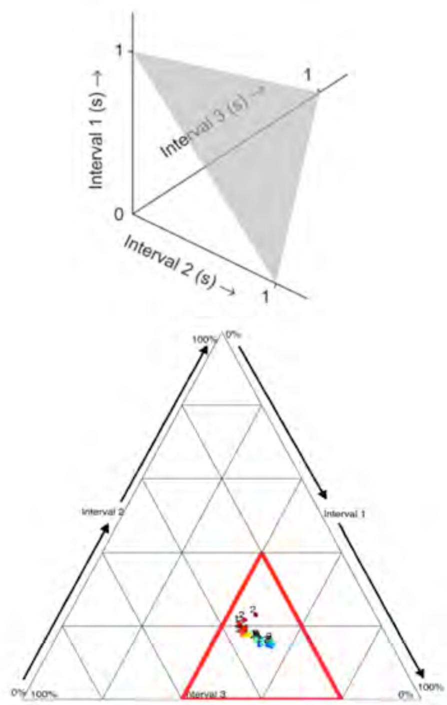

Fig. 3: Representing the 'performance space' of a three-note rhythm based on Honing (2013). Each side represents the total duration of the rhythm (100%) independent from tempo. The position of the dots is determined by the relative durations of the three intervals. As we deal with only one rhythm, the part from the triangle that was representative for this particular rhythm (red) was used in the following figures.

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Table 2: Results of the cluster analysis of timing and movement data and major changes in metrical pulse level and articulation as reported by the musicians. In DUO 5 & 7, the violinists did not report a change in metrical level, though their accompanying pianist did. In the right column, the p-values for the ANOVA on the duration of the note values in the rhythmic pattern and the acceleration on strong and weak beats are reported. Results from the Post-hoc Scheffé –tests are not included.

		Tempo																	Anova – p-values <				
Duo	Variable	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	Note1	Note 2	Note 3	Strong	Weak
1	Timing				2	2	3	3	2	2	1	1	1	1	1	1			0.001	0.001	0.001		
	Movement				3	3	3	3	3	2	2	1	1	1	1	1						0.001	0.001
	ML					x	x																
	Articulation													x	x								
2	Timing	3	3	3	3	3	3	3	3	3	3	2	2	2	2	1	1		0.001	0.001	0.001		
	Movement	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1					0.001	0.001
	ML					x	x																
	Articulation										x	x											
3	Timing			3	2	2	2	2	2	2	1	2	2	1	1	1			0.001	0.01	0.05		
	Movement			2	2	2	2	2	2	2	2	2	2	2	1	1						0.001	0.001
	ML			x	x																		
	Articulation				x	x							x	x									
4	Timing	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	0.001	0.001	0.001		
	Movement	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1				0.001	0.001
	ML						x	x							x	x							
	Articulation									x	x			x	x								
5	Timing		3	3	2	2	2	2	2	2	2	2	2	2	2	1	1		0.001	0.05	0.001		
	Movement		3	3	3	3	3	3	2	2	2	2	1	1	1	1	1					0.001	0.001
	ML (piano)		x	x				x	x														
	Articulation			x	x										x	x							
6	Timing	3	3	3	2	2	2	2	2	2	2	2	2	2	1	1	1		0.001	0.001	0.001		
	Movement	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1					0.001	0.001
	ML						x	x							x	x							
	Articulation		x	x				x	x							x	x						
7	Timing	3	3	3	3	3	3	2	2	2	2	2	2	2	1	1	1	1	0.01	0.001	0.001		
	Movement	3	3	3	3	3	3	2	2	2	2	2	2	2	2	1	1	1				0.001	0.001
	ML (piano)						x	x									x	x					
	Articulation						x	x						x	x								
8	Timing	2	2	2	2	2	3	3	3	3	3	2	2	1	1	1			0.001	0.001	0.001		
	Movement	1	1	1	1	1	1	1	2	2	2	2	1	1	1	1						0.001	0.080
	ML					x	x						x	x									
	Articulation							x	x		x	x	x	x									

the different tempi. In general, there is an increase in acceleration on the strong and weak beats when the tempo increases, resulting in high correlations between average acceleration and average tempo (r = 0.95 for both series). When comparing the strong and weak beats, the acceleration on the strong beats shows a larger increase. T-tests comparing the normalized acceleration data for all participants show that the difference becomes significant at tempo - 6. At one tempo-level higher than the initial tempo, the difference between weak and strong beats still increases, but the significance is lost due to a higher variance. Based on the acceleration on strong and weak beats, a second clustering analysis was performed, the results being summarized in Table 2. Again, three clusters were representative for the data (except for participant 4), but the transitions mostly occur at different tempo-levels as compared with the rhythmic timing of the violinists.

C. Self-report of the Musicians

The last step in the analysis was to see how the results of the sound- and movement analysis related to the experience of the performer. The tempo-levels where the musicians reported a major change in metrical level of the pulse (1) and articulation (2) are also reported in Table 2. A change in metrical level often marks a transition from one cluster to another. This can be a rhythmic timing cluster (DUO 1,3,7,8) or a head movement cluster (DUO 2,5,7). A change in articulation mostly indicates a transition in rhythmic timing (DUO 2,3,5,7,8) but in DUO 8 (and 7) it marks a change in head movement too. The changes reported by the violinists of DUO 4 & 6 are more ambiguous, as they

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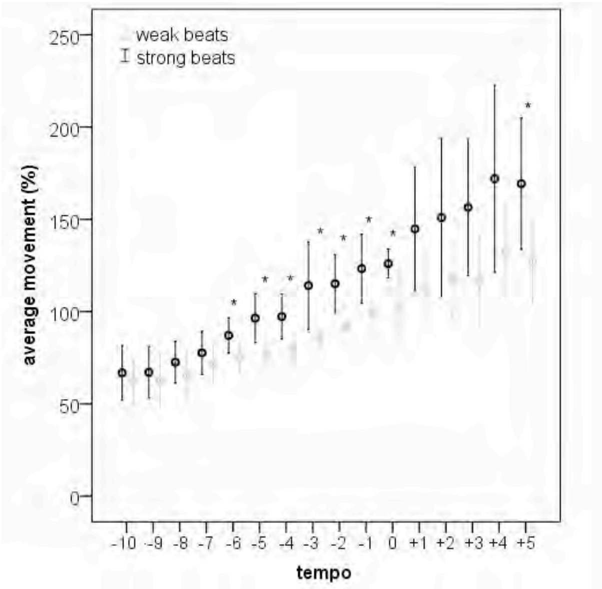

Fig. 4: Normalized acceleration of the head for all participants on strong and weak beats over the different tempi.

mostly occur one tempo-level before or after the transition from one cluster to another. Nevertheless, we could say that the changes in rhythmic timing and head movement relate to the experiences of the musicians.

V. DISCUSSION

By exploring the timing and movement of the violinist in a performance context, we were able to trace major effects of tempo in music performance on different modalities and timing levels.

The performance of particular rhythms is influenced by the tempo, but each individual adapts the rhythm in a personal way. A limited number of clusters could be used in all duos to classify these changes, pointing at a limited amount of transitions in tempo. Looking at a higher timing-level, the change of magnitude of the acceleration in strong and weak beats was studied. Here, the behaviour appeared to be more consistent over participants. At the highest tempo, the level of the strong beat is most salient in terms of movement acceleration, and as the tempo slows down, weak beats gain equal importance, decreasing less in acceleration than the strong beats. Strikingly, the transitions that are observed in the rhythmic timing of the violin are not reflected in the movement data extracted from the head. Occasionally, the changes in rhythmic timing and body movement occur at the same tempo level (as in participant 7), but mostly the two are independently influenced by the musical tempo.

Nevertheless, these results could be related with the experiences of the performers. The substantial changes in the movements of the head on strong and weak beats are partly related with changes in the interpretation of the metrical subdivision of the bar, both of which can be considered as macro-level timing features. By contrast, changes in articulation as reported by the musicians were mainly related with transitions in rhythmic timing, two dimensions of timing that can be considered at a the micro-level.

Hence, there seems to be a discrepancy between general body movement on a higher timing level and idiosyncratic timing patterns on a lower timing level. This tends towards a parallel that can be draw with the complementarity of the sensorimotor and vestibular system in the sensing of musical motion. Our sensorimotor system is related to fine-grained movements on the micro-level of timing, which, in music performance, can reflect a personal sound which is characteristic for the individual performers (Dalla Bella & Palmer, 2011). By contrast, the vestibular system accounts for the sensing of the whole body, which appeared to be more equal across individuals. Already in 1938, Truslit pointed at a difference between performers larger (more global) and smaller (more local) movements, which reflects the organization of the human motor system into two divisions – one controlling the whole body movement and the other the more peripheral limb movements.

The results presented here are indeed highly idiosyncratic, but the analysis of movement only focused on high-level timing features. In order to relate the expressive timing found in the rhythm of the violinist, a more detailed movement analysis of limb gestures (like the bowing arm) should be conducted. Moreover, the analysis only included a piece (the *canaries)* where changes in expressive timing were found. Yet, Repp et al. (2002) reported differences between two- and three-note rhythms, where the latter seemed to be more sensitive to tempo-effects on performance. One could wonder whether similar results could be obtained when using a piece containing two-note rhythms.

Approaching tempo in terms of movement dynamics instead of clean bpm-numbers thus seems to offer an alternative to understand the different expressions we experience in fast and slow music. Moreover, the musician’s intentions and reflections on their performance could help to interpret the phenomena we discover in studying music performance as a multimodal experience. Yet, much of these dynamics are still not completely understood. The interplay between higher and lower timing-levels in the production of sound and movement seems a field that needs to be explored in more detail, in order to fully understand our sensorimotor and general bodily behaviour in the interaction with music.

ACKNOWLEDGEMENTS

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Music performance anxiety – Where next?

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ABSTRACT

Background

"Stage fright", or performance anxiety is a persistent, unwelcome apprehension about performance, typically unwarranted by skill and preparation levels. Music Performance Anxiety (MPA) is recognised as a distinct form (Kenny, 2010; Salmon, 1990) and has been responsible for the blighting of music careers in professional musicians (Khalsa *et al*., 2013; Nagel, 2010).

A literature review on around 150 journal articles on MPA from the year 2000 has determined that research has been concentrated largely in two areas. The first is in scoping, quantifying and qualifying MPA (c. 80 reports), looking at correlations between anxiety and factors including: health and behaviour, type of performance and type of audience, also the instrument type (and whether solo or in a group), the musical genre, and performance evaluation. The second concerns interventions (c. 50 reports), with physical (e.g. Alexander Technique, yoga, well-being programmes), physical-mental (muscular relaxation, breathing), mental (mental practice, meditation, cognitive behaviour therapy, dynamic psychotherapy), and also music improvisational methods being trialled. Biofeedback methods and computer enabled performance simulation have been employed in some studies. There has also been some effort in developing and validating measures (c. 20 reports) for quantitative analysis, pedagogic purposes and for use in non-Western cultures.

Most of the studies have been quantitative, some experiencing difficulties in separating the variables. Relatively few (12) have been qualitative. Overall, study populations have concentrated on university music performance students (37), with fewer studies with music professionals (16) and amateur musicians (9), only one of the latter being a qualitative study.

The paucity of idiographic research in the aetiology of MPA, which is very much about the individual, rather than cohorts, shows the need for research to elicit and analyse experiential data as a precursor to further research.

Aims

Such a pilot qualitative idiographic study has been initiated in order to determine the typology and epidemiology of MPA and then determine the direction of further investigation. It intends to examine MPA in multiple populations (music students, professionals and amateurs) across two broad dimensions: firstly, performance as a solo musician or singer, or within a group (ensemble, band, orchestra); secondly, taking cognisance of instrument and music genre.

Method

The study will extend to around 30 participants across these multiple categories. Single face-to-face or skype interviews will be carried out. Initial interviews with amateurs have averaged 30 minutes. Interpretative Phenomenological Analysis (IPA, Smith, 1995) methodology is being followed.

Results

Results to date with 4 amateur folk club musicians (2 men, 2 women) from different folk clubs have uncovered the following master themes and recurrent sub-themes:

Self-efficacy: overall the participants reported MPA only a short time, minutes, before a performance, an exception being several days. The positive effects of boost (Csikszentmihalyi, 2013) was reported: "When it works it's amazing: there's that moment when everyone's just in harmony and their doing it and they are enjoying it and it's a wonderful feeling". Females reported the positive effect of support from friends, in line with Biasutti & Concina (2014).

Comparison with others: there was a general perception that others perform better: "They had other bands on that were really good, which made me more nervous". There was an echo here from a childhood music grade exam experience: "You have to sit in a chair outside the room with all the other people, you listen to them and you compare yourself". Fear of negative evaluation (FNE) was strong and manifest in two dimensions: failure to live up to one's own expectations: "I said to myself, I had better start getting good on this, because if I get this out and I'm rubbish I'm going to look an idiot", or wanting to please: "I'm trying to please as many people as possible, because I feel as if you're doing it for other people; the moment you are performing you are doing it for other people." The strongest experiences were around audience perception and lack of audience feedback, the leader of a ukulele group reporting: "I have no idea what the audience are thinking, if they bored, or just being patient, or they're really enjoying it, I've got no idea. And that is very unnerving. I think that's when you start to lose confidence half way through a song."

Skills: musicality was seen as important, evident in dwelling on failures in performance: "Once I hit a couple of bum notes I just messed the whole thing up … the 30 second long solo was just, kind of a bit pants … I knew it was not a great performance". Specific memories of failure contrast with immediate memory fade when things went well: "The actual details blur together into one, but it happens so fast it turns into a roller coaster." This conforms with other boost like experiences (Csikszentmihalyi, 2013) .

Coping strategies: common themes were of being closed off: "I am so in my bubble trying to play the song ... if there's other

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people, I should be bringing them in, but I'm not, I'm literally closing them out". Vulnerability was reported as a cause: "But when you are playing a song you are vulnerable … I find it difficult to look at people".

Putative gender differences are indicated in two areas. Men sought positive affirmation from an audience, whilst women were more concerned with maintaining musicality for the benefit of the audience rather than for themselves: this will be commented on further as participant numbers increase. Females reported much stronger somatic symptoms of MPA, such as, increased heart rate and temperature, sweating and shaky hands, in line with other studies (Brugués, 2011; Osborne & Kenny, 2008; Ryan, 2004; Studer *et al*., 2011).

Conclusions

It is too early in the study to discuss conclusions. This pilot study is intended to be a pre-cursor to a larger study potentially involving more participants but likely to be (i) within a more tightly defined population and (ii) involve a range of investigation methods, including bio-feedback.

Keywords

stage fright; music performance anxiety; musicians; anxiety; gender; interpretative phenomenological analysis

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The effects of live music on key stakeholders within dementia care home environments

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ABSTRACT

Background

Dementia is a broad term used to describe a group of syndromes that cause progressive cognitive impairment and decline in a range of human skills, functions, and behaviours (Zeilig et al., 2014; Cox et al., 2014; Knopman et al., 2001).

The number of individuals living with dementia in the UK is set to double, from c850, 0000 to around 2 million people within a generation. In the absence of curative measures there is a timely challenge to meet this population’s growing care needs (Cox et al., 2014, p. 556). Whilst dementia research maintains a strong focus on pharmacological treatments (de Medeiros & Basting, 2011), non-pharmacological methods, such as arts based practices (Beard, 2011), are gaining recognition in both dementia research and practice as positive care strategies that help individuals to “live well” with dementia (Department of Health, 2009, p. 1).

Music offers encouraging anecdotal and evidence based support as an addition to dementia care environments. The use of music in such settings can provide a range of benefits for people with dementia including improving social contact, enjoyment, and promoting empowerment in everyday life (Sixsmith & Gibson 2007).

There are many kinds of music interventions that are appropriate for people with dementia, largely defined and determined by respective care contexts, settings, and resources (Zeilig et al., 2014, p. 16). The form of music used in dementia care ranges from structured therapeutic interventions delivered by trained music therapists, through to music provision as a leisure activity (Zeilig et al., 2014). Similarly, the “modality” (Sherratt et al., 2004, p. 11) of music in these environments can take many forms including music therapy interventions, pre-recorded music listening, and live music performances (Sherratt et al., 2014).

Live music performances can be more beneficial for individuals living with dementia as compared to pre-recorded music. Live music provides a stronger sense of positive mental, emotional, and social engagement regardless of symptom severity (Holmes et al., 2006). Live music also provides temporary wellbeing, influences memory function and stimulates “frames of mind” (Spiro, 2010, p. 892). At present the long-term impacts are unknown.

It has been noted that research into music use for people with dementia has come under criticism due to a lack of methodological rigour in data measurement and analysis (Vasionyte & Madison, 2013). There is also no overarching theoretical framework that promotes the benefits of live music that may occur in dementia care. The introduction of robust methodological practices that lead to such a framework and subsequent outcome support would mean future advice about the implementation of live music in dementia care could be better tailored to meet the needs of people with dementia and their supporting care networks and environments (Cox et al., 2014).

On the last point, it is notable that existing research of live music in dementia care focuses, almost exclusively, on the effects of live music upon people with dementia. There has been little discussion of the impact upon those individuals who plan, produce and conduct live music use in dementia care (‘stakeholders’, henceforth) (Wall & Duff, 2010). Calls have been made for qualitative research to shed light on the ‘lived experiences’ of stakeholders involved in arts based practices in dementia care as a means to establish better resources for all people who participate in arts activities with individuals living with dementia (Killick, 2012).

Despite the limitations of existing evidence research into live music use in dementia care to date, studies have demonstrated how live music can be a relatively flexible, in-expensive and non-invasive addition to care environments. Building on this work, there is now a need for more research to better understand the effects of live music to enhance care settings (van der Vleuten et al., 2012, p. 488). A crucial step in expanding on the present literature, with a view to planning future rigorous, long-term live music studies, is to understand live music effects on the cohorts who are responsible for enhancing the care of people with dementia. It is vital that their experiences are understood if future live music interactions are to be effectively planned and implemented.

Aims

Primary aim: to record and analyse the process of live music sessions in dementia care, including content, flow and outcomes.

Secondary aim: to report the expectations, perceptions and hopes regarding live music sessions from two key stakeholder groups supplementing live music in dementia care; musicians and trained care staff.

Delivery of research to meet these two aims requires a substantial contribution from a partner who provides live music for dementia care homes. Our study is possible thanks to collaboration with Lost Chord, a registered charity that provides live music sessions to over 130 care homes and 2000

people with dementia every month in residential dementia care homes across the UK.

Main Contributions

The first contribution, sought from the primary aim of this study, will be a knowledge repository documenting the use of live music sessions in dementia care environments. Understanding how these sessions are developed and delivered provides firsthand evidence on live music provision in dementia care environments. These primary observations will supplement our understanding of how music can enhance care settings (van der Vleuten et al., 2012), and provide a basis for future long-term investigations.

Documenting the expectations, perceptions and hopes of key stakeholders who support live music use in dementia care will provide new insights into their experiences of live music use in dementia care (Wall & Duff, 2010). Formal documentation of stakeholder perspectives will help to inform the future support, practices and services of each respective cohort namely; care staff involvement with live music sessions for people with dementia and the recruitment and training of musicians.

Studies of live music in dementia care environments further highlight strong opportunities for interdisciplinary research concerning music and dementia care across a range of academic disciplines, such as musicology, applied music psychology, health services research and nursing. In addition, fostering future collaboration with community partners such as music charities, arts councils, and care facilities will ensure that the real world outcomes sought from music and dementia research will remain attainable and beneficial to people with dementia and all cohorts supplementing dementia care.

Implications

Though final conclusions are pending, follow on research will aim to understand the nature of live music practices in dementia care and draw awareness to the associative bodies who aim to realise this aid to care. This method will provide the most effective means by which live music sessions can be comprehensively implemented into dementia care environments; generating guidelines tailored to meet the demands of key stakeholder roles supporting live music use in dementia care, and thus promoting the widespread awareness, education, and training of live music use in dementia care environments.

Keywords

Live music, dementia, music for dementia care environments, music and memory, qualitative research methods.

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The use of ultrasound and advanced machine learning to reveal deep muscle states

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ABSTRACT

Background

Proprioception originates in the muscles as the sensory receptors therein respond to changes in their internal state. Ultrasonography is a non-invasive imaging technology which can be used to directly observe internal muscle states during dynamic tasks. There is currently no standard method for extracting information from ultrasound images.

Aims

This study presents the use of advanced machine learning techniques, namely Restricted Boltzmann Machines (RBM) (Smolensky, 1986; Hinton, 2002), for automatically extracting and interpreting the information content of ultrasound images of skeletal muscle.

Method

Ultrasound images of the human calf muscle were collected from twenty participants, in which two muscles were visible; medial gastrocnemius (MG) and soleus (SO). Concurrently, electromyography (EMG) of MG and SO were collected as well as the ankle joint angle. Feedback of participants' EMG was used to guide contractions independently of joint rotations. The resulting dataset was a set of sequential static ultrasound images of internal muscle states, and associated EMG and joint angle. Each muscle was automatically segmented and normalised to have fixed dimensions. An RBM was used to automatically extract a descriptive feature vector, representative of the time-invariant states of each muscle.

Results

Analysis of the feature vector of the RBM over entire sequences revealed significant correlations between individual raw features and the recorded EMGs independent of the joint angle and vice versa (see Fig. 1). Linear 20-fold cross validation showed that the EMG and joint angle could be predicted accurately within ≈0.3 mean square error.

Conclusions

This study has demonstrated that muscle states uniquely encode the muscle activity and joint angles that caused those states, which is important for proprioception. This study also shows that the information content of ultrasound is sufficient to extract that information. We have shown that RBMs can be used to model muscle states with only a single layer of parameters, which may indicate where in the brain proprioception occurs. This technique may be used to interpret the functional parameters of more complex muscles such as the multilayer muscles in the human neck, where normally the deepest muscle layers in the neck are inaccessible without invasive techniques.

Keywords

ultrasound, feedback, proprioception, machine learning, restricted boltzmann machines.

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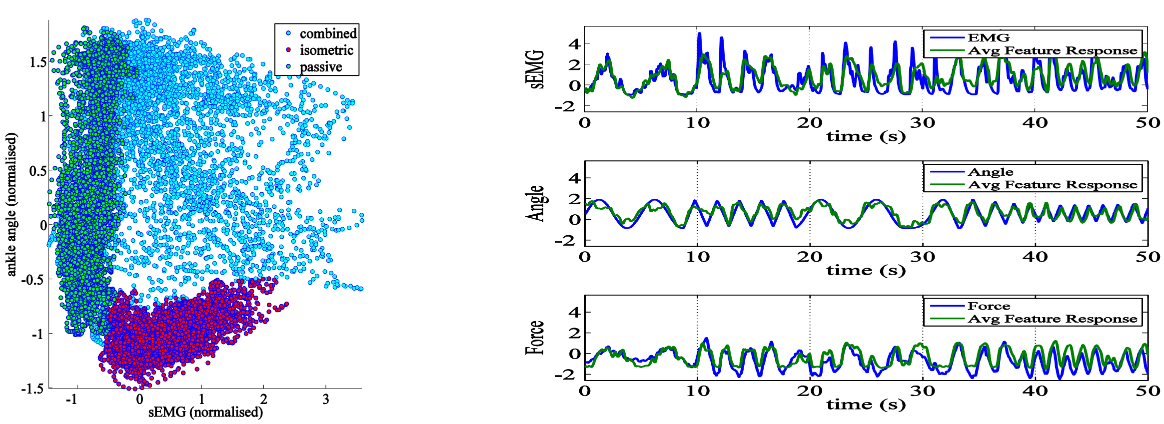

Fig. 1. Averaged MG GBRBM feature response over all trials (representative case) for the top 3 features in terms of correlation with sEMG (top), ankle angle (middle), and force (bottom). The averages of the top 3 raw features contain enough information to predict the respective signals in isolation of one another, without any combinatorial design. Left: shows a scatter plot of the averaged top 3 features in terms of correlation with sEMG (x-axis) and ankle angle (y-axis). Right: shows feature responses in the combined-function trial.

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Music and socio-political attitude

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ABSTRACT

Background

Previous studies about a correlation between socio-political attitude and music preferences in the German speaking area just refer to specific preferred genres or measure socio-political attitude by secondary variables (for example party affiliation; e. g. Dollase & Rüsenberg, 1978, 1986; Ebbecke & Lüschper, 1987; Pfaff, 2006; Schmücker, 1993). The lack of standardized test and the restriction to specific genres in these studies not just impedes a general statement on such a relationship, but makes it impossible to get a closer view of how music preferences possibly interact with personality.

At first a replication (Damm et. al., 2014) of Rentfrow's and Gosling's (2003) study on music preferences and their correlation with self-viewed intelligence, personality and political attitude was conducted.

For measuring the political attitude a questionnaire was designed, whereupon four scales could be constructed via explorative factor analysis and CTT (see method). Although different methods were used, the findings were, as regards content of the dimensions, comparable to those of Rentfrow and Gosling (2003).

Aims

This study at hand is an expansion of the prior mentioned replication of Rentfrow and Gosling and tries to replicate the dimension of music preferences by a German sample and compares the results. Furthermore correlations between socio-political attitude dimension, self-perception of intelligence and music preferences should be investigated.

Method

275 students (n_{female}= 202, n_{male}=73) were questioned online on music preferences with the STOMP (Rentfrow & Gosling, 2003), intellectual self-views based on the intelligence factors by Thurstone and personality with the PANAS-d-trait and the SKI (Krohne, Egloff, Kohlmann & Tauch, 1996).

Additionally, a comprehensive questionnaire with an item pool of 97 questions about socio-political attitude was designed and subsequently filled in by the subjects. The questionnaire included various questions within the areas of ethic, political and social attitudes, such as: Empathy, religion, gender issues, moral values or treatment of minorities.

Hence, the following attitude-dimensions were constructed via factor- and scale analyses: Religious world-view (α =0,85), gender stereotypes (α=0,76), empathy and moral attitude (α=0,71) and rigid behaviour (α=0,74) (TEPEE). The STOMP-dimensions were replicated by an exploratory factor analysis via varimax rotation. The literature-based hypotheses were tested by correlation analyses, with a significance level α = 0,05.

Tab. I: Intercorrelation of questionnaires with the music preference dimensions by Rentfrow and Gosling

Method	Scales	R&C	I&R	U&C	E&R
TEPEE	Gender stereotypes	-,217***	-,159*	,044	-,072
	Rigid behavior	-,092	-,242***	,222***	-,166**
	Religious word-view	,152*	-,383***	,524***	-,003
	Empathy and moral attitude	,097	-,115	,135*	-,030
SKI-S	Ego-strength - Insecurity	,100	,021	-,003	,078
	Attractiveness - Marginality	,051	-,093	,013	,151*
	Confidenceness - Reserve	,041	-,032	,022	,108
	Orderliness - Insouciance	-,097	-,247***	,143*	-,012
	Enforceness - Cooperation	,057	,043	-,153*	,064
PANAS	Neuroticism	-,015	,021	,028	-,103
	Extraversion	,105	-,079	,178**	-,019
Intellectual self-views based on intelligence factors by Thurstone	Space	,058	,059	-,183**	-,087
	Perceptual speed	,086	,073	,018	,020
	Numbers	,046	,054	-,153*	,097
	Memory	,077	-,073	-,111	-,025
	Reasoning	,000	,031	,067	-,063
	Word fluency	,137*	-,080	,054	-,018
	Verbal comprehension	,102	,059	-,019	-,039

R&C: Reflective and Complex; I&R: Intense and Rebellious; U&C: Upbeat and Conventional; E&R: Energetic and Rhythmic; *: p≤ 0,05; **: p≤0,01; ***: p≤0,001.

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Tab. II: Intercorrelation of questionnaires with the replicated music preference dimensions

Method	Scales	Rhythmic	Intellectual	Rock	Pop	Traditional
TEPEE	Gender stereotypes	-,267***	-,073	-,159*	,034	-,043
	Rigid behavior	-,171**	,076	-,242***	-,017	-,019
	Religious word-view	-,011	,415***	-,383***	,055	,242***
	Empathy and moral attitude	,149*	,103	-,115	-,004	-,099
SKI-S	Ego-strength - Insecurity	,080	,063	,021	-,017	,152*
	Attractiveness - Marginality	,108	,059	-,093	,071	-,055
	Confidenceness - Reserve	,116	,066	-,032	,061	-,115
	Orderliness - Insouciance	-,044	,017	-,247***	,030	-,046
	Enforceness - Cooperation	,090	-,071	,043	-,041	-,054
PANAS	Neuroticism	-,073	-,033	,021	-,031	,047
	Extraversion	,046	,205***	-,079	,004	,119*
Intellectual self-views based on intelligence factors by Thurstone	Space	,018	-,080	,059	-,165**	-,035
	Perceptual speed	,045	,104	,073	-,002	,11[illegible]
	Numbers	,108	-,007	,054	,034	-,089
	Memory	,029	,007	-,073	-,058	-,102
	Reasoning	-,027	,048	,031	-,022	,018
	Word fluency	,050	,214***	-,080	-,060	,040
	Verbal comprehension	,100	,104	,059	-,136*	,053

*: p≤ 0,05; **: p≤0,01; ***: p≤0,001.

Results

The music preference dimensions of Rentfrow and Gosling were tested within the sample: 1. Intense & Rebellious (α=0,69), 2. Reflexive & Complex (α=0,53), 3. Energetic & Rhythmic (α=0,43), 4. Upbeat & Conventional (α=0,40).

The obtained results gave reason to reanalyse the factor structure. Therefore following music preference dimensions could be constructed: 1. Rhythmic (α=0,80): Soul/Funk, Blues, Jazz, Latin/Reggae, 2. Intellectual (α=0,68): Modern Classic, Classic, Soundtracks, Religious Music, 3. Rock (α=0,69): Rock, Alternative, Heavy Metal, 4. Pop (α=0,49): Pop, Rap/Hip-Hop, Techno/Dance, 5. Traditional (α=0,46): Country/Western, Folk.

It seems that listeners of the categories Rock and Rhythmic have a more open socio-political liberal behaviour, the groups Intellectual and Traditional contrast with a more conservative attitude and yet a higher awareness of values. The group of Pop listeners shows, except the negative self-viewed intelligence, nothing conspicuous.

Detailed information and a comparison of the results can be found in Table 1 and Table 2.

Conclusions

According to the presented results of the first study (Table I), the findings of Rentfrow and Gosling (2003) could be partially confirmed. Listeners of the Upbeat & Conventional music category tend to be more conservative, have a higher rigidity and religious orientation. On the other hand listeners of heavy music showed a more open social-political liberal attitude.

However after reanalysing the dimensions, the factor-structure has changed. Presumably the instability of the dimensions could depend on music trends as well as on cultural and sociological differences in the relevance and meaning of certain music preference categories of the particular cultural background. Nevertheless both results showed that the usage of groups of popular music listeners as "normal" comparison group should be seen very critically in the research.

Keywords

Music and socio-political attitude, music preference, personality.

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Music wars between Caucasian nations

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ABSTRACT

Background

In the current presentation, I will explore how music is employed in service on nationalist ideas among the Caucasian nations: Armenians and Azerbaijanis. I will focus on two folk tunes common to both nations: *Sari Aghjik*/*Gelin* and *Shalakho*.

Construction of national identity can be viewed in terms of constant re-negotiation of boundaries, which are re-invented according to the requirements of the situation. (Kokot et al, 2004, p. 4) This is also relevant when speaking about Armenians and Azerbaijanis, who often include/exclude (un)wanted elements from folk music.

Aims

The aim of the presentation is to explore how national identity construction in Armenia and Azerbaijani uses the means of music, as music offers a good opportunity to organise collective memory.

Main Contribution

There are almost no research in Armenian and Azeri ethnomusicology that would deconstruct nationalist discourse in the reception of folk music. My focus is the reception of it in social media. The subject is interesting for research because both countries are characterised by half-totalitarian regimes where official media is under control of oligarchy/government. As it makes social media one of the very few places for free discourse, there can also be found elements of peace building between countries. Yet, on microlevel, social media reflects national myths common among these two nations.

I will combine two types of methods: music analysis and discourse analysis. At first, I will describe certain national narratives in Armenian and Azeri musicology. As for the background, I will give theoretical background to the songs, explaining differences but also similarities between the versions of different nations. Finally, I will present the web and social media research (Facebook, YouTube, blogosphere, etc) for analysing the reception of the songs, which I will link with larger national narratives.

Implications

Current presentation shows on practical, everyday level the viability of official, national myths, and how these myths are remarkably similar between Armenian and Azeri case.

Keywords

Nationalist identity constructions, folk tunes, collective memory, social media

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My life as a playlist: Investigating emotional experience in music in rituals across time

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ABSTRACT

Background

Understanding the role of music in social and cultural practice has been of key interest to a range of researchers across disciplines. The current paper explores how music is used in key rituals, building on contemporary psychological theories of music and emotion and work on personality and group behaviours. The work also draws on recent theoretical work in cultural history. It is to our knowledge the first interdisciplinary project of this nature, contributing to the emergent field of the history of emotions, and adding new perspectives to music psychology research.

Aims

With psycho-historical theoretical propositions in mind, the current study aimed to investigate the following questions: how has music played a key role in the rituals that mark peak emotional events in human lives, such as the birth of our children, falling in love and the passing of a loved one? How do modern day music choices compare with historical ones and how do they reflect the changes in societal meanings and emotional experience? The work also captures the cultural diversity of the Australian nation and so considers variations in practices between different cultural groups.

Methods

Principal methods of data collection have been two-fold: a major on-line survey promoted by the Australian Broadcasting Corporation, surveying the general public on a range of attitudinal, emotion and personality measures; and a survey of historical documents for a range of cultural backgrounds on musical practices and interpretations of them.

Results

Using refined survey analyses and close readings of historical documents, results have revealed that contemporary associations with specific socio-emotional life-markers have common musical attributes within a specific cultural group, e.g., music for funerals employing similar musical structures. Also, when historical music or music from a different culture is adopted into a contemporary setting tend its attributions are perceived and used according to the dominant cultural explanation. However, when historical musics are examined in context, it is possible to reveal the remarkably different structures, emotional experiences and meanings attributed to these musics.

Conclusions

This research has enabled the authors to draw on the concepts of emotional regimes and communities that are gaining traction in cultural history to offer a theoretical model for how music functions in everyday life and how psycho-cultural context plays into the meanings ascribed. This model offers exciting prospects for researchers looking to explain musico-emotional behaviours over time as well as within and between culture groups.

Keywords

Music and emotion, ritual, history of emotions, psycho-cultural context.

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Musical investment: Assessing and enabling musical participation for positive wellbeing impact with seniors in Australia

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ABSTRACT

Background

Investigations of musical activities for wellbeing impact have grown exponentially over the past decade. Existing work has shown positive short-term impact, yet researchers remain unclear about how music operates for these outcomes. In addition, evidence-based investigations of the long-term potentials of musical participation are scant.

The current work is part of a major nationally funded project that explores these questions across a broad range of contexts, drawing on a population scale sample. The data discussed in this paper focus on the facilitators of musical activities and their participants aged over seventy years of age who have been committed to musical activities for more than seven years.

Aims

The work aims to investigate the techniques that stimulate musical participation; practices that lead to sustained long-term musical participation; and investigation of the specific elements of the participation found to offer wellbeing benefit.

Method

A three-phase design has been developed. Stage 1 draws on discussions with focus groups to identify variables of interest. Stage 2 develops a quantitative survey of experience. Stage 3 provides case studies to investigate practice of music facilitators working with senior cohorts across a range of music disciplines and outcome foci -- culture groups (e.g. Samoan choir), therapy (e.g. geriatric unit at local hospital), community (e.g. Autumn Club in village hall) and education (e.g., University of the Third Age).

Results

The different kinds of data have produced compelling results. Techniques that stimulate musical participation vary according to context, though facilitator style displays consistent and coherent strategies. Practices for long-term participation are distinct including addressing a defined social function, establishing a routine within session and agreeing repertoire with participants. Specific participation outcomes include a firm and increasing belief in physical and mental health improvement over time, measurable social capital benefit, and improvements in mood, focus, lucidity, and relaxation; all feeding increasing motivation and self-image in relation to music.

Conclusions

The study offers evidence suitable for the development of a model of positive long-term musical investment. It also provides evidence for best practice guidelines for work with music for these cohorts.

Keywords

Music and wellbeing, social function, modeling for musical investment

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Future directions in measuring real-time audience response - During-performance social interaction

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ABSTRACT

Background

Many forms of live music, such as folk, jazz, theatre and classical Indian are overtly interactive between and among audience and performers. But even in passive audience settings such as classical music concerts, ballet, contemporary dance and films, where the experience occurs with the audience remaining still and silent, and appears to be highly personal and reflective, we simply have not had the tools to investigate systematically whether social interactions are occurring (in the case of the film, among the audience members). Despite major advances both in technology and techniques, tracking continuous response to live performance has several limitations and beckons interesting psychological and philosophical challenges that will engage the research community in the future. In terms of measuring social interaction, such response tools may interfere with the social variables of interest (interaction with performer and other audience member) because of the solitary activity of responding to a self-report device. The measuring tool itself may alienate the audience member from social interactions that may otherwise occur implicitly and unconsciously.

Aims

This paper discusses the state of the art in continuous response methods when investigating audience member reactions while in a live concert setting, and presents some possible ways forward.

Main Contribution

The problem needs to be addressed because research interest is growing in the role of empathy and mimicry in live performance, where both subconscious and overt interactions between and within performer and audience occur. We argue that many of the most recent tools in continuous response measures used in the bulk of audience response research are inadequate for addressing questions about a range of socially related parameters of audience behaviours.

Implications

One way forward for future research on real-time audience response to live performance is video and movement analysis tools. We discuss some of the approaches that are available, including video based facial expression coding. These tools will be useful because they relieve the burden of measurement made by the audience.

Keywords

audience response; live performance; social psychology; empathy.

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Music training and verbal memory: Investigating the mechanism underlying this association in 10- to 12-year old children

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ABSTRACT

Background

A positive association between music training and verbal memory has been demonstrated for adults (Jakobson, Lewycky, Kilgour, & Stoesz, 2008) as well as for children (Ho, Cheung, & Chan, 2003). For adults it was shown that the advantage in verbal memory was due to enhanced verbal rehearsal in musicians compared to non-musicians (Franklin et al., 2008). However, it remains unclear whether the same mechanism underlies the association between verbal memory and music training in children.

Aims

We investigated whether an enhanced verbal rehearsal mechanism was responsible for higher verbal memory scores in musically trained children.

Method

We tested 45 (31 girls) 10- to 12-year-old children (M = 131.24 months, SD = 6.88 months). Amount of music lessons was assessed to assign children to the musician group (n = 24) and the non-musician group (n = 21). We measured verbal memory with two wordlists (VLMT). Children memorized one list under normal conditions and the other list with articulatory suppression. In the articulatory suppression condition children had to say "the" after every word they heard from the word list in order to suppress verbal rehearsal. The order of conditions (normal vs. suppression) and the list used in the suppression condition was counterbalanced. We controlled for personality (BFI), intelligence (CFT-20R), motivation (SELLMO), musical aptitude (AMMA), and socioeconomic status (SES).

Results

Children in the musician group did not differ significantly in personality (all $ps > .1$), intelligence ($p > .12$), motivation (all $ps > .1$), and musical aptitude (all $ps > .39$) from children in the non-musician group. However, musically trained children had a significantly higher SES than untrained children ($p < .05$). Hence, SES was controlled in further analyses. An analysis of variance with SES as covariate revealed a significant difference between children with and without music training in verbal memory, $F(1,41) = 4.28$, $p = .045$. In the normal condition musically trained children remembered more words. This significant difference disappeared in the articulatory suppression condition, $F(1,41) = 1.63$, $p = .209$.

Conclusions

We conclude that an enhanced verbal rehearsal mechanism might be responsible for better verbal memory in musically trained children.

Keywords

verbal memory, children, music lessons

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Musical accent in action: Does *auditory-biography* influence accent perception in live music performance?

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ABSTRACT

This study examined musicians' perceptions of accenting within a complex ecological listening experience. Accent contributes significantly to performers' expressive communication in music performance. Despite agreement concerning complexity, a definition of accent remains elusive. Studies from artificial intelligence, musicology, music psychology, and neuro-cognitive sciences indicate multiple expressive parameters implicated within expressive accenting. Potential relationships between inter-performer accent perception and auditory-biography, i.e. personal listening history, have been little examined. To my knowledge, the current investigation represents a novel research endeavour. The trial was led by the performer-as-researcher using sound stimuli of live music performance. A group of 39 tertiary performance students listened to excerpts of live music performed consecutively by bassoon, flute, and tin whistle. Listeners were asked to mark beat onsets which they perceived as being highlighted or standing out in some way. Five different accenting patterns, using widely varied accent characters, were presented in randomised order. Data were pre-processed using Signal Detection Theory (SDT), then analysed with general linear models using inference via Bayes factors (BF). The general linear models included factorial ANOVA-equivalents as well as univariate simple effects analyses. The high-voice superiority effect hypothesis was not supported in this context. There was, however, an effect of low-voice superiority such that rhythmic perception rather than melody had received enhanced auditory encoding, thereby facilitating listener perception of the lower-voiced instrument. Results indicated correlations connecting perceptual accent accuracy scores and auditory-biography, including possible influences of timbral familiarity/unfamiliarity and instrument of specialisation.

I. INTRODUCTION

This study is exploratory in nature. To my knowledge, investigating interactions between accent perception and auditory-biography represents a novel research endeavour which includes the novelty (and complexity) of using sound stimuli from ecologically valid live music performance (Welch, 2010). The performer-as-researcher led the trial. Investigating terrain occupied by creative acts such as music performance often requires a willingness to embrace a degree of complexity and ambiguity (Montouri, 1997). The trial examined for difference in the way musicians experienced the same sound cue, i.e. expressive accent, during performance. This paper describes the first trial and its findings.

A. Accent

Studies from musicology, neuro-cognitive sciences , artificial intelligence, music psychology and linguistic prosody have identified that an expert performer's interpretive manipulation of multiple expressive parameters makes a significant contribution to emotional communicative processes (Bisesi, 2011; Friberg, 2006; Ramirez, 2010; Juslin, 2003; 2004; Lindstrom, 2003; Widmer 2003; Widmer, 2004; Parncutt, 2003; Ornoy 2008; Palmer, 2006; Cook 2008; Bhatara, 2011; Gabrielsson, 1996; 2003; Chapin 2010; Maestre, 2005; Meyer, 1956; Seashore, 1937). Within these expressive parameters, the manipulation of accent has been identified as a major element: "… this aspect (accent) is already complex enough to account for a large part of the variations in timing and dynamics that make up musical expression" (Parncutt, 2003).

Despite agreement concerning complexity, the concept of accent continues to defy definition. To quote Cooper and Meyer "… though the concept of accent is obviously of central importance … an ultimate definition … does not seem possible with our present knowledge … accent appears to be a product of a number of variables whose interaction is not precisely known … It is understandable as an experience but undefined in terms of causes" (Cooper, 1960; Friberg, 2002). The many accent descriptions include: captures listener's attention (Drake, 1993), marked for consciousness (Cooper, 1960), moment in musical flow (Lerdahl, 1983), increased salience (Huron, 1996). It would appear that interpretive accenting carries great expressive potential and requires high levels of instrumental skill and auditory acuity. Juslin lists parameters regularly manipulated by expert performers for expressive purposes as including: tempo, sound level, timing, intonation, articulation, timbre, vibrato, tone attacks, tone decays, and pauses (2002). Each one of these sound cues has also been identified as contributing to expressive accenting, (Juslin, 2002; Friberg, 2002; Parncutt, 2003; Lussy, 1900). Perceptual and physical categories of accent include the phenomenal, immanent, metric, structural, melodic contour, agogic, timbral, harmonic, gestural and subjective (Thomassen, 1982; Lerdahl, 1983; Parncutt, 1994; Huron, 1996; Lindstrom, 2003; Abacasis, 2005; Bresin, 2000; Brochard, 2003; Drake, 1993; Large, 2002; Ellis, 2009; Potter, 2009; Povel, 1981; Yeston, 1976; Tekman, 2001).

B. Auditory Biography

An individual experiences any given sound event according to the way their attention is directed (Jones, 1976; 1989; Fritz, 2007) and as a result of their unique personal listening history, or 'listening biography' (Margulis, 2009). A highly specialised auditory apparatus is required to perceive and execute the instrumental micro-manipulations of accenting.

This paper designates the term *auditory-biography* (*A-B*) to indicate an account that differs from the listening biography of previous studies. Though the investigation is at an early stage,

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the discussion section mentions aspects of *A-B* which involve overlapping dynamic processes. It (*A-B*) includes the auditory, touches the embodied (an accent sound cue which may be felt/moved/imagined very differently by rock guitarists), and the socially/contextually situated (a tin whistle playing Bach?) with influences of internal representation and bias. To use the terminology of Signal Detection Theory (SDT), this account of auditory-biography includes both *signal* (musical sounds) and *noise* (sensory/non-sensory input of psychological or physical origin) which may impact or weaken the *signal*.

The individual perceptual-neural process of adaptation related to differing backgrounds of auditory experience (Pantev, 2001; 2011; Margulis, 2009; Bharucha, 2006), is thought to influence the communicative relevance of auditory information-bearing elements (IBEs). It appears that the same combinations of IBEs are processed and interpreted differently by various listeners depending on their listening background. Amongst musicians, the listening biography is shaped primarily by long term experience of their instrument/s of specialisation. Studies have shown that enhanced auditory encoding is related specifically to the timbral qualities of their instrument of expertise (Shahin, 2008; Traube, 2006; Kraus, 2009; McAdams, 2009; 1995; Helmholtz, 1954; Giordano, 2010). In the study by Margulis et al (2009), the cerebral haemodynamic responses of expert violinists and flautists were measured (using fMRI) as they listened to 12 second excerpts from J.S. Bach Partita in A minor for Solo Flute and in D minor for Solo Violin. This study revealed an extensive cerebral network of expertise. Increased activations occurred when flautists listened to flute excerpts and violinists listened to violin excerpts and not when listening to the instrument of non-expertise. Enhancements were indicated for musical syntax, timbre of specialized instrument, and auditory/motor interactions which were associated with the instrument of expertise. The study concluded that long-term experience, training, expertise, timbral familiarity combine to exert greater effects on auditory perception and auditory/motor self-relevance than had previously been considered.

The vast majority of performances take place in group environments (Keller, 2007; Williamon, 2004). Long term experiences with particular ensemble configurations is thought to affect auditory-biograpy. Musicians work collaboratively in ensembles such as symphony orchestras, operatic companies, choirs, rock bands, string quartets and jazz trios. This musical team work necessitates the development of a highly differentiated auditory apparatus. Differences in musicians' perceptions and responses to sound cues from others during performance have received little attention. Given the importance of accenting within interpretive expression, this trial examined whether influences of auditory-biography would be discernible in listener perceptual accent accuracy scores resulting from live performance. The selection of listeners from players of divergent instrument families, e.g. strings and woodwind, enabled an investigation of auditory-biography influences on inter-instrument accenting perception.

C. High-Voice/Low-Voice Superiority Effects

A number of mismatch negativity (MMN) studies (Marie, 2012; Marie & Trainor, 2012; Trainor, 2011; 2014; Fujioka, 2005; 2008) have indicated that both musically trained and untrained listeners experience a "*high-voice superiority effect",* i.e. enhanced auditory encoding of pitch/melody deviations, when they take place in the high-voice (higher pitched/upper voice), while listening to two simultaneously sounding voices. The term *voices* is used here to denote musical melody lines or tones. MMN is a response to deviant or unexpected sounds in a sound stream and is a component of the ERP (event related potential) based on electroencephalograph (EEG) and magnetoencephalograph (MEG) recordings. The above studies have shown the "*high-voice superiority effect*" to be robust, pre-attentive, exhibiting in both infant and adult populations. The encoding enhancement applies particularly to pitch and melody discrimination and may explain why the melody in Western polyphonic (simultaneously sounding voices) music is commonly found in the highest voice. In one of the above studies (Marie &Trainor, 2012), researchers examined whether the neuro plastic changes resulting from a musician's long-term specialisation on a low-voice instrument could influence or reverse the "*high-voice superiority effect*". They compared the MMN results of two musical populations, one specialized on high-voice,soprano instruments and the other on low-voice or bass instruments. The soprano instrument specialists showed a "*high-voice superiority effect*" similar to results from former studies. By contrast, bass specialists showed equal encoding of both upper and lower-voiced melody lines. Results indicated that long term low-voice experience had enhanced the auditory encoding of the lower-voice melody line but not to the extent of resulting in a reversal or "*low-voice superiority effect*". The studies used controlled sound laboratory conditions for their trials. Sound Stimuli were synthesized musical tones (piano tones) with multiple controls exercised for aspects including directionality of sound, loudness, timbre, harmonics, duration, and participant body movements. Participants were not asked to listen to the sound stimuli (they were explicitly asked not to actively attend and instead watched silent movies during the trial).

The current study prioritized naturalness over controls which resulted in a very different trial environment. The use of live music performance as sound stimuli and active/attending listener participants meant that many controls could not be exercised. One of the current research questions concerned whether the phenomenon of "*high-voice superiority effect*" would still be discernible using stimulus of a live monophonic voice, i.e. single melody line situated in live music performance. In addition, would the effect be confounded by differences in timbre between the solo performance instruments? The use of monophonic sound stimuli created a very different trial context as it removed the major aspect of auditory scene analysis (Marie, 2012) of multiple overlapping sounds. However, though the current trial differed in fundamental ways from the above mentioned it did allow for a novel testing of the effects of timbre and familiarity within both a high-voice/low-voice superiority effect while using complex musical stimulus of live

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performance. Sound stimuli was provided by instruments of differing register (pitch height i.e. high-voice/low-voice) and timbral characteristics. The complex ecological listening experience was far removed from controlled sound laboratory conditions of former trials. Deviant tones took the form of intermittent accented beat onsets. Instead of pre-attentional measurements of MMN, active listener participants provided indications of auditory neural plasticity through their changing perceptual accuracy of the deviant accents. The highest-voice instrument was an unfamiliar one with unfamiliar timbre which added another layer of complexity to the testing of a "*high-voice superiority effect*" in the context of this trial.

Recent measurements of MMN responses in EEG studies using polyphonic sound streams have revealed superior auditory cortex encoding of timing deviations when they take place in the lower-pitched voice of two simultaneously sounding tones (Hove, 2014; 2015). As in previous studies, synthesized piano tones were used as the musical stimulus. Deviant tones were positioned 50 ms early, in randomised order, in either the high- voice or the low-voice tone. It was found that the timing deviations in the low-voice produced greater MMN responses than those in the high-voice. A "*low-voice superiority effect*" for timing/rhythm has also been supported by tapping synchronization studies (Hove, 2014) and auditory/motor synchronized interactions (Burger, 2013; Honong, 2012; Stupacher, 2013). These studies indicated that listener body movements and rhythmic/timing perceptions were more influenced by lower tones/bass rhythms, that this influence increased when combined with higher sound levels, i.e. louder music, louder bass lines (Van Dyck, 2013), and that rhythmic bass placements often favoured downbeats/strong beats, i.e. the first beat in a bar of 2/4 (two beats in a bar) or the first and third beats in a bar of 4/4 (four beats in a bar) (Lerdahl, 1983; Large, 2000). Hove (2014; 2015) suggested that a "*low-voice superiority effect*" may underpin the musical convention of the rhythmic line being carried by the lowest-sounding/bass instrument or voice and may represent the reverse of "*high-voice superiority effect*" which supports the musical convention of the melody being carried by the highest voice.

In the current study, musical stimulus was delivered by one lower-voice instrument and two high-voice instruments. This enabled a second research question which asked whether there would be any correlations evident between accuracy/error scores of low-voice specialist listener participants when listening to the lower-voice performance instrument. In other words, would a "*low-voice superiority effect*" be discernible in data gathered from listeners with long-term low-voice instrumental experience when exposed to trial stimulus from the lower-voice performance instrument?

D. Register and Timbre

Register denotes the relative pitch height (higher or lower pitch) of a particular instrument or groups of instruments. For example, bassoon plays in a lower register than flute, and tin whistle plays in a higher register than flute. In the context of this study, when the term *voice* is used it implies register as well as denoting an instrument or group of instruments i.e. *low-voice* denotes low pitched instruments and includes the aspect of low register, *high-voice* denotes high-pitched instruments and includes the aspect of high register. It was hypothesised that listener participants' long-term specialised experiences of instrument register and timbre would influence their perception of accenting patterns in live music performance.

The term timbre may be used to describe the colouration of a particular note or group of notes in music (Erickson, 1975; Hailstone, 2009; Boulez, 1987; Plomp, 1970). It is also used as part of instrument identity e.g. a listener will identify a violin primarily by the timbre of its sound. The attack (the very beginning or onset) characteristics of a particular instrumental sound or note is considered to be an essential part of timbre and instrument identity (Schaffer, 1948; Traube, 2006). For the purposes of this trial, it is the second usage of timbre that is of interest. For example, Pantev et al (2001) demonstrated that auditory cortical representations of trumpet and violin timbres were enhanced preferentially in participants who had extensive expertise on the respective instrument. Long-term exposure to the timbrel qualities of a particular instrument appears to influence auditory-biography and result in enhanced auditory encoding of particular sonic information especially when connected with the instrument (or family of instruments) of expertise (Shahin, 2008; McAdams, 2009; Pantev, 2001; 2011; Kraus, 2009). The timbre related findings from the above studies together with the centrality of timbral influences within auditory-biography, motivated enquiry concerning the potential influence of timbral familiarity or lack of familiarity. It was hypothesised that data analysis would reveal correlations connecting the degree of timbral familiarity of trial performance instruments with resulting perceptual accuracy scores.

E. Hypotheses

1) *Hypothesis 1.* A "*high-voice superiority effect*" (previously tested on polyphonic sound sources) will be evident in the accuracy/error scores resulting from a monophonic sound source. This effect will result in participants achieving their highest accuracy scores for the high-voice listening condition of Tin Whistle (TW).

2) *Hypothesis 2.* The influence of auditory-biography will pre-dispose participants specializing on bass sounding instruments to express a "*low-voice superiority effect"* in their perceptual accuracy/error scores resulting from the listening condition of Bassoon (Bsn).

3) *Hypothesis 3.* The timbral familiarity/unfamiliarity of the listening condition will be significantly correlated with participant perceptual accuracy/error scores.

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II. METHODS

A. Method

A group of forty-two tertiary music performance students comprised the listener participants. Participants were asked to listen to brief excerpts of live music performance. Each listener was given a copy of the music played and asked to mark any beat onset which they believed was highlighted or stood out in some way. The word "accent" was not used in order to avoid introducing bias to the way participants' attention was being directed and also because many musicians currently have quite a narrow, music notation oriented concept of what constitutes an accent. The inquiry examined for accuracy differences emerging between participant responses to the "three listening conditions". For the purposes of this paper, the term *listening conditions* refers to the musical stimuli produced by the three solo performance instruments which were used in the trial. In other words, the trial contained three discrete listening conditions described as Tin Whistle (TW), Bassoon (Bsn) and Flute (Fl). The term *voice* (e.g. high-voice, low-voice) is used to denote the auditory object (representing a musical instrument) of the individual listening conditions.

B. Musical Stimulus

Musical stimulus was the first eight bars from the second movement of the J.S. Bach Flute Sonata in E major (BWV 1035). Performance instruments used were tin whistle (TW), bassoon (Bsn), and flute (Fl). The J.S. Bach excerpt was transposed to D major (see Figure 1) as TW was a tin whistle in D. The eight bar excerpt (ten seconds duration) was presented with five different patterns of accenting and articulation. Each individual example of these five accenting patterns was performed three times: first on TW (played by the performer-as-researcher), then on Bsn and lastly on Fl. This resulted in a total of 15 solo performances. The order of examples was randomized. A wide range of accenting characters was employed by the performers including increased sound level, delay of onset, vibrato nuance, ornamentation, increased duration, micro-pause, percussive onset, timbral nuance and flutter-tongue. The performers were experienced professionals with extensive orchestral, chamber ensemble, and solo experience. An audio-visual recording was made of the trial performance. This allowed for validation of performer accenting compliance.

Figure 1. Trial musical stimulus, J.S. Bach (BWV 1035)

C. Participants

Forty-two tertiary music performance students took part in the trial (mean age = 22 years, range 17-55 years). Seven instrumental areas were represented: Woodwind (WW), Brass, Electric-Guitar (E-Guitar), Bowed-Strings (B-Strings), Piano, Voice, and Creative Productions (CP). CP includes sound engineer training. The cohort sizes were as follows: WW (7), Brass (3), E-Guitar (9), B-Strings (5), Piano (7), Voice (7), and CP (1). Three participants were excluded because of non-compliance, i.e. incomplete responses, leaving a total of 39.

III. RESULTS

A. Data Analysis

The thirty-nine listener participants comprised 18 female and 21 male university performance students. Length of experience ranged from 5 to 45 years (mean experience = 11 years).

In this study, Signal Detection Theory or SDT (Green 1966; Abdi, 2007) provided a framework for distinguishing between ambiguous stimuli arising either from a known source (called the *signal*) or by chance (called the *noise*). In this trial the performed accents represented the *signal.* Relative to the participant, *noise* may be internal/external, sensory or non-sensory and of psychological or physical origin. SDT explicitly assumes that non-sensory information as well as the physical trial signal will be shaping participant responses. Major SDT parameters are listener sensitivity, also known as d-prime (*d'*), and bias. Sensitivity (*d'*) is a measure of participant ability to discriminate between the presence of the *signal,* and *noise*. In other words, the ability to correctly identify accents as opposed to false alarms (fa), i.e. incorrect/misattributed accents. Bias is expressed through participant criteria of marking, i.e. a liberal marking criteria shows a willingness to detect the signal (whether or not the signal is physically present) whereas a conservative marking criteria indicates a reluctance to detect the signal.

Data were pre-processed using SDT, then analysed with general linear models using inference via Bayes factors (BF). The general linear models included factorial ANOVA-equivalents as well as univariate *simple effects analyses.*

Table 1 shows the SDT results of the seven group cohort accuracy and error scores separated across the three listening conditions. An examination of this table reveals the following: the listening condition of TW received the lowest accuracy scores across all seven cohort groups while the listening condition of Bsn received the highest percentage of correct accent identification in six out of the seven group cohorts. However, Table 1 shows that Bsn also received the highest fa scores (false alarm rate) from four of the seven cohorts and was equal highest for another two cohorts.

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Table 1. SDT perceptual accuracy/error scores using the three listening conditions of TW, Bsn and Fl.

	hTW	faTW	hBsn	faBsn	hFl	faFl
Woodwind	70	7	86	5	84	9
Brass	50	11	69	17	67	8
E-Guitar	50	20	65	28	58	22
B-Strings	74	4	87	5	84	5
Piano	58	4	64	4	73	2
Voice	61	19	75	21	73	15
CP	24	28	37	47	37	44

h = hit rate (percentage of accenting accuracy); fa = false alarm rate (percentage of accenting error/misattributed accents)

B. Bayes Factor Analysis

Following this, the Bayes factor analysis (Jeffreys, 1998; Kass, 1995) examined for difference in sensitivity (*d'*), between the three delivery instruments used for performance i.e., the three listening conditions of TW, Bsn and Fl. The results showed very strong evidence for a difference in participant sensitivity between the listening conditions.

The Bayes factor was 960-to-1 in favour of a difference in sensitivity between listening conditions (as opposed to the alternative hypothesis of no difference between listening conditions). See Table 2 for an explanation of Bayes factor inferential ratings of strength versus weakness.

The results also showed very strong evidence of difference when contrasting the *d'* results from the two listening conditions of TW and Fl. The Bayes factor was TW versus Fl: 5,700-to-1 in favour of a difference. In other words, there was a very strong likelihood of a difference in listener sensitivity between the listening conditions of TW and FL.

Mild evidence was found for a sensitivity difference between cohorts (BF=6.3-to-1) and weak evidence in favour of a different bias setting between instruments (BF=4.7-to-1).

The weakness of the bias setting between instruments indicates that the very strong Bayes factor in favour of the difference between listening conditions (960-to-1) was not due to participants changing their criterion of accent marking between the three listening conditions of TW, Bsn, Fl. In other words, there was only weak indication of participants changing from conservative to liberal marking of accents between listening conditions, i.e. showing willingness to hear accents regardless of whether or not the accents were physically present.

Table 2. Breakdown of BF strength of evidence according to Jeffreys (Kass and Raftery, 1995).

Bayes factors	Strength of evidence
1–3	not worth more than a bare mention
3–20	positive
20–150	strong
> 150	very strong

C. Simple Effects Analysis

In order to explore further what was driving the difference between cohorts, *simple effects analysis* was used to compare each cohort against each other cohort. The starting point was to calculate the average *d'* for each cohort, separately for each delivery/listening condition. Table 3 below shows the results.

Table 3. Cohort sensitivity (*d'*) averages across the three listening conditions.

	TW	Bsn	Fl.
Woodwind	2.18	2.98	2.57
Brass	1.53	1.72	2.08
E-Guitar	1.14	1.16	1.37
B-Strings	2.67	3.12	3.04
Piano	2.15	2.18	2.83
Voice	1.52	1.83	1.99
CP	-0.14	-0.26	-0.18
Cohort Average	1.77	2.05	2.19

For the purposes of examining Table 3 group cohorts scores CP will now be excluded. CP was made up of only one participant (who didn't appear to have understood the task).

Table 3 reveals that the listening condition of TW received the lowest *d'* scores in all six group cohorts which was also in line with its SDT raw accuracy scores. However, the listening condition of Bsn (which had previously received the highest raw accuracy scores in 6 out of 7 cohorts) received the highest *d'* in only two out of the six group cohorts. *D'* calculations shown here indicate participant perceptual sensitivity to each listening condition. Unlike the listening condition of TW, Bsn *d'* scores are not in line with the Bsn raw accuracy scores. This is caused by the higher Bsn false alarm rate (fa) i.e. higher error scores resulting from a greater number of misattributed accents from participants when listening to Bsn. The final row in Table 3 shows the grand total *d'* average for each listening condition across all cohorts. Here one can see that Fl received the highest listener sensitivity (and hence the lowest *noise*) while TW received the lowest degree of listener sensitivity.

The next step in the data analysis was to compare the seven cohorts against each other (7 cohorts making a total of 21 different pairs to compare) and to then calculate these separately for each of the three listening conditions making a grand total of 63 Bayes factors tests. What emerged was that the listening condition of Bsn was consistently more powerful at separating the cohort groups in a majority of cases.

Given the high number of Bayes factor tests (63), and the smallness of the cohort sizes, these results must be approached with caution because of the possibility of the phenomenon known as "family wise error rate" or "Type 1 error", i.e., as the number of tests increases so too does the possibility that a result was due to random chance. However, given the consistency of the powerful separating influence coming from the listening condition of Bsn it is worth mentioning the two strongest group cohort comparisons. In both cases the E-Guitar cohort is represented. The two noteworthy two-way group comparisons

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are listed below. When reviewing the data in Table 4 there appears to be a listener sensitivity correlation between the only low-voice representative among the group cohorts (E-Guitar cohort with bass-guitar experience) and the only lower-voice representative from the listening conditions i.e. Bsn. Referring to Table 2 informs us that a Bayes factor (BF) result of 129.85 is categorized as very strong. This resulted from testing E-Guitar versus WW for difference using the listening condition of Bsn. In other words, there is a very strong likelihood of perceptual sensitivity difference between the above two groups when listening to the delivery instrument of Bsn as compared to the alternative hypothesis of no difference in perceptual sensitivity between the two groups. This also applies to the second two-way group comparison of E-Guitar cohort versus B-Strings cohort using the listening condition of Bsn. In this case the BF result of 31.25 also indicates a strong likelihood of difference.

Table 4. Bayes factors for comparison of electric guitar cohort against several others.

Electric Guitar cohort versus:	Bayes factor in favour of difference over null:
Woodwind using Bsn:	129.85
Woodwind using Fl:	2.76
Woodwind using TW:	5.2
Bowed-Strings using Bsn:	31.25
Bowed-Strings using Fl:	4.53
Bowed Strings using TW:	10.27

IV. DISCUSSION

Hypotheses Tested

Hypothesis 1. A "*high voice superiority effect*" (previously tested on polyphonic sound sources) will be evident in the accuracy/error scores resulting from a monophonic sound source. This effect will result in participants achieving their highest accuracy scores for the highest-voice listening condition of Tin Whistle." It was hypothesised that a "*high voice superiority effect*" would be discernible in listener perceptual accuracy scores derived from a monophonic sound stream. A number of trials (Trainor, 2014; Marie, 2012; Fujioka, 2005) have consistently shown increased ERP listener responses (using pitch deviants) for the upper voice as opposed to the lower voice, when listening to two simultaneous sound streams. The effect has been shown to be pre-attentive, presenting prior to musical acculturation, and only partly attenuated, though not reversed, in musical populations where there has been extensive specialisation on a bass sounding instrument. For Hypothesis 1 to be supported, the highest sounding auditory object/voice from the three listening conditions would need to have received the highest scores for listener accuracy/sensitivity. However, the highest sounding voice, i.e. the listening condition of TW, consistently received the lowest accuracy and *d'* scores across all seven cohorts. The low TW scores were consistent in SDT and Bayes factor analyses shown in tables 1 and 3, including the Bayes factor *d'* grand total comparisons for difference between listening condition sensitivity (see final row of Table 3).

Given that *d'* values measure participant discriminability of *signal* from *noise* it appears worthwhile to examine possible contributors to *noise* for the listening condition of TW. There are several potentially strong contributors to TW *noise* including those of internal/psychological/non-sensory origin such as contextual learning, internal representations, as well as internal and external aesthetic dissent. A mismatch between instrument, venue and repertoire performed may have contributed to TW *noise* while lack of timbral familiarity may have weakened the strength of the perceived *signal* for TW. This will be examined further in Hypothesis 3 discussion.

Many research questions remain to be explored surrounding Hypothesis 1. However, TW represented the highest sounding listening condition (TW sounds one octave higher than Fl and three octaves higher than Bsn). When examining the Bayes factor (BF) analysis investigating difference between listening conditions of TW and Fl, inferential evidence of very strong difference is apparent. The BF was TW versus Fl: 5,700-to-1 in favour of a difference. A perusal of Table 3 *d'* values show that the difference in listener sensitivity between TW and Fl consistently favoured Fl across all cohorts. These values indicate that listener participants were consistently more discriminable when identifying the *signal* (accents) for Fl as opposed to TW. Fl does not represent the highest voice in this trial, therefore Hypothesis 1 has not been supported.

Hypothesis 2: "The influence of auditory-biography will pre-dispose participants specialising on bass sounding instruments to express a *"low voice superiority effect*" in their perceptual accuracy/error scores resulting from the listening condition of Bassoon." Data analysis does reveal indications of support for this hypothesis. Auditory-biography influences here are evident in particular through the higher false alarm/error scores.

1/The only cohort of low-voice bass instruments was E-Guitar cohort with the majority having rock band/electric bass-guitar experience. Table 1 shows that the E-Guitar cohort, when listening to Bsn, perceived more accent false alarms than any other cohort (excluding CP). As opposed to B-Strings cohort (the only cohort containing members who produced perfect scores), E-Guitar, when listening to Bsn, were the only group containing members who marked accents on every beat onset resulting in multiple false alarms. This elevated level of *noise* could indicate that the listening condition of Bsn had to some extent triggered a modified mode of attending (Jones, 1976; 1989) and suggests that E-Guitar cohort had switched from hearing melody to perceiving timing/rhythm. It is likely that the long-term influence of increased entrainment/increased body movements (Van Dyke, 2013) facilitated by loud bass rhythms also contributed to a stronger embodied experience of accent for E-Guitar which in turn assisted the higher false alarm rate. The "willingness" to hear beat onset accents which were not physically present could indicate a heightened sensitivity to beat/timing/rhythm through long-term auditory-biography

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exposure to a low-voice instrument (Hove, 2014; 2015) in a high sound level environment (Burger, 2013; Honong, 2012; Stupacher, 2013) and supports a "*low-voice superiority effect*".

2/ Table 3 lists the *simple effects analysis* of the two most noteworthy two-way cohort comparisons of participant sensitivity difference. Both these comparison scores involve the E-Guitar cohort and in both cases the listening condition of Bsn drives the most powerful results. This is an additional indication of links between auditory-biographies of E-Guitar and the only lower-voice listening condition of Bsn. Studies (Hove, 2014; 2015) have noted that a "*low voice superiority effect*" is facilitated by loud sound levels, strongly beating rhythms, rhythmic entrainment of body movements. All of these aspects are to be found within a rock band context.

3/ The third correlation between auditory-biography and "low voice superiority effect" is evident when examining the nature of the false alarm rate. "fa" scores from Table 1 represent the number of misattributed accents which participants perceived. E-Guitar cohort, when listening to Bsn, produced not only a higher proportion of misattributed beat onset accents, they also showed a stronger preference for misattributed *downbeat* (i.e. first beat in the bar) accents than any other cohort (Lerdahl, 1983; Large, 2000). As a group they were more strongly inclined to hear downbeat accents which were not physically present. This gives additional support to the suggestion of correlations between their particular low-voice/bass listening experiences with strongly marked rhythmic downbeats and a "*low-voice superiority effect*" experienced in a monophonic sound stream. This is in line with recent findings (Hove, 2015) showing increased rhythmic entrainment and enhanced auditory encoding of lower voices associated with the combination of increased sound levels and bass sounding instruments. This effect appears to be the reverse of "*high-voice superiority affect*" (Trainor, 2012).

*Hypothesis 3: "*The timbral familiarity/unfamiliarity of the listening condition will be significantly correlated with participants' perceptual accuracy/error scores." The aspect of timbre is central to an investigation of auditory-biography. Participant perceptual sensitivity was found to be negatively correlated with timbrel familiarity. In other words, participant lack of familiarity with the timbre of TW appears to have contributed to consistently lower accuracy and *d'* scores for all thirty-nine trial participants when listening to TW. Lack of timbral exposure, plus uniformly lower accuracy/listener sensitivity could indicate auditory-biography deficits. Though TW represented the highest sounding voice it consistently received the lowest scores. These lowest scores were consistent both when testing the complete population (39 participants), and also when comparing the individual instrument cohort groups across the three listening conditions of TW, Bsn, and Fl. This represents some support for hypothesis 3.

Tin Whistle and Lack of Familiarity: Given that TW represents the highest voice, what explanations could there be for it receiving the lowest accuracy score in this trial? One possibility is that TW performance was substandard with indistinct accenting. A review of the audio recording revealed that TW performance was clear, with controlled accenting patterns. Another possible explanation comes from studies investigating increased event related potentials (ERPs) related to familiar versus unfamiliar timbres (Pantev, 2011; 2001). It appears that unfamiliar musical sounds/timbres are not encoded as efficiently as familiar ones. This aspect of preferential timbrel processing being mediated by familiarity/expertise is central to an exploration of individual *auditory-biography*.

Two major aspects of instrument identity are attack character and timbre. Schaffer's *Cut Bell* experiments in 1948 (Traube, 2006) showed that by removing the attack from an instrumental sound a new instrument identity could be created. TW and Fl show some similarity in attack character (i.e. slow onsets) but otherwise display differing timbrel characteristics. Research by Timoney (2004) informs us: "Timbre of the tin whistle is characterised by a fundamental and only a few harmonics" (Kelleher, 2005; Gainza & Coyle; Gainza, 2004). In this regard, TW represents an outlier, possessing a spectral envelope that sets it apart from Bsn and FL.

Listener participants very limited or no ensemble/listening experiences with TW may have resulted in a listening condition occupied by an unfamiliar instrument, unfamiliar attack character and unfamiliar timbre. These aspects appear to have contributed to the low perceptual accuracy scores.

TW, Context, Aesthetic Dissent: Non-auditory contributors to the aspect of *noise* (SDT, signal/noise) may be implicated in the lower TW accuracy scores. The aspect of *noise* is included here as part of this study's account of auditory-biography. Analysing ecological, creative stimuli through the lens of the complex social environments they take place in enables the researcher to assess socially situated influences such as contextual learning (Balsam, 2014), and inter/intra group expressions of aesthetic dissent (Boden, 2004). In her Theory of Creativity, Boden differentiates between three pathways for emerging creativity: the combinational, the explorational, and the transformational. Transformational involves change, and rule breaking within conceptual spaces which then allows novelty to emerge. This transformational category is the one most likely to surprise, shock, produce discomfort and subsequently, to arouse aesthetic dissent. This paper does not intend to argue whether or not the use of TW to perform a Bach Sonata qualifies as a transformational creative act. However, within the context of this trial, it did appear to surprise, shock, make uncomfortable and arouse aesthetic dissent.

The following describes aspects of the *noise* within this testing of auditory-biography and may help to illustrate influences of contextual learning and aesthetic dissent in action: The inclusion of TW, an "outsider", a folk instrument, in this trial seems to have brought with it added layers of both social and auditory complexity. At the start of the trial when each of the performance instruments was introduced individually to the participants there were signs of unsettled listener behaviour concerning the inclusion of TW. When it was realised that TW was one of the performance instruments, performing a J.S. Bach Sonata excerpt there were adverse reactions such as widespread intra-group giggling, joking, winking, nudging, squirming in seats, and making derisive eye contact. The introduction of Bsn

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and Fl produced no such reaction. These are both generally accepted and respected orchestral instruments.

TW brought a number of clear mismatches: the first mismatch was between TW and place/venue. The trial took place in a tertiary music conservatorium. For TW this represented foreign territory. TW is not normally taught in a conservatorium environment. However, for Bsn and Fl it represented home territory. Both these instruments are taught and perform regularly at all Australian music conservatoriums.

The second mismatch was between TW and repertoire. J.S. Bach represents standard Western Art Music repertoire for Bsn and Fl but extremely incongruous repertoire for TW. It is almost certain that participants would not have previously experienced TW being used to perform JS Bach.

Anecdotally TW is not considered to be a "proper" instrument by large numbers of people. The following list suggests some generally held beliefs concerning TW which may have negatively influenced participant perceptions:

- TW is very cheap to buy, often costing less than $10 (as opposed to most instruments owned by listener participants which would likely have cost thousands of dollars);
- it is considered the equivalent of a toy by many people, played poorly by children at home and in primary schools;
- anyone can make a sound on it (usually a very screechy, ugly one);
- it is not offered as a "serious" instrument of study at the vast majority of mainstream music conservatoriums (exception: Ireland, in folk music specialization);
- unlike Bsn and Fl, buying a more expensive instrument does not necessarily improve the performance potential. (Author's note: Many of the finest TW players use the cheapest instruments);
- there is a general expectation that TW can't play music outside the folk genre.

It is likely that the majority of participants would have had minimal or no exposure to working with a TW player and would never have experienced the instrument being used to perform Western Art Music. The fact that TW was used in this trial to perform music by J.S. Bach would possibly have been experienced by trial participants as amusing, surprising, jarring, incongruent, experienced as a complete mismatch between music and instrument and resulted in an experience of individual and group aesthetic dissent.

Given the above observations, it appears likely that in the case of TW listener participants experienced a mismatch between the folk instrument, musical material, performance venue, and that this was compounded by an experience of group aesthetic dissent, negative internal representations, differing conceptual spaces for TW compared to Bsn/Fl. These influences may well have impacted listening processes, auditory encoding, direction of attention and resulting perceptual accenting accuracy.

V. CONCLUSION

"*High-voice superiority effect*" has previously been tested using controlled sound laboratory stimuli with simultaneous sounding voices of matched timbre and non-attentional participants. This represented a very different sonic approach compared to the current trial which used sound stimuli derived from the complex, often messy, ecological validity (Welch, 2010) of live music performance using a single voice sound stream and perceptually active listeners. The use of monophonic stimuli removed the fundamental aspect of auditory scene analysis present in former trials, while trial stimulus of live performance and perceptually active listeners introduced many potential trial confounds. The loss of multiple trial controls and the addition of complex, ambiguous creative acts, creative perceptions and judgements meant giving up the possibility of precise measurements, outcomes and claims. These are obvious trial disadvantages however, compelling future research questions present themselves in this situation: Was a "*high voice superiority effect*" not evident in this context owing to the powerful auditory–biography influence of timbral unfamiliarity?; Did the choice of a folk instrument, an "outsider", as the highest-voice introduce confounding elements to the testing of the effect?; Would results have been different with better matched performance instruments (e.g. piccolo versus bassoon/violin versus double bass), numerically larger listener participant cohorts and with controls exercised for listener expertise? As regards former trials, would the "*high-voice superiority effect*" (Marie and Trainor, 2012) tested on contrasting musical populations (high-voice versus low-voice specialists) have produced different results if the low-voice stimulus had been a rhythmic based one (closer to a natural music experience) rather than a second melody line?

One noteworthy point which may also indicate cohort specific auditory-biography: Only the B-Strings cohort had members who achieved a perfect score. They also achieved the highest *d'* scores (see Table 3) of any cohort across all three listening conditions. This is of particular interest as the performance instruments used all belonged to the woodwind family. Therefore, one might have expected the WW cohort to achieve the highest accuracy scores. However, any interpretation must be made with extreme caution as we are dealing with very small sample sizes. It is possible that the B-Strings cohort simply had several outstanding members who possessed high levels of instrumental and auditory competency.

One possible interpretation, which could be worthy of more investigation in the future, is that the auditory-biographies of B-String players are advantaged, during this particular type of perceptual accenting trial, by their highly differentiated bowing technique. A brief perusal of Dolmetsch Online (wwwdolmetsch.com/musictheory21.htm#wind) describing articulation/accent on wind and string instruments shows a large discrepancy in the number of accenting categories ascribed to the two. Wind instruments have a total of eight while string instruments have a total of forty-four different articulation/accenting categories involving both the bow and plucking with finger/fingernail. This is of course a simplistic way of drawing attention to possible implicit accenting complexity differences between the cohorts of WW and B-Strings. However, it does provide a signpost indicating that the bow-arm/accenting complexity inherent in B-Strings expertise may result in an auditory-biography shaped by extensive training/experience to be highly differentiated, and hence advantaged, when perceiving accenting sound cues.

This trial raises many more questions than answers. Would participants have responded differently to the three listening conditions if the trial had taken place at the local Irish Club (TW/venue/repertoire, contextual match) with musical stimuli from an Irish jig? Or alternatively, would Hypothesis 1 results have been altered by replacing TW with piccolo? Did the author's initial instructions to participants introduce a form of bias to the trial by repeatedly requesting they pay attention to the character of beat onsets? This may have influenced participant manner of "attending" and predisposed some listeners to attend more to rhythmic/timing aspects, hence advantaging low-voice Bsn and "*low voice superiority effect*".

A number of study limitations need to be considered when interpreting results. Controls could not be exerted in terms of participant numbers, instrument cohorts represented, or information concerning participant instrumental expertise. As a result, the trial had a large number of instrumental cohorts, with each one representing a very small sample size. Disparate levels of expertise were clearly present. Despite these drawbacks, data analyses do point to connections between auditory-biography and accenting perception and show a level of support for Hypotheses 2 and 3.

Interpretive accent is a major element in performer expression and inhabits a sound world far removed from the accent symbols found in music scores. Mastering accenting complexity (including positive and negative impacts on phrase shape, energy, direction) may be facilitated by *explicit* teaching, interpretive and listening approaches (Lindstrom, 2003; Juslin & Timmers, 2010; Parncutt, 2007; Laukka, 2004; Tait, 1992; Juslin & Persson, 2002; Karlsson, 2008). Accent and auditory-biography research may potentially contribute to informed ensemble experience/repertoire choices as well as heightened practitioner awareness of the *what* (auditory cue, auditory object) and the *how* (manner of attending) in ensemble and individual music preparation. Targeted use of aspects such as direction of attention, intensive versus extensive ensemble/timbral exposure, auditory focus and *explicit* aural modelling approaches may contribute to enhanced auditory-biography and performing experiences.

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Contents of self-selected music for specific mood effects differ between healthy and depressed participants

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ABSTRACT

Background

Research suggests that people in a depressed mood may be particularly attracted to mood congruent music (Miranda and Claes 2008; Hunter, Schellenberg et al. 2011; Punkanen, Eerola et al. 2011). However, there is some evidence that such music does not help all people to achieve their mood improvement goals (Garrido and Schubert 2013). People with depression often have low activation thresholds for negative affect and experience it in greater intensity and for longer periods than healthy people. Conversely they may have a higher activation threshold for positive affect and are likely to experience it with less intensity and for shorter periods than others. Thus it is possible that people with depression may experience difference emotional responses to music than healthier people.

Aims

To determine whether there are any differences in musical features or lyrical content in the music that creates sad and happy affective states between people with tendencies to depression and healthier participants.

Method

Over 500 participants nominated a piece of music that made them feel sad and a piece of music that made them feel happy. The acoustic and musical features of the songs were computationally extracted, the genres of the songs were inferred from online social streaming services and reduced to underlying dimensions, and the affective content of the lyrics was scored using affective lexicon methods.

Results

Significant differences were found in musical features and lyrical content between the songs selected by depressed and healthy participants.

Conclusions

Mental health and mood have a significant impact on both music listening choices and its effects.

Keywords

Depression, emotion, sadness, lyrics

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Genres do matter – The influence of contextual knowledge to expressed emotions in music

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ABSTRACT

Background

In the past, music and emotion studies have attempted to keep familiarity, expertise, music genres in control when collecting self-report ratings of expressed emotions. Yet it has been occasionally reported that these may influence the ratings (e.g., Bigand et al., 2005; Eerola, 2011). In order to tap into larger datasets harvested from crowdsourcing, it would be vital to know to what extend these factors do contribute to the self-reports of emotions.

Aim

To determine whether the self-reports of expressed emotions differ when participants rate excerpts within a context when a specific genre is established or within a context with a mixture of genres. In addition, we will contrast the self-reports with projections of these emotion dimensions obtained from analysis of social tags crowd-sourced from web communities.

Methods

A set of 600 music tracks was sampled in a balanced manner from last.fm to systematically cover the affective circumplex space as well as six genres. 59 participants rated short clips of the tracks using three core affect dimensions (valence, arousal, tension) and seven mood terms. Half of the participants rated the clips within blocks specified by the genres (genre-based) and half without this information (mixed). Novel semantic analysis technique (ACT, Saari & Eerola, 2014) that capitalises tags and affective circumplex emotion term positions was used in comparing the self-reports with a larger, crowd-sourced dataset.

Results

Agreement among the participants differed across the rating context and emotions. Analysis of variance revealed that the context of the ratings (genre-based or mixed) had a relative minor main effect on ratings reflecting adaption in scale usage but there were strong interactions between genre and context in several emotions. Regression analyses suggested issues of relevancy, that is, certain emotions such as happiness are not really appropriate for all genres (e.g. electronic, metal) whereas others may capture large part of the variance by themselves (e.g. dark in metal). Liking and expertise exhibited smaller contributions to the self-reports than the context provided by music genre. Crowd-sourced affect projection mirrors these contextuality effects.

Conclusions

Contextual information provided by a simple musical context (genre) does influence the ratings of expressed emotions, which can be further broken into issues of adaptation and relevancy. We discuss how the contexts for everyday music consumption (situations and moods) may also be related to these concepts.

Keywords

Emotion; expressed emotion, models, context.

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Music and sadness: Definitions, functions, and rationales for engaging in negative emotions

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ABSTRACT

Background

Recently sad music and its effects on the listener have received considerable attention in music and emotion research. This symposium directly addresses the central puzzles of this topic, starting from definitions to prevalence and the underlying mechanisms, and the way these are all moderated by individual factors. Characterizations of the music-induced sadness typically reveal a wide range of associated emotions, underscoring the multidimensional nature of the phenomenon. Also, the mechanisms responsible can be complicated and not directly related to the music itself, since memories, lyrics, and social situations have been acknowledged to have strong role. These fundamental issues will be taken up by two first presentations (#1 & #2), first of which broadens the scope by introducing non-pleasurable emotions associated with sad music. The second presentation connects and analyses the explanations with individual differences and with empathy in particular. Finally, the rationale for engaging in negative emotions is addressed by two other presentations offering alternate viewpoints (#3 & #4). In the first of these, an acceptance-based coping is found to be an important goal in choosing to listen to sad music, and the second underscores the way regulation is impaired when suffering from depression. These two studies are particularly interesting angles to the topic since they not only explain the reasons for sad music listening also implicate both healthy and maladaptive coping tendencies and suggest ways these both are connected to individual differences. This symposium addresses the central issues of music and sadness from divergent perspectives and methods, and each presentation brings novel empirical data about issue under scrutiny. There will be particular emphasis on discussion of the challenges the topic faces, which will be implemented as a series of key questions applicable to all presentations, posed by the discussant.

Keywords

emotion; expressed emotion, sadness, rumination.

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Swinging to the beat – Movement induction in electronic dance music

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ABSTRACT

Overt beat induction occurs when an individual, listening to rhythmic music, spontaneously starts moving her/his body in a synchronized manner – e.g. by tapping her/his finger or foot. However, it is not well understood which specific rhythmic features increase the likelihood of beat induction. An interesting candidate is the "swing" parameter used in electronic music production, which induces a delay of every second eighth note and thus creates a "swinging" feeling. We tested within subjects the effects of three experimental factors on the intensity of beat synchronized movements: 1) Movement instruction (none/naive vs. instructed beat synchronization), 2) the intensity of the "swing"-parameter, and 3) music excerpt. Three pieces of rhythmic electronic music with six different swing ratios each were randomly played to 18 participants. Bodily expressions of beat induction were measured using a motion capture system with reflectors attached to the subjects' feet, hands and the head. In the naive condition, the subjects were told that the reflectors will be used "later on" for another part of the study. In the instructed condition, participants were explicitly encouraged to move to the music. The order of the conditions was randomised between participants. The motion capture data were transformed to the frequency-domain and the individual movement intensities were extracted at frequencies corresponding to the BPM of the stimuli. A repeated-measures Hierarchical Linear Model revealed that both condition and piece have a significant influence on the movement intensities. The swing parameter, however, exhibits only a weak, non-significant relationship with the beat-induction movements.

I. INTRODUCTION

The spontaneous movement of individuals while listening to music is a widespread phenomenon. It manifests from single body part motions like tapping or nodding to an involvement of the whole body like swinging and swaying or dancing. For these reactions to music, a musical education or deep knowledge of music is not required. Moreover, such spontaneous and unaware motion induction is considered a fundamental skill for the development of musicality (Honing, 2012) and closely connected with linguistic abilities.

Synchronizing movements to external stimuli is more likely associated with the auditory system. People listening to a beat will easily be able to start synchronous movement which is not always the case for a rhythmic visual stimulus (Patel et al., 2005).

Furthermore, a test person moving to a visual stimulus can easily be disrupted by a different auditory signal. However, an asynchronous visual stimulus will not have such a heavy impact on people moving to an acoustical beat (Repp and Penel, 2004).

It is still under debate whether the ability to rhythmic-motoric synchronization arises spontaneously or is the result of a learning process. However, it is well established that even small children are capable of recognizing rhythms. This ability might be explained by the way parents rock their children to sleep (Trehub & Hannon, 2006) or a genetic predisposition (Winkler et al., 2009).

In previous studies, fingertapping served as a model for the investigation of beat induction. Drake et al. (2000) report that the physical synchronization occurs most frequently and precisely between 65 to 200 bpm with an optimum at 120 bpm. Furthermore, music seems to influence how people move. When listening to music, some subjects ran with double walking pace compared to test persons listening to the same beats of a metronome.

Nevertheless, the specific parameters and features in music which increase the likelihood and the intensity of beat induction are not well known. Madison (2006) proposes four factors, labeled regular-irregular, groove, having swing and flowing, describing "reflecting psychological dimensions" (Madison, 2006) which are independent of musical genre and style.

This study aims to investigate the factor "having swing", which implies the use of "swung notes", a delay of every second eighth note. The delay can quantitatively be given by the swing ratio, defined as the duration ratio of the long-short pattern.

II. Method

A. Participants

Eight female and ten male participants (age range: 23 to 37 years) were recruited by a university mailing list. All of them listen at least "regularly" to music, ten participants specified to like electronic music.

B. Stimuli

Three 30 second long excerpts of electronic dance music (demo songs bundled with music production software, Native Instruments GmbH, Berlin) with differences in musical style and tempo were selected and modified using different swing levels. The swing scale in the software ranged from 0 (no swing) to 50 (excessive swing), corresponding to swing ratios from 1:1 to 3:1. We decided to use six swing levels in steps of 10 (0, 10, 20, 30, 40, and 50). These values were applied to every instrumental track of each demo song.

C. Experimental Design and Measurements

The resulting 18 stimuli (3 tracks x 6 swing levels) were presented twice via headphone in a randomised order. During a "naive" test condition the participants were asked to answer a simple questionnaire in a 30 second break after every stimulus presentation. In the "instructed movement" test condition, participants also answered the questionnaire, but

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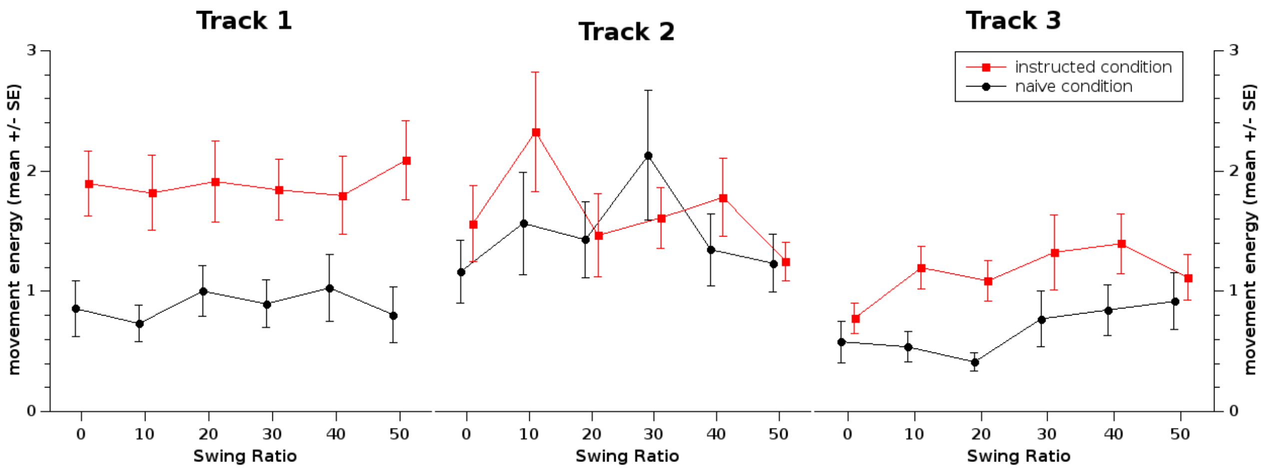

Figure 1. Movement energy by swing ratio (0-50), by musical excerpt (track 1/2/3) and by condition (instructed/naive), over all participants. Excerpt and condition have a significant influence on movement energy, the swing ratio shows no such relationship.

were additionally explicitly encouraged to move to the music. One half of the participants started with the "naive" condition, condition.

In both conditions the participants were provided with five groups of five reflectors, attached to their feet, hands and head (headphone). The participants were told that the reflectors were only needed for the "instructed movement" condition, but, to avoid interruptions, it would be necessary to wear them during the whole experiment, which worked well in all cases. Motion of the reflectors attached to the limbs was tracked in both conditions by eight OptiTrack Flex 13 cameras, positioned at a distance of two meters to the right and left in front of the test person (on two tripods). The cameras recorded the scene at 50 fps (changed to 30 fps after some trials) and at a resolution of 1.3 megapixels. Each group of reflectors was then combined to constitute one "RigidBody" within the OptiTrack software Motive:Body, representing the 3D-position of each limb. After the experiment, all participants filled in a short questionnaire that assessed inter-individual background information on age, gender, and everyday musical behavior and preferences.

D. Data processing

Data analysis was based on the extracted three-dimensional positions and corresponding timestamps of each RigidBody. In some cases, missing position values had to be interpolated (cubic interpolation) due to obstructed camera view; trials with more than 5% of the frames missing were not included in the analysis. A Fourier transformation was applied to extract the movement energy for each RigidBody, in each of the three dimensions, at frequencies corresponding to 0.5, 1 and 2 times the BPM of the presented musical excerpt. The energies in the three dimensions were then summed into a single energy value per rigid body using the Euclidean approach $E\_total = \sqrt{(Ex^2 + Ey^2 + Ez^2)}$, which seemed reasonable considering the three dimensional nature of the actual body movements. Finally, the

Table 1. Hierarchical Linear Modelling Predicting Induced Movement Energy.

Coefficient name	b	df	t	*p*
Intercept	3.73	238.0	5.4	<.001
Experimental Factors				
Order: naive condition first (vs. instructed)	-0.38	238.3	-3.3	.001
Condition: naive (vs. instructed)	-0.59	263.2	-9.1	<.001
Track 1 vs. 3	0.49	218.3	6.6	<.001
Track 2 vs. 3	0.57	259.5	6.3	<.001
Swing Ratio	<0.01	242.7	1.4	.162
Covariates from Questionnaires				
Age	-0.04	235.8	-2.6	.009
Being female (vs. male)	-0.12	234.7	-1.5	.145
Music listening frequency	-0.38	234.6	-3.8	<.001
Dancing preference	0.24	238.1	4.6	<.001
Music Preference: Classic[1]	<0.01	234.1	<0.01	.995
Music Preference: Rock[1]	-0.76	233.4	-4.6	<.001
Music Preference: Pop[1]	0.27	236.4	3.0	.003
Music Preference: Jazz[1]	0.45	232.8	5.3	<.001
Music Preference: Hip-hop[1]	-1.03	230.0	-6.9	<.001
Music Preference: Reggae[1]	0.33	239.0	3.5	.001
Music Preference: Electronica[1]	0.42	230.7	3.9	<.001

Notes: [1]dummy variable: 1=preferred 0=not preferred; According to AIC, a diagonal residual covariance structure was used to model the repeated measurement structure of the data.

mean energy of the five rigid bodies was calculated, resulting in a single movement energy value per participant and trial.

III. Results

After the experiments the participants indicated that they were surprised about the fact that their movements were tracked during the naive condition, showing a successful hidden motion tracking. The experiments yielded complete datasets for 18 test persons.

In order to test for the influence of experimental factors and inter-individual participant characteristics on movement energy, we fitted a Hierarchical Linear Model using the Mixed Procedure of SPSS (Table 1). Figure 1 presents the raw data mean values separated by experimental conditions and their standard errors. A few obvious expectations are met by the data obtained, indicating the general applicability of the above mentioned data processing procedure: Movement energy under the instructed condition is significantly higher than movement under naive condition. If the movement instruction condition precedes the naïve condition, movement energy is also higher in general. Moreover, different tracks cause movement beat induction in different intensities. In particular, when people are listening to Track 3, they synchronize significantly less than to Track 1 or 2. Nevertheless, these analyses do not show any significant impact of the swing ratio on the intensity of motion. We did also observe any significant interaction of experimental factors, not shown here. Manipulating the swing ratio in any music piece seems not to be sufficient to increase induced synchronization movement.

Furthermore, several of the background questionnaire data that were entered as covariates acted as significant predictors of movement energy: Significant negative predictors were: age, music listening frequency, and listening to Rock music and Hip-hop. Significant positive predictors were: intensity of dancing preference and liking of Pop music, Jazz, Reggae, and Electronica.

IV. CONCLUSION

In this study, we demonstrated the general applicability of motion capture technology for the measurement of movement induction phenomena. Even small periodic actions, such as foot tapping, could be successfully detected, while retaining general liberty of movement and thus not imposing any restrictions on the behaviour of the subjects. While the placement of markers on various limbs is an obvious procedure, it was still possible to create a “naïve” experimental condition by distracting the participants with a questionnaire task and explaining that the markers were placed for another part of the experiment. A downside of optical motion capture technology is the frequent loss of data when the markers are not visible enough to the cameras or when RigidBodies were mixed up. This can be overcome in later versions of the setup by using more distinctively designed RigidBodys or even full body models.

The experimental data show that experimental condition (naïve vs. instructed) and musical excerpt (track 1/2/3) exhibit a significant influence on the movement energy. The effect of condition can also be interpreted as a “sanity check” that the experimental procedures generally work, whereas the musical excerpts were varying enough in style and in BPM so that the respective movement energies could also be expected to differ. However, no significant influence of the swing ratio was found. Re-listening critically to the musical excerpts selected for this experiment, it may be the case that they are good examples for modern electronic music production techniques (in order to advertise software functionality), but do not represent music that is actually played in clubs with their specific (and possibly more efficient) rhythmic composition to make people dance. This limitation could easily be overcome with a more careful selection of authentic stimuli, leading to further insight into movement induction in electronic dance music and the influence of the swing ratio.

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Listening to empowering music – Music-induced manipulations of self-esteem

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ABSTRACT

Background

Music may not only elicit basic emotions but may mediate complex psychological states such as mixed emotions (Juslin, 2013), prosociality (Greitemeyer, 2009; Kirschner & Tomasello, 2010), and even feelings of power (Hsu, Huang, Nordgren, Rucker, & Galinsky, 2014).

Many people take advantage of music's powerful effects by using music for mood-regulation (Saarikallio, Nieminen, & Brattico, 2012), self-development (DeNora, 1999, 2000), or to cope with personal problems (Miranda & Claes, 2009). To put them in the right state of mind, people listen to music on their way to work, while they exercise, or as preparation for a sport competition.

While emotional responses to music have received a great deal of interest in the last decades, important functions relating to self-referential aspects of music listening have still been relatively unexamined.

Aims

In order to further investigate music's uplifting and empowering function, we experimentally examined if music is able to enhance and/or reduce listeners' self-esteem.

Relating to notions such as »embodied empathy« (Clarke, 2014), »co-pathy« (Koelsch, 2013), or »Einfühlung« (Lipps, 1906; Vischer, 1887), it was hypothesized that listening to and aesthetically experiencing music may manipulate listeners' self-evaluations as a function of music's expressive properties.

Method

The experiment (n = 116) consisted of three experimental conditions, which were expected to manipulate self-esteem in different ways. Nine musical pieces were taken from a pre-study (n = 30) in which different songs were evaluated with regard to their empowering potential.

The first condition was comprised of musical pieces expressing a positive self-view, evaluated as »motivating« and »powerful« music. The second condition expressed a negative self-view that was characterized as »discouraging« and »weak«. The third condition was comprised of pieces that changed from a negative to a positive self-view, which exhibited a pronounced change in emotional expression. The first and third condition was expected to enhance self-esteem. In contrast, the second condition was expected to lower self-esteem. The design combined a within-subject with a between-groups design, measuring both state self-esteem (short scale; Rosenberg, 1965) and implicit self-esteem (IAT; Greenwald & Farnham, 2000) before and after the music listening.

Additionally, each participant indicated his/her liking, empathy, familiarity, and nostalgia for each musical piece on seven-point scales. These variables were identified as potential moderators of the effect.

Results

An analysis of variance of state self-esteem manipulation indicated that music listening significantly changed explicit state self-esteem.

Additional analyses of implicit self-esteem and moderating variables are reported elsewhere.

Conclusions

The results contribute to a broader picture of music-induced positive feelings by showing that music influences self-evaluative judgements and that these effects rely on the expressive properties of the musical pieces. Music perceived as »motivating« and »powerful« enhanced self-esteem, while music perceived as »discouraging« and »weak« lowered self-esteem.

This suggests that listening to music affords a subjective aesthetic experience in which the expressed properties of the music are, to a certain extent adopted and transferred to one's own self-view.

The identified potential of music to manipulate self-esteem broadens the notion of the affective power of music and helps to explain its uplifting and empowering function. By showing that listening to music may serve as a form of self-enhancement, it further supports the claim that music plays an important role for wellbeing in everyday life.

Keywords

Social Psychology of Music; Music & Emotion; Music & Wellbeing.

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The development of a new assessment of notational audiation by professional musicians

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ABSTRACT

Background

According to Gordon's (1993) *music learning theory*, notational audiation is based on the skill of generating a mental representation of unfamiliar music from only reading the score without the presence of physical sounds. This skill is indispensable for composers, conductors, and performing musicians. However, the degree to which this skill has been developed in different groups of professional musicians remains unknown, as there is no reliable test for measurement.

Aims

The aim of this study is the development of a standardized measurement of professional musicians' ability to generate a mental representation (audiation) from written notation without the presence of physical sounds.

Method

In line with previous studies by Brodsky et al. (2003; 2008), an embedded melody paradigm was used. In contrast to Brodsky et al. (2003; 2008), entirely new and unknown examples were constructed to prevent the confounding effects of familiarity. First, N = 70 triple combinations were generated by a group of composers: (a) a diatonic melody (theme) of eight bars length; (b) a melodic-outline variation (figuration) of the theme (so-called embedded melody); (c) a "lure" variation that showed a certain similarity to the original theme but was characterized by significant harmonic and melodic deviations and would thus result in a different embedded melody. In a second step, six music theory teachers evaluated the material according to the criteria of musical plausibility and its suitable use as test items. As an outcome, N = 29 triple combinations were selected. In a third step, 30 students of music theory, composition and conducting participated in the experimental testing: first, they silently read either the notated variation or lure variation followed by the original theme. Secondly, participants had to decide whether the visually presented notation contained those invariant notes represented by the original theme. Finally, items were analyzed by means of item-response theory and were excluded if they did not meet all model-fit-criteria.

Results

Data collection is ongoing, and final results are expected in spring 2015.

Conclusions

We will address differences in notational audiation between groups of musicians and the consequences for music education.

Keywords

Auditory imagery, audiation, inner hearing, music reading, test construction

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A musicology of performance? Complex systems and the non-linearity of expressive variation

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ABSTRACT

Background

Contemporary inter- and transdisciplinary research has increasingly demonstrated the complex nature of music performance. Psychological, historical, ethnographical, computational, neurological, etc. approaches provide rich and diverse insights, at times overemphasizing one or another aspect of this complexity. Taken together they show there is no obvious limit on viable performance options and therefore no best singular-linear approach for its study.

Aims

To demonstrate that music performance is best understood as a complex dynamical system with a multitude of diversely layered interactions, loops and circuits.

Main Contribution

If music performance is a complex dynamical system then it needs to be approached in a comprehensive manner enlisting a combination of inter-disciplinary methods. This may assist the unpacking of mechanisms that contribute to ever changing interpretative styles and the individuality of each performance, whether created through edited studio recordings or live concerts. To demonstrate this I've analyzed over 40 relatively recent commercial recordings of J.S. Bach's Solo Violin Sonatas and Partitas in their historical and cultural context.

Currently there are two main stylistic approaches to performing music from the baroque: historically informed (HIP) and mainstream (MSP). Cultural theorists debate the origins of and differences between the two aesthetics while perceptual and cognitive studies of music performance tend to ignore not just the debate but also the existence of these differences. I conducted both aural and software assisted analyses of the audio files accounting for performance features such as tempo, timing, dynamics, bowing, articulation, ornamentation, and vibrato. I also checked listeners' affective responses to some of the recordings as found in published reviews, research conducted by Spitzer and Coutinho (2014), and as gathered from a listening experiment involving forty participants. The results were compared to characteristics of complex dynamical systems based on Cilliers (1998).

Eight aspects of complex systems were found to be typical of the analysed recordings. 1) A large number of elements are necessary but not sufficient; the elements have to interact and their interaction must be dynamic. A complex system changes with time. The interactions do not have to be *physical*; they can also be thought of as the transference of *information*. 2) The interaction is fairly rich, i.e. any element in the system influences, and is influenced by, quite a few other ones. 3) The interactions themselves have a number of important characteristics. Firstly, the interactions are non-linear which means that small causes can have large results and vice versa. This is a precondition for complexity. 4) There are loops in the interactions. The effect of any activity can feed back onto itself, sometimes directly, sometimes after a number of intervening stages. 5) Complex systems are usually open systems, i.e. they interact with their environment. 6) Complex systems operate under conditions far from equilibrium or stability. There has to be a constant flow of energy to ensure survival. 7) Complex systems have history. Not only do they evolve through time, but their past is co-responsible for their present behaviour. 8) The interactions often take the form of clusters of elements which co-operate with each-other and also compete with other clusters. An element in the system may belong to more than one clustering. Clusters should not be interpreted in a special sense, or seen as fixed, hermetically sealed entities. They can grow or shrink, be subdivided or absorbed, flourish or decay.

Through examples from my dataset I demonstrate how these characteristics are present in music performance. This highlights the importance of analysing the interaction of performance elements because essentially similar uses of a performance feature (e.g. dynamics or bowing or tempo fluctuation, etc.) can contribute to diverse stylistic and affective outcomes depending on differences in the interactions with other features. The layered and dynamic interactions among players, musician, instrument and movement, performer and listener, cultural expectations and historical concerns can all be traced once the focus is on complexity and non-linearity. The richness of the phenomenon is exposed and made accessible.

Implications

This approach accounts for both the cognitive and perceptual as well as the cultural-aesthetical and historical aspects of western classical music performance. It enables addressing stylistic issues that are of great interests to musicians and fosters a focus on the aural domain. As such it may assist a more holistic understanding of humans' capacity for aural-musical communication.

Keywords

performance analysis, sound recording, violin, complex systems, J.S. Bach.

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Guided imagery in music - A neurometric EEG/LORETA case study

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ABSTRACT

Background

Musical imagery research investigates imagination of intervals, melodies and other musical elements in order to compare them to the listening process (Hubbard, 2010). This may include any imagery of sound and music where there is no physical source, e.g. when conductors study scores or composers compose without piano. Visual imagery plays an important role in music-induced emotions, especially when music is combined with narrative descriptions (Eerola & Vuoskoski, 2013). In search of invariants of altered state of consciousness (ASC) Dittrich (1998) described visual restructuring and auditory alterations as core ingredients of an ASC. Listening to music can completely absorb people, cutting off other sensory input, but absorption skills seem to be linked to music preference, imagery, hypnotisability and intensity of emotions evoked (Kreutz, Ott, Teichmann, Osawa, & Vaitl, 2008; , Fachner, & Smukalla, 2013 ; Snodgrass & Lynn, 1989). In the Bonny Method of Guided Imagery and Music (GIM) a client describes images, feelings, or thoughts that occur spontaneously while eyes-closed listening to special music programs in an induced ASC (Bonny & Savary, 1973). Commonly, certain passages during the imagery process will have pivotal meaning for the traveller and become a focus in the therapy process (Grocke, 1999). Imagery is diverse including visual, auditory, somatic, direct memories, involuntary and unbidden imagery, images of significant p o pl , pla s and v n ts om t p son's isto y [5].

Aims

Here we are interested how spontaneously evoked and guided imagery in connection to music and ASC is processed. What happens in the brain during ASC and imagery processes of pivotal moments in GIM?

Method

A typical GIM session comprises an initial discussion of the li n t's o n ns, and a o us o t musi and imag y experience. The therapist provides a relaxation induction for the client who reclines with eyes closed. The therapist chooses a pre-determined music program, or spontaneously chooses musi to mat t li nt's imag y. As t musi plays t client describes any imagery, feeling, or thoughts.

The EEG of an experienced GIM traveler was recorded during rest, ASC induction and listening (Imagery – music progam). EEG data (Power, Asymmetry) was compared (z-scores) against a normative EEG/LORETA database (John, 1989; Thatcher, Biver, & North, 2009) investigating artifact free rest, ASC and pivotal parts of the music listening preceding verbal response. Verbal responses were analysed separately and GIM EEG data was chosen based on the ratings of an independent GIM therapist.

Results

A difference between rest and ASC induction indicated a state change on lower alpha (8-10 Hz). Z-scored LORETA Alpha1 power 8+9Hz bins exhibited highest z-score values in cuneus (8Hz) and precuneus (9Hz). Z-Scored LORETA power differences (inter-individual rest – ASC) were most prominent in Brodmann Area (BA) 23 (8Hz) and BA 31 (9Hz) indicating involvement of cuneus and posterior cingulate in state changes. Verbal GIM responses elicited two nodes of interest. During pivotal music listening one node exhibited a high beta anterior left temporal (T5) asymmetry decrease (resembling the ASC induction topography), while z-LORETA current density values increased in BA 37 (Left inferior / Middle temporal lobe on 21-30Hz). On lower Alpha right parietal z-score power values and z-LORETA current density increased in pre-cuneus (resembling the ASC pattern).

Conclusions

ASC seem to be of importance for GIM and seems to influence the music listening process. ASC related change indicates connection to visual imagery processing during GIM Music listening.

Keywords

Guided imagery, musical imagery, music listening, altered states of consciousness, Neurometrics, EEG, alpha1, beta, topography, asymmetry, cuneus, pre-cuneus

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Psychobiological responses of mental health service users to group drumming

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ABSTRACT

Background

A growing body of research is focusing on the therapeutic benefits of music for different populations, including people living with mental and physical health conditions (MacDonald & Kreutz, 2012). Alongside this research are a vast number of projects utilising music in different ways, from various forms of music therapy to music education, public performance, recorded music (or 'music medicine'), and community music. One of the core findings from both research and practice is the ability of music to modulate emotions, especially through music performance (Juslin, 2008).

Within the field of psychobiology there is growing evidence of the interactions between biology and emotions; in particular the role of cytokines operating both within the central nervous system and peripherally (Aleman, Swart, & van Rijn, 2008; Miller, Capuron, & Raison, 2005). However, despite there being a number of studies exploring the impact of music on biological function, including immune response (Fancourt, Ockelford, & Belai, 2014), there has to date been very little exploration of the interactions between biology and music-induced emotions.

To explore this in more detail, a study was conducted to investigate psychobiological responses to group drumming. Fancourt et al. (in press), showed that group drumming for mental health service users led to modulations in four affects (stress, relaxation, tiredness and energy) as well as the emotion happiness, alongside modulations in levels of the stress hormone cortisol and eight immune cytokines: interleukin (IL) 2, IL4, IL6, IL10, interferon gamma (IFNɣ), tumour necrosis factor alpha (TNFα), monocyte chemoattractant protein 1 (MCP1), and transforming growth factor beta (TGFβ). The current study builds upon this foundation, scrutinising psychobiological response to different drumming conditions.

Aims

The aims of this study were twofold: (1) to ascertain whether the specific act of performing drumming led to a greater modulation in self-reported measures than control conditions, and (2) whether there were biological underpinnings to such a response. To test this, three control interventions, each missing a crucial element, were created to be studied alongside the performing drumming condition: a watching control (participants watched the drumming condition but did not take part); a listening control (participants listened to the drumming but could not see the drums or take part); an audio control (participants listened to audio stories as a comparative audio stimulation).

Method

74 participants involved with mental health services were recruited and randomised to four groups where they undertook one of the four interventions. Immediately before and after each one-off, 90-minute session, visual analogue scales were used to measure affect (energetic, tired, tense, relaxed, connected, stressed) and emotion (anxious, afraid, confused, sad, angry, happy) and assess individual appraisal of the activities (boring-stimulating, meaningless-meaningful, unpleasant-pleasant). In addition, saliva samples were taken immediately before and after each session and tested for the stress hormone cortisol and immune cytokines interleukin (IL) 2, IL4, IL6, IL17, monocyte chemoattractant protein 1 (MCP-1), tumour necrosis factor alpha (TNFα), transforming growth factor beta (TGFβ) and interferon gamma (IFNɣ).

Results

Group drumming led to significant changes in eight of the twelve affect and emotion scales measured, six of which were maintained when controlling for multiple comparisons: decreases in confusion, anger, tension and anxiety and increases in relaxation and connectedness ($p<0.05$). By contrast, there were no changes in the watching intervention or listening intervention. Although the audio control led to changes in four affects (decreases in tension, anxiety and stress and increases in relaxation), there were no significant changes in emotion. There were not clear differences in biological response based on the parameters of the four interventions, but there were correlations between several cytokines and both affect and emotion.

Conclusions

This study confirmed the initial hypothesis that group drumming leads to a greater change in self-reported affect and emotion than control interventions in which participants do not perform. There were also interactions between these self-rated measures and cytokine activity. Following research within psychobiology, it is likely that these directions are bidirectional (Solomon, 1987), suggesting the potential ability of performing music to modulate not just affect and emotion but also underlying biomarkers associated with such response.

Keywords

Participatory music, mental health, immunology, stress response, psychology, psychobiology, psychophysiology.

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Frequency and affective evaluation of involuntary musical imagery correlate with resting state networks of spontaneous cognition

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ABSTRACT

Background

Involuntary musical imagery (INMI) is the experience of repetitive music in the head beyond one's control. INMI is a spontaneous and frequent phenomenon emerging in daily life (Liikkanen 2008), and is triggered in comparable ways than other forms of self-generated thoughts (SGT) (Andrews-Hanna, Smallwood & Spreng 2014). We have recently shown that structural features of brain areas involved in music perception and imagery (right auditory cortex and inferior frontal gyrus), as well as regions of the Default Mode Network (DMN) such as the anterior cingulate cortex and the angular gyrus, correlate with the frequency and affective evaluation of INMI (Farrugia, Jakubowski, Cusack & Stewart, 2015).

Aims

The current study extends our previous work by testing the hypothesis that INMI emerge from interactions between auditory networks and functional networks involved in SGT, such as the DMN.

Method

We related the frequency and affective evaluation of INMI with intrinsic functional connectivity using resting-state MRI. 40 subjects (20 women) aged 18 to 31 years old (23 +/- 3.2 years) were recruited for this study. Subjects reported an absence of any history of neurological damage or hearing loss. In addition to a high resolution T1-weighted structural image, resting-state MRI was acquired using a T2* weighted Echo-Planar Imaging sequence (TR = 2s, 3mm isotropic) for 10 minutes with eyes open.

Individual differences in the INMI experience was assessed using the Involuntary Musical Imagery Scale (IMIS) (Floridou, Williamson, Stewart & Mullensiefen 2015). The IMIS includes questions on (a) how often people experience INMI (5-point Likert scale from « Never » to « Almost continuously ») and (b) how much people are irritated or would like to suppress their INMI (Negative Valence factor), as well as questions on whether they consider their INMI helpful in their daily activities (Help factor).

All images were preprocessed and analyzed with FSL. Preprocessing included slice-timing correction, motion correction using MCFLIRT, temporal filtering using a high-pass filter (sigma = 100s) and spatial smoothing using a FWHM filter of radius 6 mm. A multiple regression was run to remove the following nuisance parameters: signal from cerebrospinal fluid, white matter and head motion parameters.

Preprocessed images were submitted to an analysis of functional connectivity using seed four seed regions. One seed was placed in the right parahippocampal cortex to yield the core DMN (MNI coordinates 27, -34, -18, sphere of radius 3mm) and corresponding to our previous results (Farrugia et al. 2015). In addition, we used three seed regions respectively in bilateral Heschl's gyrus, non-primary auditory cortex (superior temporal gyrus), and middle temporal gyrus (from Linke & Cusack 2015). For each seed, the average time course was calculated for all voxels included in the seed region, and the Pearson product-moment correlation coefficient was calculated with all other voxels. Resulting maps of correlation coefficients were thresholded using a gray matter probability map (40%).

Finally, the correlation maps entered a multiple regression model using either INMI Frequency or the two IMIS factors Help and Negative valence as covariates of interest, and head motion as a covariate of no interest. Significant clusters were formed using a threshold of $Z > 3.2$ and corrected for multiple comparisons using FDR ($p < 0.05$).

Results

We found that (1) the connectivity between non primary Auditory cortex, middle Temporal Gyrus and core regions of the DMN (posterior cingulate, precuneus and anteromedial prefrontal cortex) modulated the frequency of INMI episodes. Furthermore, (2) increased connectivity between the right parahippocampal cortex and the right inferior temporal gyrus and ventral temporo-parietal junction, were associated with higher scores in the affective evaluation of INMI episodes (Help and Negative Valence factors), suggesting an involvement of episodic / semantic memory retrieval systems.

Conclusions

Functional coupling between auditory association areas and core regions of the DMN may influence the occurrence of INMI by modulating their frequency. This data is consistent with previous results on possible triggers of the INMI experience (Williamson et al. 2011), and are in line with predictions from the theoretical frameworks on SGT (Smallwood & Schooler 2015). Taken together, these results support the idea that coupling between the core DMN and sensory areas contribute to the emergence of endogenous sensory experiences, while their emotional aspects of such experiences rely on coupling within DMN subsystems (rPHC and lateral temporal cortex).

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Keywords

Involuntary, music, imagery, resting state, fMRI, mind wandering, emotions, default mode network, auditory cortex.

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The program music in Valle's *26 Characteristic and Concert Preludes for Violin Alone*: The performer-audience relation on Stage

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ABSTRACT

Background

Flausino Valle was a Brazilian violinist and composer who lived in the beginning of the 20th century. His most famous work is the set of the "26 Characteristic and Concert Preludes for Violin Alone". All of these Preludes have names that relate to their musical content, but at the same time Valle himself explained some of the effects wanted and the content of some of the Preludes in his catalogue 'Imitation of Nature Voices'. Therefore, this research is focused on how much of the music and effects made on the violin can be understood by the audience only through the title of the Prelude and the music itself.

Aims

It is understood that not always the title and the music themselves are able to make the intentions of the composer clear. Therefore, the purpose of this research is to show that sometimes an explanation about the musical content can help the audience to better understand the composer's intentions, mainly for composers that use unusual effects on the violin or that want to describe a specific soundscape, like Flausino Valle. The research has the purpose of helping the interpreter with its musical interpretation consistent with the composer's intentions and a close transmission of its poetic message to the audience.

Method

Harmonic and phraseological analysis were used as methods, as well as interviews and visits to Valle's family. Important references were also used, as Donin (2007), Ostrower (1978) and Valle (1978). Moreover, an experiment was carried out with 18 music students, in which they were given the name of the preludes and the performer played the pieces randomly – the students were supposed to associate the piece to its title. In addition, another important method in this research was the use of various recitals as a transmission experiment of the poetic message and the composer's intentions.

Results

The results found from these recitals and the experiment carried out, suggest the existence of a gap in the relation between the work title and its musical discourse. The intention of the effects produced on the violin may not always be clear, thus showing the need to improve the communication of the performer to the audience, and that through verbal explanation of the music, the public can better understand the composer's intentions.

Conclusion

It can be concluded from this research that the poetic message in Flausino Valle's descriptive music is best conveyed to the audience when making use of a brief verbal explanation of the work's descriptive elements prior to the performance

Keywords

solo violin, Flausino Valle, descriptive music, Brazilian Music

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Validation of the Gold-MSI Questionnaire to measure *Musical Sophistication* of German students at secondary education schools

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ABSTRACT

This study introduces an adapted German-language version of the Goldsmiths Musical Sophistication Index (Gold-MSI) inventory (Schaal, Bauer & Müllensiefen, 2014) to measure musical sophistication in a sample of students (n = 688) in secondary schools (10 to 17 years). Musical sophistication is a psychometric construct that refers "to musical skills, expertise, achievements and related behaviours across a range of facets that are measured on different subscales" (Müllensiefen, Gingras, Musil & Stewart, 2014, p. 2). Reliability and confirmatory factor analyses indicate acceptable to good subscale reliabilities and model fit indices with the data from this student sample. In addition, a structural equation model outlines the relationships between the facets of musical sophistication and demographic as well as socioeconomic background variables. In summary, the results demonstrate that the German version of the Gold-MSI questionnaire can be used with students in secondary school education.

I. INTRODUCTION

Musical expertise, skills and behaviours can develop very differently during adolescence, and the reasons and mechanisms behind these differences are often objects of research in music psychology and music education. It is generally assumed that the development of musical skills is integrated into the individual's overall development, where culture and education system play important roles (Gembris, 2013). In the past, musical skills, expertise, and competences either were measured with tests that quantify students' musical competences and achievements (Colwell, 1969; 1970; 1979; Gordon, 1971; Bähr, 2001; see also tests of musical academic achievement by Persky, Sandene & Askew, 2001; Allen, Jenkins & Schoeps, 2004; Fisher, 2008), or were measured with aptitude and musicality tests that assess the student's potential for future musical achievement (Seashore, 1919; Bentley, 1968; Gordon, 1989). Furthermore, several German and international longitudinal surveys have investigated the (positive) influence of musical training on non-musical abilities and behaviours , such as intelligence, social behaviours and cognitive effects, (e.g. Weber, Spychiger & Party, 1993; Bastian, 2000; Ho, Cheung & Chan, 2003; Schellenberg, 2004). However, in music psychology (and sometimes in music education) studies, the measure of musical skills, expertise, and competence is often simply the participant's amount of instrumental musical training or extracurricular music education. Using such simplified measures neglects the complex and multi-faceted nature of musical expertise, skill, and related behaviour (Gembris, 2013; Hallam, 2010; 2006; Hallam & Prince, 2003). In contrast, the newly developed *Goldsmiths Musical Sophistication Index* (Gold-MSI) questionnaire by Müllensiefen, Gingras, Musil and Stewart (2014), with its broad conceptualization of *musical sophistication*, provides a much more suitable measurement tool. However, the Gold-MSI was originally developed for use with adults, and has not yet been validated on younger children respectively on students in secondary education schools. In this paper we test the assumption that the adapted German Gold-MSI inventory by Schaal, Bauer and Müllensiefen (2014) can be used with students to evaluate self-reported musical abilities and musical expertise in different contexts, because it is not restricted to extracurricular music education or music training on an instrument. In line with Hallam (Hallam & Prince, 2003; Hallam, 2010) and Ollen (2006), the novel term *musical sophistication* conceptually includes different facets of musical expertise and behaviours. Furthermore, it "has been used infrequently in earlier research and is therefore less loaded with biases and preconceptions than more commonly used terms such as musicality, musical talent, ability, aptitude, or musical potential" (Müllensiefen et al., 2014, p. 2). This conceptualisation of *musical sophistication* assumes that musical abilities, skills, and behaviours are developed through active engagement with music in its many different forms as well as that individual differences in the sophistication of observable musical behaviours are related to differences in cognitive categorisation and processing of music (Müllensiefen et al., 2014; Schaal et al., 2014). High levels of *musical sophistication* "are generally characterized by a) higher frequencies of exerting musical skills or behaviours, b) greater ease, accuracy or effect of musical behaviours when executed, and c) a greater and more varied repertoire of musical behaviour patterns" (Müllensiefen et al., 2014, p. 2).

The empirically derived differentiation of *musical sophistication* contains the five subscales *Active Engagement (F1)*, *Perceptual Abilities (F2)*, *Musical Training (F3)*, *Singing Abilities (F4)* and *Emotions (F5)* as well as the general factor *Musical Sophistication (F6)*, and therefore describes musical behaviours "ranging from performance on an instrument and listening expertise, to the ability to employ music in functional settings or to communicate about music" (Müllensiefen et al., 2014, p. 1).

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A. Previous studies

The concept of *musical sophistication* has been empirically operationalised (Müllensiefen et al., 2014)[1] using a very large English-speaking sample (n = 147,633), in a multilevel process. One result of this operationalisation process is the Gold-MSI questionnaire, with its empirically derived multidimensional factor structure, assessing many different elements of musical expertise (Müllensiefen et al., 2014). Subsequently, the Gold-MSI questionnaire was translated into German and evaluated with a German-speaking sample (n = 641; mean age = 31.7; SD = 15.9) (Schaal et al., 2014). The results of confirmatory factor analyses (CFA) showed that the German-language Gold-MSI questionnaire possessed the same underlying factor structure as the original Gold-MSI questionnaire of Müllensiefen et al. (2014). Furthermore, the results showed high reliabilities of the five sub-factors as well as the general factor *Musical Sophistication* (Schaal et al., 2014). Additionally, the relationships between variables of the socioeconomic status and the five plus one sub-factors of the Gold-MSI of the German sample are investigated using a structural equation model (SEM). The statistical results of this validation and replication study reveal positive relationships between participants' income and professional status (socioeconomic status) on the one hand and musical training, perceptual abilities and emotional engagement with music on the other hand. Beyond that the German-language inventory (Schaal et al, 2014) is freely available and is designed to contribute to the refined investigation of *musical sophistication* in German speaking countries. (Schaal et al., 2014, p. 2).[2]

B. Motivation for the application of the Gold-MSI questionnaire to students at secondary education schools

The operationalization of *musical sophistication* given by the Gold-MSI is very important for music education research, because it provides the first standardised measuring tool that is able to represent musical skills and behaviours, and assess besides musical education also students musical "Gebrauchspraxis" (English: common uses of music) (Kaiser, 2002). These factors generally have a considerable influence on the development of competence areas of musical learning (Niessen, Lehmann-Wermser, Knigge & Lehmann, 2008; Knigge & Lehmann-Wermser, 2008; Knigge, 2010; Jordan, Knigge & Lehmann-Wermser, 2010; Jordan, Knigge, Lehmann, Niessen & Lehmann-Wermser, 2012), as well as on the development of musical skills, expertise and achievements (Müllensiefen et al., 2014). The Gold-MSI can also contribute to music education and teaching research by identifying relationships between adolescents' attitudes towards music lessons as well as its methodical orientation, and by developing theoretical models to investigate the influence of personal and socioeconomic variables on the educational music lessons and students' musical achievement (Heß, 2011a).

[1] The complete construction process of the English Gold-MSI is documented in Müllensiefen et al. (2014).

[2] http://www.gold.ac.uk/music-mind-brain/gold-msi/download

C. Aim of the study

The principal aim of this study is to adapt the freely available Gold-MSI questionnaire (Müllensiefen et al., 2014) in the German translation of Schaal et al. (2014), developed to measure *musical sophistication* of the adult population, for the use with students at secondary education schools. Therefore the Gold-MSI shall be validated with a sufficiently large student sample. The Gold-MSI questionnaire, and its corresponding concept of *musical sophistication,* is proposed as an effective universal tool for music education research, and has the potential to improve the comparability of further studies and contribute to the generation of a broad evidence base in music education research. Further aims of this study are to replicate the original Gold-MSI factor structures and internal validity with a population of German secondary school students, to validate the adapted Gold-MSI questionnaire against teacher assessments of students' musical abilities and competences, and to identify relationships between musical, demographic, and socioeconomic variables.

II. METHOD

A. Sample

The sample consisted of 688 students (female = 360; male = 326; not specified = 2) from four Grammar Schools (n = 420) and three Middle Schools (n = 268) across different regions in the south-west of Germany. The average age was 12.94 years (SD = 1.782 years; not specified = 33) with an age range of 10 to 17 years. Concerning the age and types of school as well as teaching groups the sample shows no representativeness.

B. Collection and measuring instrument

The complete questionnaire was distributed on paper and assessed *musical sophistication* with the Gold-MSI, music-related self-concept of abilities (Rost & Sparfeldt, 2002; Heß, 2011b), self-closeness to music (Kessels & Hannover, 2004; Heß, 2011b), interest in the school subject "Music" (Rakoczy, Klieme & Pauli, 2008; Heß, 2011b), and self-attribution concerning marks in "Music" (Rakoczy, Buff & Lipowsky, 2005, S. 164). Variables assessing socioeconomic status (SES) gather the *Number of Books* (Frey, Taskinen & Schütte, 2009; Heß, 2011b) and the *Parents' Profession* (Frey et al., 2009; Heß, 2011b) which was used to derive the socioeconomic status (SES) of the students' family on the basis of the European Socio-economic Classification (ESeC) (Rose & Harrison, 2007; Office for National Statistics, 2010). In addition to the students' self-reports the music teachers' assessments of each individual student on various dimensions and the school marks in the school subject "Music" were collected with the aid of a separate validation form filled in by the music teachers.

C. Data analyses

The data were analysed using confirmatory factor analysis (CFA) to verify the factor structures and to assess the Factor Reliability (FR) and Average Variance Extracted (AVE). Reliability measurements were employed to determine the

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internal validity (Cronbach's Alpha), correlational analyses to assess the criterion-related validity, and structural equation models (SEM) to reveal relationships between the Gold-MSI factors and the variables *Age*, *Parents'* socioeconomic status or SES and *"Educational Achievement"* (marks in "Music") as well as the latent variable *"Motivation"*. Firstly, an analysis of empirically extreme values was conducted to identify outliers. All students (n_{obs} = 711) with a tendency to only tick extreme values (one and seven) on the Gold-MSI questionnaire were identified using the inner-fences criterion (≥ 26) and were excluded from the data set (n = 23, 3.2%). This left 688 students in the final dataset used for analysis.

III. RESULTS[3]

Table 1 outlines the means (*M*), standard deviations (*SD*), and ranges of the Gold-MSI scales derived from the students in the sample and documents the respective reliability coefficients plus the additional quality criteria Factor Reliability (*FR*) and Average Variance Extracted (*AVE*) (see Weiber & Mühlhaus, 2014) for each Gold-MSI dimension. The values of internal consistency (or reliability) for the Gold-MSI subscales, as well as for the general factor *Musical Sophistication (F6)*, generally ranged between α = .721 ($\alpha_{\text{standardised}}$ = .719) and α = .827 ($\alpha_{\text{standardised}}$ = .833). The one exception was the subscale *Emotions (F5)*, with α = .623 ($\alpha_{\text{standardised}}$ = .624), only displaying a satisfactory reliability. All other subscales as well as the general factor rest in good to very good Cronbach's Alpha ranges. Moreover the additional quality criteria *FR* and *AVE* achieve threshold values recommended in the literature (Bagozzi & Yi, 1988, S. 82; Fornell & Larcker, 1981, S. 46). The intercorrelation of the five subscales spanned from r = .300 to r = .585 (see *Table 2*). The confirmatory factor analyses (CFA) of the structure of the English Gold-MSI (Müllensiefen et al., 2014) with the German student data set revealed a good fit of data and model, with *RMSEA* = .053 and *CMIN/DF* = 2.946. Furthermore, the CFA showed with *TLI* = .786 and *CFI* = .818 satisfactory incremental fit indices.

In order to analyse concurrent validity, the relationships between each single Gold-MSI subscale with various criterion-related music-specific and socioeconomic variables were analysed (see *Table 3* for an overview). *Table 4* shows Pearson correlations between the Gold-MSI subscales with the marks in the school subject "Music", with significant correlations being between r = .081 and r = .431. This reveals weak to moderate correlations (r = .225 to r = .431) between the factors *Musical Training (F3)* and the general factor *Musical Sophistication (F6)* with the teachers' assessment on various dimensions, school marks, and overall marks in "Music". Additionally, *Table 5* demonstrates the concurrent validity (criterion validity) between the Gold-MSI dimensions with the various on self- and causal-attribution existing variables *music-related self-concept of abilities (M2)*, *self-closeness to (M1)* and *interest in the school subject "Music" (M3)*. The correlation coefficients range from r = .176 to r = .576, whereas the correlation of the z-standardised total score of the variables M1, M2 and M3 (latent variable *"Motivation"*) are between r = .341 and r = .576. The correlations between the socioeconomic variables including *Number of Books (SES1)* and *Parents' Income (SES2)* with the Gold-MSI subscales are shown in *Table 6*. The correlations (Kendall's-Tau) of the five subscales and the Gold-MSI general factor *Musical Sophistication (F6)* with the above-mentioned variables as well as the z-standardised total score *SES* (socioeconomic status) range from τ = .076 to τ = .234 (see *Table 6*), whereas weak correlations were observed between the variables *Number of Books (SES1)* and *Parents' Income (SES2)* as well as the z-standardised total score *SES* with the subscale *Musical Training (F3)* (Kendall's-Tau correlation coefficients: τ = .136 to τ = .234).

The structural equation model[4], which describes the relationships between the variables *Age*, students' *"Educational Achievement"* (marks in "Music"), the latent variable *"Motivation"* and the parents' socioeconomic status (*SES*) as well as the Gold-MSI subscales, had an acceptable to good fit to the data (*RMSEA* = .051, *SRMR* = .076, *TLI* = .777 and *CFI* = .790, see *Figure 1*). The model shows that there is a significant positive influence of the students' *Age* on the variables *Active Engagement with Music (F1)*, *Perceptual Abilities (F2)* and *Emotions (F5)*. Further significant positive relationships exist between the variable *SES* (socioeconomic status) and the Gold-MSI dimensions *Musical Training (F3)* and *Perceptual Abilities (F2)*. Additionally, the factor *Musical Training (F3)* is significant positively linked with the variable students' *"Educational Achievement"*. There is also a significant positive influence of the latent variable *"Motivation"* on students' *"Educational Achievement"*. Lastly, the structural equation model reveals that the subscales *Active Engagement with Music (F1)* and *Perceptual Abilities (F2)* have a significant positive impact on the latent variable *"Motivation"*.

IV. DISCUSSION

The primary aim of the present validation study was to use the German version of the Gold-MSI questionnaire by Schaal et al. (2014) with students at secondary schools, and thereby to test the multifaceted construct of *musical sophistication* with a heterogeneous sample in a music-pedagogical context, assessing musical skills, expertise and achievements in students. The collected data confirm the underlying factor structure of the Gold-MSI (Müllensiefen et al., 2014). Moreover the good to

[3] Note that all tables as well as the structural equation model (*Figure 1*) can be found at the end of the paper.

[4] With the help of the Maximum-Likelihood-method and the Huber-White procedure a complete model was estimated and all path coefficients, which had not been significant on the 5%-level, were fixed on zero and excluded from the rational structure. The assessment of the structural equation models followed by references to the in general suggested cutoff-values in literacy (Marsh, Hau & Wen, 2004; Hu & Bentler, 1999).

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very good fit indices show that the structural equation models of the factors are similar to the adult sample analysed by Müllensiefen et al. (2014) and Schaal et al. (2014). In addition, the good reliabilities of each Gold-MSI dimension suggest that the German version of the Gold-MSI questionnaire (Schaal et al., 2014) can be used with students at secondary education schools. The Gold-MSI with its conceptualisation of *musical sophistication* can therefore provide the first standardised measuring instrument for research in (German) music education that enables the measurement of musical skills, expertise, achievements and related behaviours on several different facets with different subscales.

Also, the concurrent validity between the Gold-MSI subscales and the captured criterion-related background variables demonstrates that various relationships exist between the respective Gold-MSI subscales and the academic marks and assessment categories (*"Educational Achievement"*) – which were acquired from each music teacher – and the music-specific and socioeconomic background variables – which were gathered from the students (see *Table 4*, *Table 5*, and *Table 6*). Particularly interesting are the significant and moderate correlations between the Gold-MSI subscales *Perceptual Abilities (F2)*, *Musical Training (F3)*, *Singing Abilities (F4)* and the general factor *Musical Sophistication (F6)* with the *teachers' assessment of the student's perceptual abilities (N5)*. These correlations show, as expected, that there is accordance between the individual teachers' assessment and the students' assessed *musical sophistication.* In contrast, weaker correlations were found between the Gold-MSI factor *Musical Training (F3)* and the general factor *Musical Sophistication (F6)* with the *current overall mark (N6)* in the school subject "Music". The moderate correlation between the subscale *Musical Training (F3)* and the overall mark in the school subject "Music" (N6) provides some support for the notion previously suggested (Heß, 2011a) that school music lessons are often not inclusive regarding children who do not play an instrument. This is evidenced by the fact that those students who receive musical training in their spare time have a much larger benefit from music lessons in school.

Regarding the further concurrent validities between the Gold-MSI subscales and the gathered music-specific variables (see *Table 5*), only weak to moderate correlations can be reported, which already reveal a relationship between the variables *self-closeness to "Music" (M1)*, *music-related self-concept of abilities (M2)* and the *interest in the school subject "Music" (M3)* with the particular factors of *musical sophistication*. At that there are significant moderate correlations between the latent variable *"Motivation"* (z-standardised total score M4) and every Gold-MSI subscale. Along these lines the Gold-MSI concept includes the cognitive, motivational, volitional and social abilities and willingness referring to Weinert's competence definition (2014). In addition there is a connection between the competence areas of musical learning, which are identified by Niessen et al. (2008), and the Gold-MSI dimensions. These implications for research in music education and the domain-specific competence modelling can help to rebut the argument that within the competence models the focus is only on the cognitive aspect (Niessen et al., 2008). Furthermore new dimensions can be included to the competence areas of musical learning and to the intensive empirical activities in the domain-specific competence modelling.

The relationships between the gathered socioeconomic variables (*Number of Books (SES1)* and *Parents' Income (SES2)*) and the as z-standardised generated total score *SES (SES3)* show some significant positive, but rather weak influences on the Gold-MSI subscales. However, these relationships support the results of previous studies (see *table 6*) (McCarthy, 1980, 2007; Albert, 2006; Brändström & Wiklund, 1996; Phillips, 2003). Schaal et al. (2014) deduce from similar results that the purchase and lending of instruments is associated with household income, despite the large musical subsidies provided by public schools in Germany. This assessment is supported by the results of this study, and the effect size of the correlations could be even underestimated because of the relatively homogenous nature of the sample regarding socioeconomic background variables (SES).

The structural equation model (SEM), which relates the variables *Age*, *SES* (socioeconomic status), *"Motivation"* as well as the students' *"Educational Achievement"* and the five subscales of *musical sophistication*, reveals a significant positive influence of *Age* on the Gold-MSI facets *Active Engagement (F1)*, *Perceptual Abilities (F2)* and *Emotions (F5)* (see *Figure 1*). This supports the results of Müllensiefen et al. (2014) and Schaal et al. (2014). From this Müllensiefen et al. (2014) conclude that *musical sophistication* and the related differentiated behaviours with music, which lead the education of musical skills, seem to happen in younger and more flexible stages of life. Schaal et al. (2014) interpret this result as indicating that students in particular seem to have a high motivation and more time as well as a flexible time management, which can lead to an extensive involvement with music. This interpretation is further supported by the results of Bonneville-Roussy, Rentfrow, Xu and Potter (2013), who found negative relationships between age and the extent of musical behaviours in an American sample group.

Concerning socioeconomic status *(SES)*, assessed with the variables *Number of Books (SES1)* and *Parents' Income (SES2)*, a significant positive influence of *SES* on the Gold-MSI factors *Perceptual Abilities (F2)* and *Musical Training (F3)* was found. Thereby the relationships confirm for the most part the results of previous studies by McCarthy (1980, 2007), Albert (2006) and Brändström and Wiklund (1996), which also found positive correlations between parents' SES and duration of instrumental training. Above all, the considerable positive relationships between *SES* and the Gold-MSI subscale *Musical Training (F3)* must be emphasized (Phillips, 2003). No empirical relationship between socioeconomic status (*SES*) and the Gold-MSI factor *Active Engagement with Music (F1)* was found, a result consistent with the findings of Müllensiefen et al. (2014) and Schaal et al. (2014), who concluded that active engagement with music is not necessarily associated with a higher income or with a higher parents' SES. It must be assumed that students at secondary education schools actively engage with music no matter what SES their parents have.

Further relationships between the latent music-specific background variable *"Motivation"*, which includes the variables *self-closeness to music (M1)*, *music-related self-concept of abilities (M2)* and *interest in the school subject "Music" (M3)*, as well as the students' individual *"Educational Achievement"* in "Music" with the five subscales of *musical sophistication* could be found. The Gold-MSI factor *Active Engagement with Music (F1)* has a significant positive and the Gold-MSI facet *Perceptual Abilities (F2)* a minor positive influence on the latent variable *"Motivation"*. However, it shows that the active involvement with music is clearly related to the latent variable *"Motivation"* and by association with the attitude to the school subject "Music". This means that learners who received extracurricular musical training achieved better marks in the school subject "Music". In addition there is a significant positive relationship between the variables *"Motivation"* and *"Educational Achievement"* with higher motivation leading to greater achievements in music lessons.[5] This structural network, which incorporates personal, socioeconomic and extracurricular variables, demonstrates the large degree to which active engagement with music can drive the motivation and interest in school music lessons. But the network also shows how music teaching in school is of much higher benefit to those children who receive musical training on an instrument in their spare time which in turn depends on the SES of their parents. Thus, network also suggests the non-inclusive character that school music lessons can have. However future research in music education ought to examine the relationships between these variables further and trace the development of students' *musical sophistication* and related factors over the adolescent period.

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[5] Note that the numerical relationship and regression coefficients in the model are actually positive. This is because the variable *"Educational Achievement"* is reverse coded. In German schools normally the top grade is represented by a one (1) and the lowest grade by a six (6).

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Table 1

Summary of the results of the reliability coefficients as well as the quality criteria (of the second gerneration) of the Gold-MSI subscales and the general factor Musical Sophistication (n = 688)

Scale	M	SD	Min	Max	Cronbach's Alpha (standardised)	FR	AVE
Active Engagement with Muisc (F1)	3.85	0.98	1.14	6.44	.721 (.719)	.727	.234
Perceptual Abilities (F2)	4.95	0.87	2.11	7.00	.730 (.733)	.732	.250
Musical Training (F3)	3.42	1.26	1.00	7.00	.825 (.837)	.825	.422
Singing Abilities (F4)	4.32	1.07	1.17	6.86	.729 (.736)	.752	.311
Emotions (F5)	4.51	0.98	1.00	7.00	.623 (.624)	.635	.244
General Musical Sophistication (F6)	4.02	0.88	1.55	6.39	.827 (.833)	.838	.231

Note. Measurements of the internal consistency (Cronbach's Alpha) and the quality criterions of the second generation factor reliablity (FR) and average variance extracted (AVE)

Table 2

Intercorrelations (Pearson) between the Gold-MSI subscales and the general factor Musical Sophistication

Scale	F1	F2	F3	F4	F5
F1 (Active Engagement with Music)					
F2 (Perceptual Abilities)	.421**				
F3 (Musical Training)	.410**	.415**			
F4 (Singing Abilities)	.451**	.551**	.348**		
F5 (Emotions)	.585**	.395**	.300**	.377**	

Note. n = 688, $^{**}p \leq 0{,}01$ (2-tailed)

Table 3

Overview of the gathered criterion-related variables from the teachers and the students to analyse the concurrent validity

Music teachers			Students			
Marks in the school subject "Music"	*n*	*M (SD)*	Gold-MSI subscales	Criterion-related variables	*n*	*M (SD)*
Written (N1)	619	2.18 (0.79)	Active Engagement with Music (F1)	Self-closeness to "Music" (M1)	607	3.28 (1.29)
Oral (N2)	659	2.40 (0.98)	Perceptual Abilities (F2)			
Singing mark or playing an instrument mark (N3)	114	1.87 (0.60)	Musical Training (F3)	Muisc-related self-concept of abilities (M2)	686	3.62 (1.14)
Cooperation in "Muisc" mark (N4)	328	2.11 (0.81)	Singing Abilities (F4)	Interest in "Music" (M3)	686	3.06 (0.70)
Musical perception (teachers' personal assessment mark) (N5)	307	2.10 (0.77)	Emotions (F5)	SES (socio-economic status)		
Current overal mark (N6)	678	2.22 (0.82)	General Musical Sophistication (F6)			

Table 4

Correlations (Pearson) between the Gold-MSI subscales and the general factor Musical Sophistication with the teachers' assessment and the marks in the school subject "Muisc"

Variable	F1 (AEwM)	F2 (PerA)	F3 (MusT)	F4 (SingA)	F5 (Emo)	F6 (GMusS)
N1 (written mark)	.081*	.155**	.281**	.103*	.110**	.225**
N2 (oral mark)	.111**	.214**	.308**	.096*	.123**	.248**
N3 (singing mark)			.321**			.248**
N4 (cooperation in "Music" mark)	.120*	.225**	.293**	.140*	.134*	.278**
N5 (teachers' personal assessment mark)	.187**	.347**	.431**	.262**	.140*	.397**
N6 (current overall mark)	.114**	.189**	.300**	.113**	.130**	.253**

Note. $^{**}p \leq 0{,}01$ (2-tailed), $^{*}p \leq 0{,}05$ (2-tailed)

Table 5

Correlations (Pearson) between the Gold-MSI subscales with the variables self-closeness to "Music", muisc-related self-concept of abilities and interest in the school subject "Music" as well as the z-standardised latent variable "Motivation"

Variable	F1 (AEwM)	F2 (PerA)	F3 (MusT)	F4 (SingA)	F5 (Emo)	F6 (GMusS)
M1 (self-closeness to "Music")	.318**	.293**	.370**	.234**	.258**	.420**
M2 (music-related self-concept of abilities)	.249**	.387**	.413**	.309**	.176**	.458**
M3 (interest in the school subject "Music")	.521**	.366**	.388**	.293**	.399**	.523**
M4 (z-standardised total score - latent variable "*Motivation*")	.448**	.432**	.481**	.343**	.341**	.576**

Note. $^{**}p \leq 0{,}01$ (2-tailed)

Table 6

Correlations (Kendall's-Tau) between the Gold-MSI subscales and the socio-economic background variables Number of Books (SES1) and Parents' Income (SES2)

Variable	F1 (AEwM)	F2 (PerA)	F3 (MusT)	F4 (SingA)	F5 (Emo)	F6 (GMusS)
SES1 (Number of Books (at home))	.088**	.181**	.234**		.077**	.157**
SES2 (Parents' Income)		.093**	.136**		.076*	.089**
SES3 (z-standardised total score SES)	.074**	.171**	.213**		.085**	.143**

Note. $^{**}p \leq 0{,}01$ (2-tailed), $^{*}p \leq 0{,}05$ (2-tailed)

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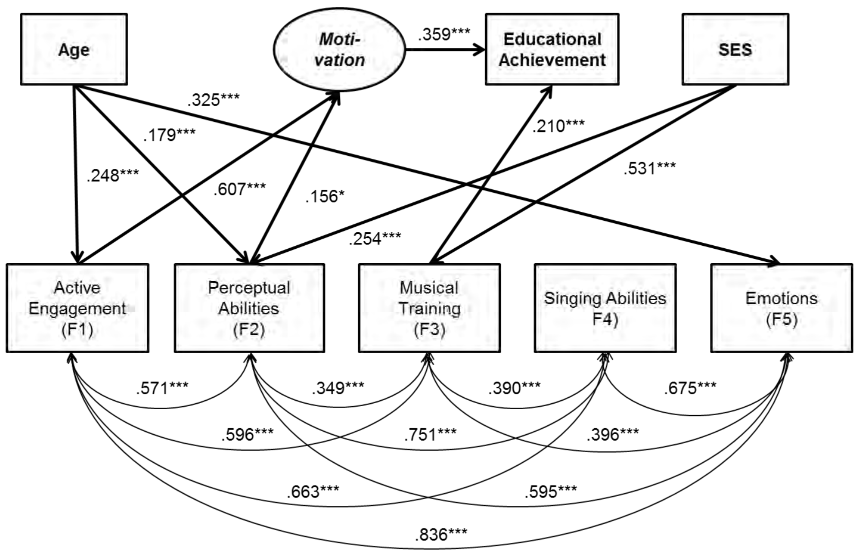

Figure 1. Structural Equation Model (SEM) between the five Gold-MSI subscales and the variables Age, *Motivation*, Educational Achievement in the school subject Music as well as the *SES*.

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Conditioning the mind in music: Involuntary musical imagery and everyday life music listening

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ABSTRACT

Background

The focus of this project is on involuntary musical imagery (InMI) and particularly on the concept that InMI is the product of an unconscious conditioning that results from everyday music listening. In more detail, people have very specific and personal ways they use music, by using certain music (as a formed musical taste) in certain circumstances (see more on uses of music in everyday life Gabrielsson, 2011; Sloboda,2001). These combinations become systematic over the years, and this process may resemble a form of conditioning.

Aims

In the experiment presented here, we are exploring the prevalence of InMI as the product of associative learning/ conditioning between music and everyday activities. We attempted to create that systematic pairing of music and certain activities through a series of repetitive exposure to music whilst performing a certain –everyday- activity, in order to investigate the prevalence of InMI.

Method

The method was designed with aim to investigate the association between music and activities and if that would be reflected through InMI. Therefore, participants were required to attend three training sessions, divided into two consecutive days. The training sessions were comprised of performing three different activities, all paired with different auditory information. The final testable condition included performing each activity without their usual pairing. The testable condition was the activity systematically paired with music. The data was gathered through questionnaires in the end of each activity. As control conditions we used different activities paired with either podcast or silence. Furthermore, the activities were paired differently per participant, and the order of the pairing was randomised across the training sessions.

The music was selected to be a jazz piece with a distinct melody so it would be easy to remember, and without lyrics to avoid any personal associations. The podcast was chosen to contain no musical information in the form of reference or actual music, and it had a scientific topic. All three conditions were timed at 1'23'', and for the silent condition we created a silent track with a tone to indicate the end of the activity. The activities were chosen to be different in ability and cognitive uses since the pairing would be counterbalanced across participants. All the activities however were everyday and non-demanding activities. One of the activities was pairing socks, the other forming a ball of yarn and the final was an easy puzzle.

Each training session consisted of performing the three different tasks with their designated pairings. The participants had three training sessions in two consecutive days, and a fourth test session. In the testable condition, the participants were asked to perform the activities without their pairings (music, podcast), and complete a questionnaire, regarding any InMI they experienced.

After each training session they are asked to complete a questionnaire, which besides the questions of InMI, includes questions about mood and the combination of the activities, in order to mask the purpose of this study to minimise as possible the introspective bias. Furthermore, after each completion of the questionnaire, the participants were asked to take a few minutes break, to separate the activities. Background information was gathered prior to the experiment, including demographic questions, and questions regarding music listening, musical engagement, and InMI.

The expectations were that participants would associate music only with the certain activity that was presented with and would report InMI only on that activity and not during the others.

Results

Results from the study showed no significant effect of the training, meaning that participants did not have InMI during the activity that was previously paired with music. However, the responses indicate an effect in the predicted direction suggesting that evidence in favour of the hypothesis might be found with increases of statistical power of the experiment. The reports of InMI related to the session were more on the testable music condition (activity performed without music) with 33.3%, N=30, compared to 16,7% for the podcast condition, and 20% for the silent. Furthermore, the reports for internal podcast were very low (10% in the testable condition).

Conclusions

The results are not significant but the direction of the results is promising. Therefore, the follow-up of this experiment includes further training time and a larger number of participants to increase the statistical power.

Keywords

Involuntary musical imagery (InMI), earworms, conditioning, associative learning, music in everyday life

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Choir acoustics: An empirical case study on the influence of reverberation during choir singing

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ABSTRACT

Background

The aesthetic appreciation of a choir performance highly relies upon both the singer's expertise as well as the acoustical characteristics of the venue (Ternström, 1993). Empirical studies on the influence of room acoustics on solo music performance revealed that a considerable amount of more than 50% of the performance feature's variance such as e.g. tempo or loudness could be explained by room acoustical parameters (Schärer Kalkandjiev & Weinzierl, 2013). However, little is known about the specific influence of room acoustics on choir singing. To our knowledge, there has been no attempt to investigate the influence of different room acoustics on choir singing using multitrack recordings under systematically varied and controlled feedback conditions.

Aims

In order to evaluate the effects of room acoustics including reverberation time (RT) during choir singing we tackled the following questions: Will there be any changes in a choir's performance regarding intonation, timing, tempo, and intensity if the room acoustics (simulations based on room impulse responses) is changing? How do choristers experience these different acoustical conditions (ACs) during choir singing? Which of the different reverberation conditions are experienced to be the most pleasant with respect to the ease of singing, the best for hearing the other singers as well as the singer's own voice?

Method

A mixed adult choir from Jyväskylä (Finland) with 23 singers (5 sopranos, 8 altos, 7 tenors, 3 basses) participated in the study (average time as a choir singer was about 29 years).

Multitrack recordings of the choir were conducted in the recording studio at the department of music of the University of Jyväskylä. Each singer was equipped with a head set microphone to record each singer separately. Through headphones, singers heard all of the other singers as well as their own voice. The choir was asked to sing Locus Iste by Anton Bruckner (1824-1986) under three different room acoustical conditions: AC1: RT = 0,00s, AC2: RT = 1,77s and AC3: RT = 4,79s.

Results

Objective measures revealed the following main results: the larger the room (and RT) the slower the tempo chosen by the director of the choir, intonation was hardly affected by different room acoustics, timing precision was less good in AC3 compared to AC1 and AC2, and the differences between intensity levels were the largest in AC2.

Subjective measures (questionnaire on the singer's subjective experiences) showed a clear preference for AC2 whereas AC1 was felt to be the best to sing in time.

Conclusions

The main outcome of the present study with respect to objective measures is that tempo tends to be notably slower and timing is less precise for increasing virtual room sizes, whereas intonation is only weakly influenced. However, the analyses of the intonation data indicate that there seems to be an optimal choir singing room size of condition AC2, at least with regard to this particular piece of music ("Locus Iste"). It could also be observed that singers consistently sung louder in condition AC2 compared to AC1 and AC3.

Overall, the choir study presented here may be exemplary for future research on choir acoustics in search of verified knowledge about the complex interactions between voices of a choir and room acoustical influences during actual performance.

Keywords

Choir singing, room acoustics, reverberation, intonation, timing, tempo

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Formal measures of complexity predict the accuracy in guessing the end of rhythmic patterns

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ABSTRACT

Background

There is a long history of using notions of complexity to understand how people perceive art. Empirical research initially explored the influence of stimulus complexity, often arbitrarily assigned by the experimenter, on its aesthetic perception (Berlyne, 1970; Heyduk, 1975; North & Hargreaves, 1995; Vitz, 1966). While some studies have been conducted with measures derived from music theory (Fitch & Rosenfeld, 2007; Gomez, Thul, & Toussaint, 2007) or human performance (Essens, 1995; Povel & Essens, 1985), more recent work has been using formal measures in order to quantify the complexity of art – including music and rhythm – and its relationship with human perception and the effects of repeated exposure, familiarity, and musical training, among others (Hansen & Pearce, 2012; Madsen & Widmer, 2006; Shmulevich and Povel, 2000).

Aims

This study aims to identify if theoretically derived measures of complexity can predict the difficulty of correctly guessing the next note in rhythmic sequences. We used five measures from information theory and algorithmic complexity: Shannon entropy, entropy rate, excess entropy, transient information, and Kolmogorov complexity. These measures differ from classical indicators (e.g. Povel & Essens, 1985) insofar as there are no background assumptions, such as the existence of an internal clock; the measures relate purely to abstract structural properties. The influence of musical expertise and general pattern identification ability on the success in this task is also investigated.

Method

We artificially generated 48 rhythmic sequences of 50 symbols (1's and 0's), and measured their complexity according to the five selected formal measures. We replaced the 1's by drum hits and the 0's by rests, with a notional pulse of 150bpm, resulting in sequences that were approximately 20 seconds long. These, while not giving rise to metric sensation, are rhythmic in the musical sense of durational patterns. We designed a rhythm perception experiment, in which 32 participants guessed the last beat of each sequence, by selecting 'drum hit' or 'rest', and indicated the difficulty of doing so, aided by a visual representation of the length of each sequence. The participants also completed a short version of the Raven's Matrices and the Gold-MSI questionnaire in order to quantify their general pattern identification ability and several aspects of their musical expertise.

Results

Predication accuracy and judgements of the task difficulty were moderately correlated ($r = .407$, $p = .004$), which suggests that the sequences perceived as easier to solve were solved more successfully. The average prediction accuracy for each sequence was correlated with their entropy rate ($r = -.407$, $p = .004$) and Kolmogorov complexity ($r = -.402$, $p = .005$), and the average judgement of the task difficulty for each sequence was highly correlated with their entropy rate ($r = -.834$, $p < .001$) and Kolmogorov complexity ($r = -.866$, $p < .001$), suggesting that entropy rate and Kolmogorov complexity can accurately predict the perceived complexity of rhythmic patterns. The participants' overall score on the rhythm perception task was correlated with their self-assessed musical perceptual abilities ($r = .449$, $p = .011$). Finally, a logistic regression showed main effects of entropy rate, Kolmogorov complexity, and musical training, and interactions between these two measures of complexity and musical training.

Conclusions

Our results show that formal measures of complexity capture some aspects of human rhythm perception, and more specifically that the perception of rhythm complexity scales with departure from periodicity. Moreover, we add to the body of evidence showing the effect of musical expertise on music perception. Tentative interpretations are provided, as well as suggestions for further research.

Keywords

Rhythm perception; Rhythm complexity; Information theory measures; Musical expertise

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Measuring the earworm experience: The involuntary musical imagery scale (IMIS)

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ABSTRACT

Background

Involuntary Musical Imagery (INMI, or earworms) refers to the internal experience of a musical excerpt that spontaneously comes to mind and repeats. Studies so far have mostly focused on the phenomenological aspects of the experience such as frequency, length, triggers and pleasantness, while few studies have examined individual differences in relation to INMI.

Aims

This study aimed to a) develop and validate a new scale that would capture multiple facets of the INMI experience and b) explore the relationship of the scale's factors with potentially related constructs.

Method

For the Exploratory Factor Analysis (EFA), 360 individuals completed an online version of the initial Involuntary Musical Imagery Scale (IMIS) with 68 items. For the Confirmatory Factor Analysis (CFA) 2671 participants completed an online or pen and paper version of a revised scale constructed based on the results from the EFA. The same number of participants completed a wide array of questionnaires measuring thinking styles, voluntary auditory imagery abilities and musical behaviors. To establish test-retest reliability 649 individuals completed the IMIS twice.

Results

The EFA resulted in a 15 item, 4-factor model with eigenvalues of >1, which explained 67% of the variance. The items within each factor could be related to the following themes, which were used as factor labels: Negative Valence (subjective evaluation of INMI), Movement (embodied responses), Personal Reflections (personal qualities) and Help (beneficial and constructive aspects). This model, which allowed for inter-factor correlations, had the best confirmatory fit to the data (RMSEA=.06) and all the factors showed good or very good estimates of internal (Cronbach's α from .76 to .91) and test-retest reliability (Cronbach's α from .65 to .79). The IMIS showed strong correlations with other scales measuring partly overlapping constructs (e.g., daydreaming and active musical engagement).

Conclusions

IMIS is a novel and reliable instrument, which allows for systematic measurement of multiple distinct aspects of the INMI experience. The four IMIS factors represent a range of behaviors, emotions, reactions and evaluations related to INMI and its associations with other scales reflect similarities of the INMI experience with task unrelated thought and music behaviors. For more information see the published paper: Floridou, Williamson, Stewart and Müllensiefen (2015) or visit our website: www.gold.ac.uk/music-mind-brain/imis

Keywords

involuntary musical imagery, earworms, individual differences, scale development

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Performance expertise of DJs in the club-context

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ABSTRACT

Background

Recent theories on musical interaction propose a close, inherent relationship between music and body movements both within the performer and the recipient. This interconnection is especially strong in the club context, where danceable music with pronounced rhythmics is played by DJs and electronic live performers.

Aims

We want to investigate which movements occur during a DJ performance, and whether these movements differ according to the degree of expertise of the performer. Further, we are interested in which (stereotypical) movements are used by DJs to interact with their audiences.

Method

An explorative video content analysis of a popular Youtube channel regularly publishing professional DJ performances (BoilerRoom) was conducted, including the most viewed prototypical performances from 8 different DJs. Additionally, 6 semi-professional DJs were invited to record video data during an actual performance in front of an audience. For both groups, we analysed the amout of time spent with operating the equipment, with dancing and with gestures, by developing descriptive categories. Additionally, we looked for specific individual characteristics within the performances.

Results

The video analysis revealed that professional DJs dance much more than the semi-professionals, show largely idiosyncratic behaviour and vary in their gestural expressiveness. Some professional DJs frequently use expansive gestures to address the audience (e.g. fist pumps, raised arms), whereas this does not occur in the semi-professional group. Beyond that, professionals spend more time operating the mixer and less time operating the players than semi-professionals.

Conclusions

We conclude that professional DJs have developed a distinct „performance expertise“, allowing them to set the energy level and to lead a crowd through the evening, whereas semi-professional DJs seem to react in a more passive way to the overall situation. Additionally, professional DJs operate their equipment almost continuously, often beyond the mere creation of a smooth transition to the next track endeavoured in semi-professional performances. Consequently, we argue that classical musical concepts such as improvisation and interpretation could also be applied to the work of a DJ.

Keywords

DJ, Club Culture, Gesture, Interaction, New Musical Interfaces, Video Analysis

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The effect on music listening on perception of urban and natural scenes

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ABSTRACT

Background

A large body of research was devoted to the way in which music shapes perception of visual stimuli, namely in film and video. In addition, the current research (Yamasaki et al., 2015) demonstrated that the evaluation of outdoor scenes can be affected by characteristics of the listened music. In our previous study (Franěk et al., 2014) we investigated, whether music listened while walking in an urban environment could modify the effects of surrounding environmental features. The present study using the eye tracking method was intended to investigate differences in perception of urban and natural scenes while listening to different types of music.

Aims

The effects of (1) motivational music, which had a fast tempo and a strong rhythm, (2) non-motivational music, which was slower, but with no strong implication to movement, and (3) no-music condition on perception of various urban and natural scenes were investigated. We were interested, whether particular types of music can influence an extent of perceived visual information and a viewer preference.

Method

Thirty-nine participants aged 19-22 years took part in the experiment. They viewed successively 27 photographs. Simultaneously, they listened to either motivational or non-motivational music, or viewed the photographs without music. Participants' gaze was recorded using the Tobii X2-60 eye tracker.

Results

The duration and the number of fixations on selected areas of interest on the photographs were analyzed. The results showed that participants, who listened to the motivational music, took attention to smaller extent to photographs compared to the participants, who listened the non-motivational music or those, who did not listen any music. Music did not influence the viewer preference.

Conclusions

The results showed that listening music while viewing photographs can influence perception of the scenes. The data suggest that listening to the fast motivational music while viewing the photographs required larger cognitive load, which resulted in perception of smaller extent of the scene compared to the slower non-motivational music. The research could enhance our understanding of phenomena associated with music listening while walking or running in an outdoor environment.

Keywords

Multimodal perception, eye tracking, motivational music, outdoor scenes.

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Workshop: Introduction to CAMP – Computer-aided Music Psychology

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ABSTRACT

Background

In the last decade, significant steps towards more user-friendly and reliable software tools for musicological research have been made. This opens up opportunities for new experimental paradigms and methodologies that have been rarely employed in the past due to the large efforts involved. For example, experiments using a production paradigm are very time-consuming due to the necessary transcription step, which can be now significantly sped up using semi-automatic approaches. Moreover, modern computer-based methods allow characterising and comparing musical stimuli and experimental outcomes in a much more comprehensive, objective and flexible way. Hence, these tools are likely to boost the development of cognitive and other music psychological models and to improve experimental productivity.

Aims

The workshop aims at promoting computer-aided methods in music psychology by giving a compact introduction to state-of-the-art tools and techniques.

Short outline of activities to be undertaken by presenters/audience

Using freely available tools, such as Sonic Visualiser and the MeloSpyGUI, and data, such as the Essen Folk Song Collection or the Weimar Jazz Database, the participants will be engaged in a hands-on introduction with carefully crafted samples, exercises and use-cases. A comprehensive overview of available tools, techniques and user-scenarios will be given.

Implications for practice

Knowledge about available software tools is likely to enhance productivity of music psychological researchers and facilitate the use of currently under-employed experimental paradigms. Numerical characterisation of stimuli and experimental outcome allow for a more detailed modelling of music psychological processes. Likewise, corpus-based methods are a promising approach for incorporating aspects of music cultural background into cognitive models

Keywords

Music Psychology, Computation Musicology, Computer, Methods, Tools.

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Mid-level analysis of monophonic jazz solos: A new approach to the study of improvisation

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ABSTRACT

Background

Jazz improvisation has mostly been investigated using either detailed analysis of selected solos (see Pfleiderer & Frieler, 2010 for an overview) or combination of performer interviews and ethnographical accounts (e.g. Berliner, 1994; Norgaard 2008). Recently, a qualitative mid-level approach of annotating jazz piano solos with regard to underlying playing strategies has been developed (Schütz, 2012; Lothwesen & Frieler, 2013, Frieler, Lothwesen & Schütz, 2012). These mid-level plans (“ideas”) result in musical units of about 2-3s which are probably shaped by overlearned, semi-automatic motor processes. The annotation method showed high external validity according to interviews with performers (Schütz, 2015), and admits also statistical analysis, thus, contributing to a deeper phenomenology of jazz solos, which in turn provides new and more solid evidence for models of jazz solo improvisation (e.g., Pressing, 1988).

Aims

This study aims at gaining a deeper understanding of the creative processes during jazz improvisation.

Method

Building on the system of idea categories as proposed by Schütz (2012), a modified version specifically suited for monophonic jazz improvisation was devised and further enhanced with syntactical rules for expressing relationships between musical units in order to capture motivic improvisation. The system consists of nine main categories (“line”, “lick”, “theme”, “quotation”, “melody”, “rhythm”, “expressive”, “fragment”, “void”) with 19 sub- and 38 sub-subcategories. It was fine-tuned and evaluated together with the designated annotators in an iterative process in order to maximise inter-rater consensus beforehand. Seventy-seven solos by 48 different performers from the Weimar Jazz Database covering a range of styles (Swing, Bebop, Hard Bop, Cool, Postbop) were annotated, resulting in a total of 3040 ideas. Inter-rater reliability was estimated to be about 90% for segmentation borders and about 75% for category labelling.

Results

Expectedly, the most common main categories were licks (42.7%) and lines (32.8%), with the most frequent subcategory of wavy lines (lines with twist and turns). Distribution of categories did not differ significantly between styles, though there are some tendencies, as expressive and rhythmic ideas can be found more often in postbop solos, thematic ideas more often in swing solos, and melodic ideas more often in cool jazz. Moreover, the largest proportion of lines as well as the smallest proportion of thematic improvisation can be found in hardbop solos. Average duration of mid-level units ranged from 0.5 s (fragments) to 3.5s (theme) with a grand average of 2.23 s, well in line with earlier results (Schütz, 2015). About 20-30% (AM = 28%, range 0-60%) of ideas were based on motivic improvisation, i.e., derived from some other idea, whereby long-range correlations between ideas were rather scarce, with an average relationship distance of 0.55 ideas (SD=0.47). Mean length of motivic chains was 2.8 (SD=0.96), indicative of frequent AA’A’’ structures. With respect to amount of motivic improvisation, there were no significant differences between styles (Kruskal-Wallis test, $\chi^2(4) = 2.08$, $p= 0.721$), but performers differed considerably (Chi-Square test $\chi^2(47) = 211.53$, $p< 0.001$).

Conclusions

The mean duration of mid-level units lies in the vicinity of the subjective present (Fraisse, 1982), which can be linked to the chunk size of working memory (Pöppel, 1997). To our view, this is a strong hint that the annotated categories are indeed reflecting (to some extent) operational planning processes in the mind of the performers. This is also in line with the results from Schütz (2015), who confronted jazz piano player with the method of mid-level analysis, which most players considered as a valid description of their improvising. However, an alternative explanation for this result might be due to the subjective present of the annotators. But, we deem the first interpretation more likely, since the annotators were working analytically and not in real-time.

We observed that motivic improvisation is not confined to certain styles and players (e.g. Sonny Rollins, see Schuller 1958), but can be found in nearly all examined jazz solos, though to largely varying amounts.

To sum up, by combining the benefits of qualitative and quantitative methods the proposed mid-level approach further solidifies and enhances our knowledge of creative strategies during jazz improvisation. For the future, we plan to annotate a more extensive set of solos as well as to analyse the sequences of ideas in more detail, e.g., using automated classification, Markov chains, and feature analysis.

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Keywords

Improvisation, Jazz, Melody, Structure, Creativity, Cognition, Mid-level Analysis

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Hearing aids and music: The experiences of D/deaf musicians

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ABSTRACT

Musicians such as Ludwig van Beethoven and more recently Evelyn Glennie show us that even a profound level of deafness is no barrier to the creation or performance of music. While there is a growing literature on the perception of music using cochlear implant technology, there exists comparatively less empirical research about the amplification of music using hearing aid (HA) technology. As part of a recent AHRC-funded project exploring the perception of music using vibrations, an interview study was conducted by the first author to explore issues relating to performing and perceiving music in the presence of a hearing impairment. Semi-structured interviews were conducted with twelve musicians who spoke about their musical background and training, history of hearing loss, and experience of using HAs. Transcripts were coded and analysed using thematic analysis. Overall, satisfaction with digital HAs was low, with pitch and timbre distortion often reported to compromise music listening experiences. Some musicians sought enhanced HAs while some dispensed with them altogether. Preferences for digital or analogue technology were found to relate to musicians' history and level of hearing loss and evidence of dynamic auditory attending was found. The results suggest that musicians who use HA technology draw on a range on strategies to compensate for impaired auditory feedback. Advanced signal processing algorithms within digital HAs have necessarily prioritised speech perception with potentially negative effects on their ability to amplify musical acoustic input. Further research is needed to understand how HA technology and fitting may be improved for music listening.

I. INTRODUCTION

There are over 10 million deaf and hearing impaired people in the UK representing one in six of the population (AOHL, 2011). It is also suggested that over 6 million people in the UK (1 in 10) would benefit from wearing hearing aids (HAs) but only 1.4 million actually wear them regularly (Ibid.). HAs, unlike reading glasses, are not corrective and have a bad image: there is a social stigma attached to wearing HAs and manufacturers work hard to position their products as attractive and discreet, as evidenced by the miniaturisation of HA technology over the decades (Mills, 2011). Yet despite low uptake, the market is growing. As people live longer, an estimated 14.5 million people will have a hearing loss by 2031, by which time the World Health Organisation may classify it in "the top-ten disease burdens in the UK, above diabetes and cataracts" (AOHL, 2011, p. 4). The nine companies dominating the UK market sell to the NHS and private HA dispensers to the value of £57.5m and £42m respectively (British Hearing Aid Manufacturers Association, personal correspondence 2013).

The topic of noise-induced hearing loss (NIHL) has gained media attention in recent years due to the increasing prevalence of acquired hearing impairments and tinnitus attributable to exposure to loud music exemplified by pop / rock performers such as Ozzy Osbourne, Phil Collins or will.i.am. For a recent review, see Zhao et al. (2010), and for industry advice for professional musicians see the BBC 'Noise Project' report by Ruth Hansford (2011). Yet performers and composers in other genres remind us what musical achievements remain possible in the presence of a hearing impairment. Beethoven was profoundly deaf for the last eight years of his life during which time he wrote his Ninth Symphony (Cooper, 2008) and percussionist Evelyn Glennie has been profoundly deaf from the age of 12 (Cleall, 1983). Music perception is inevitably affected by deafness and has a circular effect: music can cause hearing impairment if it is too loud for too long and the impairment affects the auditory perception of music itself.

Music is an important part of peoples' lives and can have powerful physical, social, intellectual and emotional effects on individuals (Greasley, 2008; MacDonald, Kreutz, & Mitchell, 2012). Recent qualitative research has highlighted that our musical preferences are diverse; people listen to many different styles of music, not just one or two, and engage with music in many different ways (Greasley, Lamont, & Sloboda, 2013). This is likely to be true for people who are D/deaf or who have a hearing impairment too. Little is known however about the perception of music by the D/deaf or hearing impaired populations. One study examined the experiences of musicians with hearing impairments and revealed the use of a variety of listening and performance strategies that facilitated engagement with music, such as listening with a score or watching a live performance (Fulford, Ginsborg, & Goldbart, 2011). The current paper re-examines data from this previous study reporting findings relating specifically to the use of HA technology in the perception and appreciation of music.

Digital HAs are necessarily designed to amplify the speech signal to facilitate verbal communication between people. Problems in the perception of music using HAs therefore arise from differences in the acoustical properties of musical and speech signals (Tozer & Crook, 2012) the former having far larger dynamic and frequency ranges than the latter (Chasin & Russo, 2004). Objectively, HAs preserve far more of the auditory signal than do cochlear implants (CI) and yet music is rated as sounding more pleasant by adult CI than HA users (Looi, McDermott, McKay, & Hickson, 2007). It is surprising therefore that there has been far more research conducted in the last decade on the perception of music using cochlear implants (Tozer & Crook, 2012; van Besouw, Grasmeder, Hamilton, & Baumann, 2011) than there has been for music

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perception using HAs, despite there being roughly 100 times more HA than CI users.

A number of signal processing systems have been incorporated into digital HAs in the last two decades since their inception in the mid-1990s to improve their ability to amplify human speech selectively. The most common technique employed is a form of frequency compression, Wide Dynamic Range Compression (WDRC), which compresses the input range by applying more gain for quieter sounds and less for louder ones to enhance speech sounds. Frequency compression is highly prevalent in recorded music and we rarely notice it; however, WDRC parameters are rarely altered for HA music programs, which may lead to distortion (Croghan, Arehart, & Kates, 2014).

A special issue of *Hearing Research* in 2014 was devoted to research on auditory neuroscience and music. In this issue, Chasin and Hockley (2014) discuss the 'crest factor' (i.e., the difference between the average and peak intensity levels), which is far larger in music than speech and can therefore cause distortion and make the following practical suggestions for clinicians. Audiologists may 1) set similar WDRC parameters for speech and music (contradicting Croghan et al. (2014)), 2) use 6dB less gain for music than for 'speech in noise', 3) adjust bandwidths depending on level of hearing loss and 4) turn off feedback cancellation and noise reduction. Similarly, HA users may 1) turn down the volume of the recording (not possible in live performances) and turn up the HA, 2) remove the hearing altogether for music listening, 3) use tape to cover the microphone of the HA to reduce input prior to the A/D conversion and/or 4) change their musical instrument.

Chasin, an audiologist himself, comments that audiologists and musicians 'speak a different language' (Chasin, 2013). The terminology that audiologists and musicians use to describe the parameters of musical sound is certainly different. However, there is very little empirical research on which to base enquiries into the perception of music using HAs. A recent survey of 523 HA users by Madsen and Moore (2014) showed that users found HAs helpful for music listening, although they commonly experienced problems such as acoustic feedback, distortion, loudness issues and poor sound quality. Such reports can be attributed to the use of feedback cancellation systems, A/D converters and Automatic Gain Control (AGC), but the research remains exploratory. It is said that prevention is better than cure and it is right that NIHL due to music has received more public awareness than the issue of music amplification using HAs. However, further research into the latter resulting in improved technology has the potential to improve the quality of life of millions of HA users in the UK alone and might also help increase the uptake and use of HA technology

This paper reports data collected as part of a recent AHRC-funded project exploring the perception of music using vibrations. An interview study was conducted by the first author to explore issues relating to performing and perceiving music in the presence of a hearing impairment. While the study revealed many challenges and strategies used by D/deaf musicians, especially in interactive performance (Fulford et al., 2011), participants also spoke at length about their HAs. This paper will present a selection of their quotes and summarise the main themes that were derived from the data.

II. METHOD

Semi-structured interviews were conducted with eleven musicians. Participants were initially recruited with the help of the charity Music and the Deaf, an education charity based at the time in Huddersfield and now in Halifax. Close links between musical people in the deaf community facilitated the recruitment of further participants through snowball sampling, whereby existing respondents suggested potential participants known to them. The interview schedule was designed to cover a broad range of topics: personal background; musical experience; history of hearing loss; HAs and use in music-making; interactive music-making, rehearsal, performance and teaching; and vibrotactile feedback, that is, the sensation of music felt as vibrations either on the skin or by bone conduction. As such, HA technology formed only a small portion of the questions on the interview schedule. Participants were asked:

- Do you use a hearing aid?
- What make or model do you use?
- Do you use them for music listening / performance?

Some were also asked more in-depth questions about their HAs such 'Did you notice a change when you got digital HAs?' on the basis of prior knowledge gained from email correspondence prior to interview. Schedules were tailored in this way as far as possible to include items that were relevant for each participant.

Table 1. Participant summary.

Name or "pseudonym"	Level of deafness	Deaf since birth?	Hearing aid
"Anne"	Profound	No	None
"Anthony"	Mod/Severe	No	Digital
"Penny"	Mild	Yes	None
"Philip"	Moderate	No	Digital
Angela Taylor	Moderate	Yes	Digital
Danny Lane	Profound	Yes	Analogue
Evelyn Glennie	Profound	No	None worn
Janice Brown	Mod/Severe	No	Digital
Janine Roebuck	Profound	No	Digital
Nick Palfreyman	Profound	Yes	Digital
Paul Whittaker	Profound	Yes	Analogue

The final sample consisted of 11 amateur and professional, regularly practising musicians, male and female, as summarised in Table 1. There was a wide range of ages, from 17 to 72 years. All but four respondents were happy to be identified in this research, with pseudonyms being adopted in

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these cases. In the absence of audiometric data describing exact hearing thresholds by frequency, respondents' levels of deafness were reported subjectively, accurate to the best of their memory, ranging from mild (with a threshold of 25-39 dB), moderate (40-69 dB), severe (79-94 dB) to the modal level of profound deafness (95+ dB) (AOHL, 2011). Those with mild, moderate or severe levels of deafness identified themselves socially as 'hearing impaired' rather than deaf or Deaf. Causes of the respondents' hearing losses varied, the most common being sensorineural, a problem with the inner ear, cochlear hair cells or the vestibulocochlear nerve itself (Moore, 2003). Two respondents had a conductive hearing loss: a problem in the outer or middle ear, attenuating the transmission of sound waves to the cochlear, which can be caused by an infection or otosclerosis, for example (ibid.). Seven respondents had had their hearing impairments from birth, while the others became deaf or were deafened in their childhood, teenage or adult years.

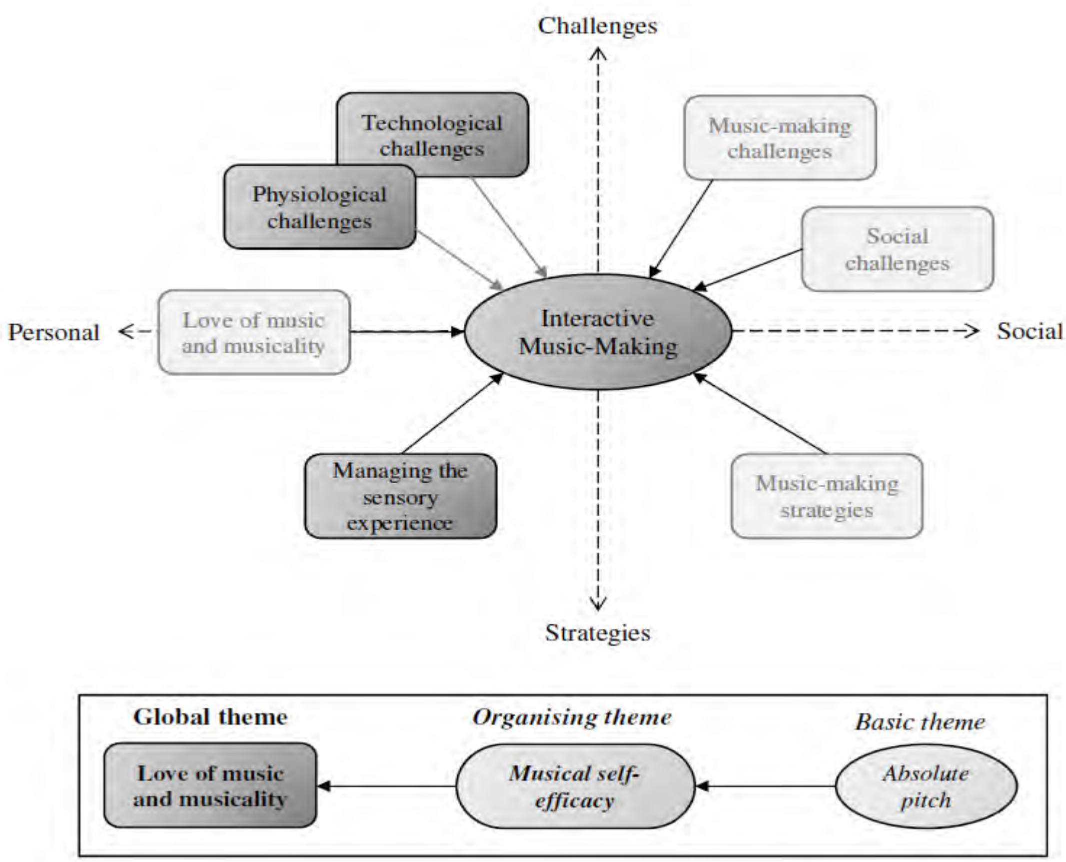
Interviews were carried out, face-to-face, by the first author using the services of a sign language interpreter where necessary. Interviews were recorded on a Roland Edirol R-09 24bit recorder, transcribed and loaded into QSR NVivo 8. Transcription was conducted using traditional orthography with pauses indicated simply by dashes. Data were analysed and interpreted using thematic analysis as described by Braun and Clarke (2006) which allowed flexibility in generating themes and the coding process to be inductive. To facilitate this analysis, a thematic network (*cf.* Attride-Stirling, 2001) was created in NVivo. The network is a visual representation of the themes showing their hierarchy and inter-relationships.

RESULTS

Data are presented in relation to the thematic network, where global themes comprise smaller organising themes which are themselves made up of basic themes that relate most closely to coded sections of transcript. The degree to which challenges and strategies for interactive music making with a hearing impairment were personal and/or social helped notionally organise the global themes, as illustrated in Figure 1.

In focusing on HAs, this paper will summarise findings categorised under the global themes 'Technological and Physiological Challenges' and 'Managing the Sensory Experience'.

Figure 1. Thematic Network



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A. Technological Challenges

This section presents five themes arising from the interviews with musicians that related directly to the type of HA technology used. Most of the themes represent issues experienced as problems for the participants; their responses suggest that HAs are challenging for musicians because they are designed chiefly to amplify speech rather than music.

i) Analogue versus digital hearing aids

For some participants, particularly those who were born with severe or profound deafness and were therefore accustomed to using old-style analogue aids, the transition to digital HAs in the mid-90s was reported to be difficult. These participants were dissatisfied with the new digital HAs they were offered, as they distorted sounds or were not powerful enough. Ruth, Paul and Danny all retained their analogue HAs (although Paul has recently acquired good digital aids). Here, Danny states why:

> Because digital hearing aids, they control what I hear. And I've always wanted to hear everything even the horrible bits - I think it's important when you're a musician.

In general, participants reported that their subjective experience of listening to music was better when using old-style analogue HAs than new digital HAs. This is likely to be for the following reasons: analogue HAs provide a wide frequency range and linear amplification, while digital HAs use complex signal processing to produce non-linear amplification, gain control and other bespoke features designed for speech. Ruth, a profoundly deaf flautist, remains extremely attached to her older-style analogue HAs:

> I went to the School for the Deaf, picked up the flute at the age of 12, and I was making good progress, and when I was 15 – that was in 1995, digital hearing aids came out and – everybody was told to have them – but I rejected them straight away- I said I can't hear the high notes on the flute. It's gone! It's dead. […] Analogue hearing aids pick up anything around you. Whereas digital hearing aids control sound […] I used to collect analogue hearing aids off my friends, and I need them just in case they go [...] When my analogue hearing aids go, my music career is finished.

For Ruth (and previously Paul), the decision to reject digital aids was based on negative experiences of the perception of music when using them. Even participants such as Angie (a pianist with a moderate deafness) reported the benefits of older analogue HAs:

> And in many ways they ['the analogue ones'] were better for getting music and speech and once. Even though they were not perfect, in many ways they were better than what people are being provided with now. I have to fight quite hard to get the compromise that I want to be able to play and talk in one breath. It's an incredible fuss I have to make.

Angie's comment also hints at the effort required by musicians and their audiologists or HA fitters to provide good amplification for both speech and music, a topic discussed in full below. No technology is perfect for everyone, of course, and some participants reported problems not only with digital but also with old-style analogue HAs. Janine was one:

> The analogue was just a blanket of sound. Erm... and so you couldn't really say with any great ease, hear the individual instruments.

ii) Negative remarks about digital hearing aids

By far the largest proportion of responses to questions about HAs concerned the negative attributes of digital HAs when listening to, or during the performance of, music. A large number of these referred to pitch distortion. Janice, a moderately to severely deaf pianist and singer, spoke about her reaction to hearing her newly tuned piano for the first time:

> It sounded like a pub piano. Honestly, it was heartbreaking. I thought, I've just paid to have the piano tuned by a professional piano tuner – and I didn't think it was out of tune before!

Some pitch distortions are hard to distinguish as being sharp or flat, as described by Janine:

> Well you suddenly feel that you're out. And my singing teacher will tell me well you're not, but I will think that I'm out. […] I think – oh yes I feel that I'm singing under the piano. And he's got a great ear – and when I am he'll tell me – he says 'no that was spot on' and I think why didn't I hear it spot on?

Distortions to pitch may be the result of wide dynamic range compression (WDRC), noise reduction or feedback cancellation systems. The operation of these systems will depend on the individual's level of deafness, the make or model of their hearing aid and the way they have been fitted. For example, Philip, a retired professional orchestral flautist, talked about his experience of acoustic feedback:

> I may be able to get my hearing aids readjusted, but I've found going to a concert and the piccolo and trumpets are playing very loudly, or it's an organ recital and it's lots of mixture stops, lots of mixed high frequencies, and my hearing aids will start to feedback on themselves. I tell you, the Central Line is the worst for this, 'please stand clear of the doors- beep, beep, beep, beep, beep, beep!' And my hearing aids' going ['beep'] for about 4/5/6 seconds after the noise has actually stopped.

It may be the case that, at the time, Philip's HAs did not have a feedback cancellation system applied or it had been disabled to facilitate better music listening. Such a system uses phase cancellation but may interpret a held note at high frequency in music as feedback and apply an off-phase signal. Other distortions related not to pitch but to loudness. Some musicians described sudden drops in volume when listening to music which may be the result of Automatic Gain Control

(AGC) being applied by the HA at a level perceptible to the user. Janine shared her experience of this:

> I had this trouble when I first got some digital aids – they program them so that when you get to a certain pitch or level or volume – and the whole thing just suddenly drops – and it's like 'Oh my God, what happened there?' So you have to make sure that your hearing aid isn't programmed like that. You need it to be able to – you don't want any overly intelligent hearing aid.

The profoundly deaf musicians in the present sample who had previous experience of analogue aids often reported the reduced pitch range and power of newer digital aids. Ruth stated:

> From top E onwards [on the flute] – you cannot hear sound. At all. And I'm blowing so hard. I pick up the piccolo and I can't hear it. My brother says 'shut up!' and I couldn't believe it! But I could only hear the keys flicking – just very weird.

In this summary given by Paul, digital HAs are shown to be superb for some types aural input but not others:

> So I stepped out into London - boom! Completely different. They were in many ways a revelation because I could hear all of these things that I'd never heard before. Like the fridge humming and the kettle boiling. Which are not really useful or interesting sounds – but I still couldn't hear music […] I couldn't pick up the sounds that I wanted. There was no power in them. The frequency range was really, really squashed. Nothing useful at all. It didn't matter that I wasn't wearing them while playing the organ or playing the piano – it mattered when I was trying to train my choir.

As one might expect, for some of the participants who are performing musicians, the negative aspects of music perception using digital HAs manifested as challenges in the music-making situation itself. Anthony is a professional orchestral string player with a moderate-to-severe deafness. He uses expensive digital HAs that cannot be seen as they sit completely in the ear canal; furthermore the volume control and settings for speech and music can be adjusted discreetly during rehearsals using an external remote control device:

> The real essence of the problem I have is that I need one sort of hearing aid help for playing and I need another sort for interacting and speaking during those rehearsals. […] So I need something that's adjustable so that I can use it as attenuation, but at the same time I need to hear what's going in on in rehearsal, we stop, we start, we talk, things are said, things are marked in parts and so on and so forth. You need to be able to hear, but also to be able to adjust the volume so that you can reduce or increase according to what's required.

iii) Positive remarks about digital hearing aids

Reassuringly for manufacturers and users alike, a large proportion of responses concerning modern digital HAs were positive. In general, participants reported that HAs provide them with access to music that would otherwise simply be unavailable. As Janice stated:

> Without them, I wouldn't be able to sing in a choir at all. I wouldn't really hear what was happening – I wouldn't be able to hear the harmony – 'cause I've actually lost low frequency as opposed to high frequency - which is quite unusual!

While simultaneously reporting negative issues, other participants were also generally positive about them:

> Well they help generally (Philip);
>
> I hear the rest of the orchestra better (Anthony).

Nick spoke of the improvements that have been made to digital technology over the years that have addressed the perceived lack of power produced by them:

> They're much, much better now than when they first came out – especially for people with my level of hearing loss. Because I think at first they were mostly geared around older people, with less hearing loss than me so they weren't powerful enough for me. But now they are much more powerful.

iv) Awareness of hearing aid needs

Many of the participants' comments revealed the effort required to obtain the best technology to meet their specific musical needs. The process begins with an awareness of the musician's own needs with respect to amplification and may include the desire for HAs that are discreet to the point of invisibility, a high priority for professional musicians seeking to conceal their hearing loss from colleagues in the working environment:

> And of course you don't want to turn up to work and find 80 or so musicians, your colleagues in the pit and you turn up with one of these great old NHS things – you know, there is a stigma attached to that (Anthony).

Some participants mentioned the financial costs of smaller, highly customised HAs for musicians:

> My mum said 'if you really want it, we could find the money and pay for that' – you know, discreet ones, but I don't really want to put extra financial pressure on my parents (Penny).

Meanwhile, others talked about the social stigma attached to wearing HAs above and beyond any musical needs:

> My daughter was saying to me you know 'if you hide it, nobody knows you've got a hearing loss and then they get a surprise when you say "I'm sorry I've got a hearing problem please could you speak up!"' On the other hand, the negative side to that is somebody sees the hearing aid and thinks, 'oh there's no point talking to him he's deaf'. That can be the case. It's getting better, it's getting better. (Philip).

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v) Audiology and hearing aid fitting

Having established their own needs and priorities when it comes to amplification, many of the participants spoke about the challenges involved in getting the best programming for their HAs. For example, Paul spoke about his frustration at not being able to find suitable HAs for so many years:

> I appreciate the immense technology that goes into them. But I don't think manufacturers and audiologists actually appreciate that this human being in front of me, my patient who knows what they like and knows what they need and I as that provider know that what I'm giving them is not good enough. And that's annoying – because it's not in the best interests of the patient. It's in the best interests of the manufacturers and the developers and the technology people because they're making money out of it. But what's the point of doing all that if it doesn't help the person who's wearing it.

Ruth summed up the situation thus:

> Musicians are a minority – they're thinking about the bigger market.

Thankfully, other participants were able to share stories about working with their audiologists that were more positive:

> But I was very fortunate with the hearing aid – practitioner. They vary – and I've had positive experiences and less positive ones (Angela);

> A really good audiologist will have a program that they can – go with your partner or whoever - and they can play you a piece of music or whatever and they can say this is how your partner or your mother or your daughter is hearing it – and they can assimilate how they hear it. Which I think is really good because it gives them a better understanding (Janine).

B. Managing the sensory experience

While the section above presented a range of issues – some problematic, others not – participants also spoke about strategies for exerting control over their auditory environments, often in response to these issues. The following themes were coded under the global theme 'Managing the Sensory Experience' and illustrate ways in which the D/deaf musicians in this sample optimise their music sound-world. The strategies are primarily auditory but more often than not involve other senses and may therefore be multi-modal.

i) Rejecting hearing aids

Although this may appear extreme, several participants reported rejecting using digital HAs for music listening altogether. In Anne's case, this was part of a larger decision in her life not to wear HAs in any situation at all, musical or otherwise. During her late teens, while learning the violin, she used analogue HAs. However, she found they would distort musical sounds and over the course of a year, she learned to take them out for music, yet still used them for conversation:

> They were brilliant to start with when I had partial hearing loss. But then as it got worse and the top frequencies - we could never boost them anyway. […] It was not a nice sound that I heard- that I was expecting to hear. I would prefer not to hear it than to hear what I was hearing. […] I mean I remember it sounding like a badly tuned radio.

As time went by, Anne chose not to use HAs at all:

> I never really like being a second-rate hearing person - so I didn't like to feel like I was relying on something that wasn't reliable. So it was much easier to just get rid of it.

ii) Using a music program

Most digital HAs are sold with the capacity to deliver more than one program. For example, one may be set up for 'speech in noise' and another for music listening. One might expect HA users identifying as musicians to use a special program for music listening. However, participants in this sample were not all able to report if their HAs had a music program or if it was set up for use. If they were, they did not always use the program consistently for music listening or performance. Anthony commented:

> I put it on to a program which I use in the pit which they call the music program – it's simply where all the frequencies are compressed. Unfortunately technology on these doesn't allow for individual frequencies to be compressed, more than others. You compress the whole level.

iii) Adapting to hearing aid technology

Unlike reading glasses, HAs are not simply corrective. Instead there is a degree to which users will maximise the potential of their HAs by taking the time to adapt to the new sound-world that they provide. This process of aural rehabilitation has been explored in the context of music perception by Rachel van Besouw for cochlear implant users (van Besouw et al., 2011) and it is likely that similar principles may apply for hearing aid users. Paul outlines the nature of the problem:

> I meet so many people who say, 'well I've lost my hearing, and I can't cope with the hearing aid. I used to love music but I just can't listen to it any more'. And it's sad because they don't get the help that they need, and we're not yet in a position to help deafened people in a way that I would like.

Ruth related a story about an encounter with another deaf musician in the US who had had a cochlear implant:

> I remember when I went to America, to give a seminar about music and the deaf, and I met other deaf musicians- there was one man who was hearing perfectly – normal hearing – and he

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lost his hearing when he was maybe 35. He had a cochlear implant and he used to play in a rock band. He was a piano player and he was coming home from hospital and he dropped his keys and he thought 'this sounds really different' and then you just have to go along with that difference. And I thought – that's so disappointing. If he said 'oh, it's what I used to hear before', then I would have thought 'oh good, that cochlear implant must be good', but it was completely different – It made me paranoid about it.

iv) Using earplugs

Finally, a very important strategy used especially by professional performing musicians is the use of earplugs to attenuate sound and protect against NIHL. The issue of noise exposure as a result of loud music has gained plenty of press attention as there is a genuine concern that young people in particular are damaging their ears by loud music and personal sound systems and will need amplification later in life (Bennett, 2007). After measuring the average noise exposure levels of professional musicians, it was found that, were they in any other profession, they should be wearing ear defenders. Anthony highlighted the provision of musicians' earplugs by professional orchestras in reaction to this occupational risk and the challenge associated with wearing them:

So obviously they [the orchestra] will now pay for Ellerson filters which you know is one of the leading brands of moulded plugs with a filter in the end […] so the basic attenuation is 9db, 15db or 25db, now I tried a 15 and actually it cut out so much noise I couldn't really perceive my own sound or what was going on around me adequately [...] it creates a barrier and suddenly you've got to overcome that both emotionally and physically.

And Philip explained why earplugs are sometimes essential:

The only time people really started to think, 'I'm going to wear ear plugs for this', was when we did Gawain and the Green Knight by Harrison Birtwistle, and there was a bit in this where the three bassoons had to play swanee whistles really loudly and we marked it in the part 'plugs in'- and it really did hurt.

III. DISCUSSION

Participants' attitudes towards their HAs were found to be both positive and negative, thus suggesting attitudinal ambivalence (Mark & Griffin, 1995). Most participants were acutely aware of any issues with their HAs and the ways in which they would want them improved if they had the money and/or time to do so. Yet the majority of the musicians interviewed depend on their HAs to the extent that participation in musical activities – especially interactive performance – would simply not be possible without them. HA users with greater control over their technology (which was in turn related to their ability to afford bespoke solutions) tended to hold more positive attitudes (compare for example Anthony's responses with Janice's), but other mediating factors such as age and degree of loss and type of hearing aid used are also important.

The idea that the simpler, linear amplification provided by old analogue hearing aids is preferable for music listening was supported by this study, but only for a specific subset of the sample: musicians with profound deafness from birth. For these participants, the fact that analogue hearing aids are no longer manufactured or sold is a cause for concern, alongside their dissatisfaction with newer digital aids to replicate the level and type of 'clean' amplification they became accustomed to. A specific type of hearing aid technology, the analogue K-AMP, is regarded as advantageous for musicians but is no longer available (Killion, 2009). Some manufacturers today are now developing hybrid technology to allow for analogue input limiting before the A/D converter which preserves the musical signal better and reduces the potential for distortion (Chasin & Hockley, 2014).

Regardless of one's level of hearing, it is likely that musical training heightens one's ability to attend selectively to some auditory features while ignoring others. The results suggest that the participants in this study preferred to use different levels of auditory attending. Fully 'auditory attending' musicians tended to be those born with profound deafness whose musical development occurred while using powerful analogue HAs (e.g., Paul, Ruth and Danny) and were thus reluctant to adopt modern digital HAs. At the other end of the spectrum, non-auditory attending musicians were those who, being hearing at birth, were deafened to a profound level (e.g., Evelyn and Anne). These musicians instead recruit proprioceptive, kinesthetic, vibrotactile and visual information in their music-making and ultimately rejected all forms of HA technology. Between these two extreme positions, there were the participants who can be described as 'discriminately attending' to some but not all features of their auditory environment. These musicians both rely on, and thus tolerate distortions resulting from, their digital HAs (e.g., Angela, Anthony, Janice, Nick and William). Auditory attending styles are thus shown to vary depending on the current level and the age of onset of hearing loss which can impact the type of amplification preferred and in turn preferences for different musical instruments and listening experiences. A summary is given below in Table 2 and a full discussion of auditory attending styles can be found in Fulford, Ginsborg & Goldbart (2011).

Table 2. Auditory attending styles

Hearing at Birth	**Hearing now**	**Preferred amplification**	**Auditory attending style**
Severe / Profound	Severe / Profound	Analogue	Fully attending
Hearing	Mod/Severe	Digital	Discriminate attending
Hearing	Profound	None	Non-attending

The results of the present study suggest that distortions resulting from using digital HAs cause musicians to become increasingly discriminating in their auditory attending, especially during musical performance. Such dynamic attending to sensory information is common during musical performance; our experience of music is multi-modal and the recruitment of other senses mediates and modulates our reliance on auditory information, whether it is amplified or not, especially in the context of communication between performers or between performers and their audience (Davidson, 1993; King & Ginsborg, 2011). However, where HA technology is rejected altogether, to the detriment of involvement in music performance or listening enjoyment, there is room for improvement. Aural music listening abilities carry wider benefits regardless of hearing level. For example, musical training has been shown to reduce age-related decline in central auditory processing such that, despite similar rates of presbycusis (age-related hearing loss), musicians can do more with what little hearing they may be left with (Zendel & Alain, 2011).

IV. CONCLUSIONS

The present study used a sample of only 11 musicians and thus the generalisation of patterns, such as those described in Table 2, to wider populations of hearing aid users would not be appropriate. However data from the current study strongly support that digital HA technology is problematic for music listening and further studies are now needed to clarify the extent to which issues with music listening are prevalent in the wider population, in particular for non-musicians.

A newly-funded AHRC research grant awarded to the first and third authors and Dr Harriet Crook (Lead Clinical Scientist, Department of Neurotology, Sheffield Teaching Hospitals NHS Foundation Trust) aims to explore the prevalence of issues with music listening via a clinical interview study and large-scale national survey. The research will investigate the ways in which HA technology and hearing impairments, in particular presbycusis, affect music listening behaviour over the lifespan. It will seek to identify how HA technology may be improved for music listening based on reported behaviours and preferences of different demographic groups within the HA user population. In addition to providing advice on music listening issues, the project will produce an advice leaflet for clinical audiologists to raise awareness and confidence in the fitting and optimising of HA technology for music listening. Further information about the project can be found at www.musicandhearingaids.org.

The high-fidelity (hi-fi) revolution which occurred during the '50s and '60s raised public expectations with regard to sound quality with no noise or distortion. It drove the development of hi-fi technology that brought high quality sound into the home and therefore into everyday life (Keightley, 1996). For digital HA technology, there is much further to go. As Chasin and Hockley (2014) state, "Music amplified through hearing aids has some interesting characteristics but high fidelity is not typically one of them" (p. 2). All the participants in the present study illustrated this point in their comments but Janice articulated it particularly well:

> I'm aware that I'm probably missing out a lot of the time, not always, on the sheer sensual experience of the beauty of sound. Because it is filtered through an electrical – so it's going to sound like it's on an intercom. So it's bound to reduce the pleasure. That's not always the case, but a lot of the time.

The challenge for manufacturers and digital signal processing engineers will be to develop technologies that improve music listening experiences whilst retaining and prioritising the amplification of human speech. The high fidelity amplification of music for the D/deaf and hearing impaired is an issue of 'quality of life' rather than necessity but this can also be said of our current smart-phone, smart-watch and tablet technology. For professional musicians with hearing impairments, like Anthony, the pinnacle of aural technology may be a combination of attenuation and amplification specially designed for each individual; the former to address hearing loss and the latter to protect against the Noise- (or Music-) Induced Hearing Loss (NIHL). While not everyone needs such bespoke technology, the demand for higher quality amplification of music will likely increase as the HA user population grows. Currently, private clinics such as the Musicians' Hearing Services, part of Harley Street Hearing in London, are arguably best placed to address the need of musicians who represent a very special sub-set of HA users. In time, a competitive market of HA manufacturers may facilitate access to improved HAs via the NHS and in turn the general public, and allow audiologists greater confidence in fitting HAs for the purpose of general music listening.

ACKNOWLEDGMENT

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Ginsborg, J., Lamont, A., Phillips, M., Bramley, S. (Editors)

Sad music use in people with tendencies to Depression

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ABSTRACT

Background

Recent research indicates that mood regulation is one of the primary reasons that people listen to sad music, and that it can be a successful strategy for processing negative emotions or obtaining other psychological benefits. However, depression is characterized by impaired capacities to regulate affect. It is therefore possible that people with tendencies to depression may not use music as successfully as other people to improve their mood.

Aims

To investigate the mood effects of listening to sad music on people with tendencies to depression.

Method

In a series of studies, participants were asked to listen to a piece of sad music. Pre- and post- listening mood scores were taken on the POMS and participants were also asked to describe the effect the music had on their mood.

Results

People with tendencies to depression experienced increased levels of depression after listening to sad music, despite claiming to have benefited from the experience.

Conclusions

Using Trapnell and Campbell's (1999) discussion of the 'self-absorption paradox' as a framework, the results suggest that people with tendencies to depression may not enjoy the same psychological benefits from listening to sad music that other people can, and that they often remain unaware of the negative impact sad music can have on their mood.

Keywords

Sad music, rumination, depression, mood

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Measuring sadness as a response to music in a live performance setting

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ABSTRACT

Background

A large proportion of music and emotion studies use either bi-dimensional models or discrete models of emotion for measuring sadness responses in the listener (Eerola and Vuoskoski 2013). However, research suggests that this may be an over-simplification of our experience of sadness in an aesthetic context. Furthermore, few investigations have considered the mechanisms by which emotions are induced in contexts outside the laboratory.

Aims

To explore audience experiences of sadness in a live-performance situation, and to investigate the relationship between the emotions experienced and the mechanisms involved in triggering them.

Method

Audience members were surveyed about their emotional experiences and particularly their experiences of sadness in response to a live performance. The GEMS (Zentner, Grandjean et al. 2008) and BRECVEMA (Juslin, Harmat et al. 2013) frameworks provided the basis for the survey, but these were extended to allow for the possibility of complex sadness responses and for the influence of the live performance situation.

Results

Results suggest that experiences of sadness in response to music can be both positive in valence and high in arousal and that the pleasantness or otherwise of the experience may be related to the mechanism by which it is evoked such as memories, extra-musical associations and visual imagery. Results also indicate that the contextual aspects of a live performance such as the ambience of the hall and the reaction of other audience members also contribute to emotional experience.

Conclusions

The study confirms the complex interplay of multiple personal and situational variables in emotional response to music. It further demonstrates that commonly used models for measuring emotional response may not be sufficiently sensitive for measuring the complex ways in which sadness can be experienced, and that further investigation of emotion-induction mechanisms outside of laboratory situations is warranted.

Keywords

Sad music, audience response

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The use of music in everyday life and personality: A cross sectional study of a whole sample of school children in Germany

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ABSTRACT

Background

The use of music (UofM) in everyday life is a field of growing interest, particularly due to its obvious role as an important suppressor or mediator variable with regard to existing affect and emotion, personality, and different behavior variables. Up to now, existing questionnaires comprise only instruments (Chamorro-Premuzic & Furnham, 2007; Saarikallio, 2008) focusing on a mainly passive reception behaviour. The IAAM (Inventory for the Measurement of Activation and Arousal Modulation) was constructed in 2004 (von Georgi et al, 2006), a questionnaire for the measurement of UofM with a high reliability (over .80 for all scales) and validity, including Rasch-scaling (von Georgi, 2007, 2013; von Georgi et al., 2009a, 2009b). A short summery of the existing studies and the theory behind the IAAM is given in von Georgi & Polat (2013) or Gebhard et al. (2014).

Aims

The aim of the present study was to evaluate a possible change in the UofM in dependency of age and personality variables in young school children by using the IAAM. It was hypothesized that a remarkable increase in UofM for negative affect modulation will occur because emotional development in adolescence.

Method

618 participants (286 females) (12-19 years) completed the IAAM, the NEO-ffi and further questionnaires. The items of the IAAM ask for the active and conscious use of music and it consists of the following five scales (eleven items per scale): relaxation (RX: somatic and psychological relaxation through music), cognitive problem solving (CP: thinking about social and internal problems and affects, including memory aspects), reduction of negative activation (RA: modulation of a strong negative activation and emotional arousal), fun stimulation (FS: positive psychological and motoric activation and establishment of social relationships) and, finally, arousal modulation (AM: the modulation of concentration skills and general capability). Level of significance for regression and variance analyses was set at 0.05.

Results

Correlation and non linear regression analyses shows a significant effect only in case of the UofM for positive stimulation in everyday live ($r=.158$; $p<.001$). Only females show an additional positive effect over the years with respect to the UofM for relaxation ($r=.133$; $p=.025$). Additional ANOVA analyses result in a clear effect of neuroticism on the first three IAAM scales which measure the modulating of strain, negative feelings and affect ($p<.05$). Further results will be presented.

Conclusions

With the restriction of the given cross-sectional design it seems that the UofM is developed also in younger children. No significant increase can be observed in case of the modulation of negative feelings as hypothesized. On the other hand the results indicate an important influence of personality and gender. Especially a high emotional lability causes a high UofM in everyday live. Further results focus on music preference and time dependent IAAM scale intercorrelations.

Keywords

use of music, emotion regulation, personality, development

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Musical and verbal short-term memory

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ABSTRACT

Background

Music and language are considered two highly linked human abilities, which could possibly influence each other. Music and speech-language both involve the control of pitch, but in music we find a higher degree of precision for both the control and perception of pitch than does ordinary speech (Patel, 2008). However the role of consonance and dissonance in music and in language still remains unexplained (Malberg, 1918).

Aims

The goal of the present study is to investigate whether two-voice consonant and dissonant musical stimuli can influence short-term verbal memory, and vice versa, in musicians and non-musicians. This hypothesis was based on studies that support the potential for shared resources or neural overlap in auditory short-term memory (Williamson, Baddeley, & Hitch, 2010), and on studies that show that musicians process the musical stimuli differently than non-musicians (Brattico, Näätänen, & Tervaniemi, 2001).

Method

Twenty-four neurologically and acoustically healthy volunteers (12 non-musicians and 12 musicians, 15 men and 14 women, mean age = 26.20, SD = 5.64) participated in the study. The examination material were 20 musical stimuli (10 consonant and 10 dissonant intervals, which were characterized as these according to the classical music harmony approach) paired with 20 verbal stimuli (neutral words), which were each time differently linked with the musical stimuli for each participant. Participants' memory (for both the sound-word and word-sound pairs) was examined with the use of multiple choice tasks immediately after the presentation and 5 minutes after their initial exposure to the music-word and word-music pairs.

Results

Results indicated that for the condition of music prior to words pairs there were no statistically different scores for the musicians and non-musicians ($p > 0.05$). But it was found for the majority of the participants (musicians and non-musicians) that the listening of dissonant musical intervals (mainly intervals of minor 2nds) preceding neutral words was linked with more accurate responses in the multiple choice task of indicating the missing word from the other three alternatives ($p = 0.005$), in contrast with the pairs of consonant musical intervals and neutral words. For the condition of words prior to music pairs, a statistically different recognition pattern was found for non-musicians and musicians, with the latter showing a better performance in recognizing the right tonic interval (consonant and dissonant) which followed the given word ($p = 0.000$). This superior performance for the group of musicians could be interpreted through the prism of music education and experience.

Conclusions

This differentiation pattern for dissonant-consonant musical stimuli, may be due to the claimed stressful impact of musical dissonance on human physiology (stress responses; Pallesen et al., 2005), and the relaxing impact of musical consonance. Memory effects, such as creating distinct traces, should also be considered as a possible explanation.

Keywords

consonant intervals, dissonant intervals words, short-term memory

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Solving traditional harmony exercises: A metacognitive perspective

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ABSTRACT

Background

Subjective experiences, such as metacognitive experiences in problem solving are very important (Flavell, 1976), but the research so far is focusing only on mathematical problems or text processing problems.

Aims

The aim of the present study was to investigate a form of problem solving concerning harmony exercises by examining (a) the effect of university studies of students (studying musicology as a major or not), educational level (senior high vs. university) and gender on performance on traditional tonal harmony exercises, and (b) on metacognitive experiences, namely feeling of difficulty, estimate of effort, estimate of solution correctness, and confidence.

Method

The sample consisted of 50 students of senior high school and 30 university students of both genders (34 female students of senior high school and 21 female university students), who were all healthy and had a musical background (at least 8 years of music lessons). They were asked to solve four brief harmony exercises (9 meters each) that differed in the level of difficulty and their form (given basses or given melodies-soprano voice). Half of the participants were provided with theoretical instructions about the appropriate move for the inner voices that was needed for the solution of the exercises. Before and after each exercise they were asked to report on their metacognitive experiences. The metacognitive experiences that were examined were the metacognitive feeling of difficulty and the feeling of confidence. Also metacognitive judgments were examined including the estimate of effort and the estimate of solution correctness. A self-report questionnaire in the form of a 1-5 Likert scale was used.

Results

The analyses revealed a main effect of task as well as interactions of task with direction of studies, educational level, gender and instructions both in performance ($p < .005$) and metacognitive experiences ($p < .005$). It seems that the two easy harmony exercises create better performance (correct solutions) and less negative metacognitive feelings (lower reported feeling of difficulty and higher reported feeling of confidence) and more positive metacognitive judgments (higher estimate of solution correctness) for the male university students who were given clear theoretical instructions before testing. The presence of clear instructions interacted with task and affected the reported feeling of difficulty before solving the exercises, but not estimate of effort. After problem solving, only the main effect of task was found to be significant.

Conclusions

In general the findings, although preliminary, show for the first time the importance of studying various aspects of metacognition. These findings suggest that metacognition applied on music education may not only reveal the possible differences that students with different demographic characteristics may have in a cognitive and metacognitive level, but also reveal new ways to improve their music education.

Keywords

harmony, exercises, solving, metacognition.

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Students' perceptions of a technology-enhanced learning environment aimed at fostering meta-representational competence in music

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ABSTRACT

Background

The focus of this paper is on two definite areas: designing of powerful learning environments, and graphical representation of music. With respect to the former, technology-enhanced learning environments (TELEs) have revealed as powerful tools for fostering students' learning (Azevedo & Cromley, 2004). In this respect, scaffolding (Collins, Brown, & Newman, 1989) plays an important role in order to guide students' construction of knowledge. As to the latter, dealing with music by means of idiosyncratic representations has been comprehensively investigated (see Barrett, 1997 for an overview). One of the most recent approaches (Verschaffel, Reybrouck, Jans, & van Dooren, 2010) is related to the concept of meta-representational competence (MRC), described in a generic sense as the full complex of abilities dealing with representational issues (diSessa, 2002). In a recent study, Gil, Reybrouck, Tejada, & Verschaffel (in press) claimed that TELEs could contribute to enhance students' MRC in the domain of music.

Aims

The primary concern of this study was to examine students' perceptions of a TELE aimed at fostering their MRC in the domain of music. We hypothesized that providing students with scaffolding in the context of such a TELE would overall increase their positive experience of learning. We inquired also into the partial effect for six separate constructs, namely 'Relevance', 'Reflective thinking', 'Interactivity', 'Tutor Support', 'Peer Support', and 'Interpretation'.

Method

A basic randomized design comparing a treatment to a control group was used. Participants were 75 students aged 12 enrolled in a middle school music course. An educational intervention was carried out by means of a virtual classroom (Moodle™) so that the students allocated to the experimental (E) group were provided with both fixed and adaptive scaffolding, while the control (C) group students did not. The scaffolding consisted of small hints and reminders provided by the teacher to help students carry out design-related tasks, such as representing musical sounds or judging their representational adequacy. Students' perceptions of the TELE were measured after the intervention by means of the Constructivist On-Line Learning Environment Survey which consisted of 24 Likert-type items distributed into the aforementioned six subscales. Chi-square tests were performed so as to compare the E and C groups' scores on the survey.

Results

An overall effect of the intervention on students' perception of the TELE was found, with a significant difference between the E and the C group (chi-square=16.45, df=4, p=.002). Significant differences were also found for the subscales 'Reflective thinking' (chi-square=14.24, df=4, p=.007) and 'Tutor support' (chi-square=10.78, df=4, p=.029).

Conclusions

The results corroborated the beneficial effect of scaffolding in a TELE, as described in previous literature (Azevedo & Cromley, 2004). First, fixed scaffolding accounted for the enhancement of the students' critical reflective thinking. Second, adaptive scaffolding provided by the teacher explained the acknowledgment of his role as a mediator to help the students carry out tasks.

Keywords

Hypermedia, Learning environment, Scaffolding, Graphical representations, Meta-representational competence.

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Overtone-based pitch selection in Hermit Thrush song: Implications for the origins of Human musical systems

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ABSTRACT

Background

Many human musical scales, including the diatonic major scale prevalent in Western music, are built partially or entirely from intervals (frequency ratios) corresponding to small-integer proportions drawn from the harmonic series. For a long time, scientists have debated the relative contribution of biology and culture in shaping these pitch systems. One way to address this question is to study animal "song": if the vocal displays of some animals, such as birds or whales, follow some of the same principles that characterize human musical systems, this might suggest a biological basis for these musical systems.

Aims

Here, we investigated whether the songs of the hermit thrush (*Catharus guttatus*), a medium-sized North American songbird whose song has attracted the attention of ornithologists and musicologists for more than a century, use pitches that are related by simple frequency ratios. This hypothesis was based on early 20th-century claims which relied on anecdotal reports.

Method

71 high-quality recordings of the songs of 14 male hermit thrushes were analyzed. Pitch relationships were examined using both a simple linear regression model and a Bayesian generative model. These analytical methods were also applied to alphorn (a wind instrument that can only produce notes from the harmonic series) recordings and to a computer-generated ground truth dataset (to assess the validity of our statistical models).

Results

The frequencies corresponding to the notes of the hermit thrush songs were, in most cases, simple integer multiples of a base frequency, corresponding to an overtone series. After controlling for other possible explanations, such as the possibility that hermit thrushes could select notes using the resonances of their vocal tract in a manner similar to the alphorn, our results strongly suggest that hermit thrushes actively select the pitches they sing.

Conclusions

Our findings support the idea that some features of human musical systems may be based, at least in part, on biological principles that are shared with other animals such as songbirds. These results are thus especially relevant in the context of the longstanding debate regarding the origins of human musical systems (Doolittle, Gingras, Endres, & Fitch, 2014).

Keywords

Overtones, birdsong, evolution, scales

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Chunking by intermittent motor control in music

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ABSTRACT

Background

Various theories in music perception and cognition, from classical gestalt theory to more recent experimental work and data-driven modeling, have contributed to our understanding of chunking in musical experience (see Godøy 2008 for a summary). But our own research on music-related body motion has singled out *intermittency in motor control*, i.e. a basically discontinuous and point-by-point control scheme, as an essential factor in chunking. Classical motor control theories with claims of so-called *closed loop* continuous feedback have in recent years been challenged by models suggesting intermittent control, manifest in so-called *open loop* and preprogrammed motor commands, because continuous feedback loops are thought to be too slow for many highly demanding tasks (Loram et al. 2011, 2014). Various findings in human motor control, i.e. the so-called *psychological refractory period*, principles of *posture-based motion control*, of *action hierarchies*, of *goal-directed behavior*, etc., and our own research on music-related body motion, seem to converge in suggesting the existence of intermittent motor control for chunking at the short-term timescale of very approximately 0.5 seconds duration, all in all suggesting that there are what could be called *quantal elements* in musical experience (Godøy 2013).

Our interest in chunking stems from several years of research and reflections on what Pierre Schaeffer called *sonic objects* (Schaeffer 1966), i.e. holistically perceived fragments of musical sound in the approximately 0.5. to 5 seconds range, and which we with Schaeffer regard as one of the most essential elements of musical experience (Godøy 2006). However, this also leads to questions of what are the criteria for the constitution of such sonic objects, and of how they are perceived in musical contexts. It seems that various features in the auditory signal (e.g. shifts between sound and silence, contrasts in pitch registers, contrasts in timbre, or the occurrence of repeated patterns, etc.) may be fairly robust cues for chunking, but in many cases, these cues may be less salient (e.g. be weak, competing, masked, or even temporarily absent), requiring the use of other perceptual schemas. Adopting a so-called *motor theory* perspective (Galantucci, Fowler, and Turvey 2006) on music perception in general and chunking in particular, we believe images of sound-producing body motion may be effective in chunking continuous streams of sound into somehow meaningful units in musical experience (Godøy 2001, 2003, 2013, 2014).

The basic tenet here is that schemas of sound-producing body motion are projected onto whatever musical sound it is that we are hearing. This in turn means recognizing a number of constraints of body motion and motor control, something that suggests an unequal distribution of attention and effort in musical experience. Although the underlying neurocognitive processes of our organism may very well be continuous (Spivey 2008), the main argument for intermittency is that control takes time, and that continuous feedback is just not feasible (Loram et al. 2011, 2014). The various constraints of motor control also fit well with the idea of action gestalts as optimal for our organism (Klapp and Jagacinski 2011).

This means that we need a novel theory of chunking based on the idea of intermittency in motor control. Such a theory should also be capable of accommodating the (seemingly paradoxical) coexistence of continuity and discontinuity in musical experience, something we shall argue is possible by recognizing intermittent motor control of chunks, yet recognizing that chunks unfold continuously in time, and furthermore, that the concatenation of several chunks in succession may give rise to subjective sensations of continuity in musical experience.

Aims

The aim of the presentation is to demonstrate a novel model of intermittent motor control in musical performance and its consequences for chunking in music perception, based on convergent findings in several domains and our own research on music-related body motion, in particular our findings on coarticulation in music-related body motion, i.e. the fusion and the contextual smearing of otherwise distinct motion and sound events into holistically perceived chunks. The main claims of the model are as follows:

- That chunking is based on a confluence of production constraints
- That anticipatory cognition is manifest in sound-producing (and also sound-accompanying) body motion
- That we have fusion by coarticulation in musical performance
- That we need a more rigorous analysis and differentiation of timescales involved in the perception and production of music, and notably so, of both sound and corresponding body motion.

This last point means that we in particular need to differentiate the features of the sub-0.5 seconds timescale, what could be called the *delta timescale*, and which typically includes the psychological refractory period, as well as coarticulation and thresholds for so-called *phase-transitions*, meaning the fusion of singular events into superordinate events (or conversely, the fission of superordinate events into singular

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events), all dependent on the rate (the speed or temporal distance) and duration of events (Godøy 2014).

Furthermore, the model should establish chunking in music as conditioned by *goal-directed behavior*, similar to goal-directed body motion in various everyday contexts, and as focused on certain salient postures (Rosenbaum et al. 2007). We could say that chunking is focused on what we call *key-postures*, meaning salient shapes and positions of the effectors (fingers, hands, vocal tract, etc.), and that there is continuous, coarticulated motion between these key-postures. Furthermore, we think these key-postures are found at salient moments in time, typically at downbeats or other accented points in the music, at what we call *goal-points*. In music, we think of these key-postures at goal-points as surrounded by *prefixes* (trajectories to the key-postures) and *suffixes* (trajectories from the key-postures), with overlap of suffixes and prefixes in sequences of chunks producing the effect of continuous motion. The basic tenet here is that all motion takes time, i.e. that instantaneous displacement of the effectors is impossible, and hence, that there always will be contextual smearing of motion leading to coarticulation within any chunk (Godøy 2013, 2014, in press).

Also, we think we can detect these goal-points and key-postures in motion capture data of musicians' sound-producing body motion, as points associated with maximal acceleration and velocity reversals (Godøy 2013, 2014), points in time that we in turn understand as the basis for intermittent control.

Main Contribution

The main contribution of the presentation is a novel theory of chunking in music based on constraints of human motor cognition, in particular on the need for anticipatory motor control, its manifestation in intermittent control, and the associated coarticulation and contextual smearing of motion and sound within any chunk. This will all come together in a conceptual model that will include:

1. Intermittent motor control, focused on key-postures at goal-points
2. Continuity, coherence, fusion, integration, etc. within any chunk because of continuous motion trajectories with coarticulation

One attractive feature of this model is that the duality of discontinuity and continuity is built into the model: the within chunk coherence is due to a single discontinuous impulse, i.e. to the intermittent, so-called *serial ballistic* (Loram et al. 2014), control impulse, focused on one goal-point. The evidence for this model so far is in various other cognitive science research on human motor control, as well as the interpretation of our own empirical findings:

- Motion capture data on sound-producing motion trajectory shapes and their corresponding velocity and acceleration features suggest the existence of goal-points
- Motion capture data clearly indicate the coarticulatory shaping of sound-producing motion trajectories.

Implications

One consequence of recognizing intermittent motor control is to modify our basic understanding of chunking in music so that we see chunking as just as much dependent on intermittent motor control schemas as on purely acoustic features. Specifically, such an understanding of chunking may:

- Account for chunking difficult to induce by purely signal-driven schemes
- In focusing on goal-points, shift our attention towards chunk centroids from chunk boundaries, i.e. boundaries are seen as secondary to centroids, and this model may also accommodate/tolerate fuzzy boundaries.
- Account for the internal coherence and cohesion within the chunk as the result of one singular and intermittent control impulse

But clearly, we also need to:

- Develop experimental methods for more systematic studies of intermittency in practice
- EMG measurements to indicate temporal distribution of effort in sound-producing body motion
- Computational models (i.e. so-called *reverse engineering*) of intermittent control in sound-producing body motion

Keywords

Intermittency, motor control, action gestalts, coarticulation, contextual cohesion

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Common serial order processes in musical and verbal short-term memory: Evidence from a novel serial order probe recognition paradigm

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ABSTRACT

Background

In the domain of verbal short-term memory (STM), many models consider a dissociation between item and serial order processing (e.g., Burgess & Hitch, 2006; Majerus, 2013). This is supported by data showing that serial order processing is significantly more impaired by rhythm production interfering tasks than is item processing (Henson et al., 2003). Moreover, recent data showed that the pattern of serial ordering errors during the reproduction of musical pieces (Mathias, Pfordresher & Palmer, 2014) is similar to that obtained in verbal serial order memory tasks. The purpose of this study was to investigate the verbal-musical domain generality of the item-order dissociation in STM. We posit that, under rhythmic interference, serial order retention of musical information will decrease to a stronger extent than will item retention.

Aims

1) Providing empirical evidence for domain-general serial order processes in short-term memory.

2) Validate a novel task assessing musical STM performance with a serial order probe recognition paradigm.

Method

Twenty-six non-musician participants had to retain sequences of four syllables or tones presented in time with a regular beat. After a short delay, they heard the beat of the sequence and they had to repeat the sequence in their head in synchrony with the beat; one item was then played in time with the beat at one of the four positions. In the item condition, participants had to decide if the item played was present in the target sequence independently of its position; in the order condition, the participants had to decide whether the item was presented in the correct serial order position (STM condition). For each condition, during the maintenance interval, an interfering task requiring to reproduce a non-regular rhythmic sequence by finger tapping response was presented, and this for half of trials.

Results

A 2 (musical/verbal) X 2 (item/order) X 2 (interference, no interference) ANOVA revealed a significant main effect of modality, $F_{(1, 25)} = 230.174$, MSE = .018, $p < .001$, $\eta^2_{par} = .902$, a significant main effect of interference, $F_{(1, 25)} = 15.316$, MSE = .009, $p < .001$, $\eta^2_{par} = .380$, a significant interaction between modality and item/order STM condition, $F_{(1, 25)} = 4.860$, MSE = .008, $p = .037$, $\eta^2_{par} = .163$, and a significant interaction between STM condition and interference condition, $F_{(1, 25)} = 10.959$, MSE = .005, $p = .003$, $\eta^2_{par} = .305$. All other effects were not significant.

Tukey post-hoc analyses were conducted for exploring the two interactions. For the modality by STM condition interaction, we observed better recognition performance for item than for order information in the verbal modality ($p = .035$) while no difference was obtained in the musical modality ($p = .997$). For the STM condition by interference condition, there was no significant interference effect in the item condition ($p = .929$) but the interference effect was significant in the order condition ($p = .002$).

Conclusions

As predicted the results showed a critical, similar effect of rhythm interference on the ability to maintain order information in verbal STM and musical STM, while STM for item information was insensitive to this manipulation in both modalities. This experiment is the first to demonstrate a dissociation between serial order and item processing in musical STM. These results provide evidence for the existence of common serial order processes in verbal STM and musical STM, the latter statement being consistent with recent findings suggesting amodal serial order processing mechanisms (Hurlstone & Hitch, 2015).

Keywords

Short-term memory; verbal; musical; serial order; recall; list probe; dissociation process

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Influence of the home musical environment on phonological competencies in preschool children

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ABSTRACT

Background

In the early years of child development, music and language seem to share the same basic learning mechanisms for sound categories (Patel 2008; Lamb & Gregory 1993). In the last years many intervention studies with preschool children have shown that phonological competencies can be influenced by specially-designed short-time music training (Bolduc & Montésinos-Gelet 2005; Richards 2011; Degé & Schwarzer, 2011). A brief overview regarding the effects of such musical interventions on children's phonological competencies and reading skills can be gleaned from the meta-analysis of Wade-Woolley, Chan, Heggie & Sebok (2013). The positive effects of the Home Literacy Environment on the development of linguistic competencies (Niklas 2015) as well as the effects of the Home Musical Environment on the development of musical competencies in preschoolers (Etopio 2009; Kirkpatrick 1962) have already been thoroughly documented. However, research regarding the interrelations between aspects of a given Home Musical Environment and the development of phonological competencies is lacking.

Aims

To address this question regarding the influence of the Home Musical Environment on the development of phonological competencies, we operationalized five different components of the stable Home Musical Environment: (1) the child's formal participation in music-related hobbies; (2) the availability of and access to audio equipment; (3) the value of music in the home and parents' music-related activities; (4) familial home musical interactions; and (5) the child's frequency and duration of exposure to music. Then, we investigated their relationship to the development of phonological competencies (phonological awareness) and of musical competencies (music perception) in preschoolers.

Method

We examined 342 children (*mean age* = 54.82 months, *SD* = 4.37 months; 52 % girls) at the beginning and at the end of the second year in German kindergarten. We assessed their phonological awareness with four subtests; three of them (rhymes, segmentation of words, phoneme recognition in words) stemmed from a well-established test battery (BISC, Jansen, Mannhaupt, Marx & Skowronek, 2002). The fourth subtest (initial sound recognition) contained author-developed items. For measuring music perception abilities we used the musical game AUDIE (Gordon, 1989) which contains pairwise comparisons of short rhythmic and melodic patterns. The concept is similar others of Edwin Gordon's music aptitude tests. Music production abilities were also assessed but the corresponding results are not part of this presentation. To explore children's Home Musical Environments, parents completed a questionnaire including items regarding demographic data and the aforementioned five aspects regarding of the Home Musical Environment: (1) the child's formal participation in music-related hobbies; (2) the availability and access to audio equipment; (3) the value of music in the home and parents' music-related activities; (4) familial home musical interactions; (5) the child's frequency and duration of exposure to music. The questions concerning the Home Musical Environment were adapted from the HOMES inventory (Brand 1985) and author-developed items. The Home Literacy Environment was also assessed within this questionnaire but the corresponding results are not part of this presentation.

Results

Three repeated measurement ANOVAs (t1, t2 as repeated measures) were calculated for each of the five Home Musical Environment Variables [HMEV] as independent variable. In each case the three dependent variables consisted of phonological awareness [PA] (from BISC and author-developed items), rhythm [R] (from AUDIE) and melody [M] (from AUDIE). The five HMEV were separately aggregated from the items of the HOMES. We generated a dichotomous variable for each one. The exact categorizations will be explained along with the particular results under (1) to (5) below.

All of the fifteen ANOVAs showed a significant main within subjects effect for PA, R and M (PA, R, M: $p < 0.1$; PA: $\eta^2 = .234 - .348$; R: $\eta^2 = .199 - .300$; M: $\eta^2 = .179 - .281$). This can clearly be taken as evidence for the development of competencies at this age. For each ANOVA we tested the group-differences regarding HMEV at both measurement points with a t-Test for independent samples. A ceiling effect for the music perception abilities (R and M) was observed at t2 which may account for the lack of significant results. The exact results are illustrated below:

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(1) *The child`s formal participation in music-related hobbies:*

Coding of the dichotomous variable: The child participates in some formal music activity such as learning a musical instrument, singing in a choir, playing in a band etc. or it does not.

The t-Tests for PA at both measurement points [t1 & t2] were highly significant ($p < .01$; $\eta^2 = .054$). The t-Tests for R revealed a significant result for t1 ($p < .01$; $\eta^2 = .028$), but only an expected positive tendency for t2. The data for M showed only a distinct positive trend in general, but no significance (p = n.s.; $\eta^2 = .008$).

(2) *Availability of and access to audio equipment:*

Coding of the dichotomous variable: The median split of the additive variable implying the number of musical media (number of CDs, cassette tapes, records) and the existence of audio equipment (CD-Player, MP3-Player, cassette tape recorder, record player, radio, musical instruments, computer with audio-program).

At t1 and t2 the t-Tests for PA showed a highly significant result ($p < .01$; $\eta^2 = .068$). The t-Test output for R and M stayed just under significance, although a distinct positive tendency was observable.

(3) *Value of music in the home and parents' music-related activities:*

Coding of the dichotomous variable: This variable was analyzed separately for the father and the mother. It includes whether or not the parents themselves take part in musical activities or music-related hobbies (playing an instrument, singing in a choir, playing in an orchestra or a band).

Here we found in both cases that the t-Tests for PA at t1 and t2 were highly significant (for music-related involvement of the father: $p < .05$; $\eta^2 = .036$; of the mother: $p < .01$; $\eta^2 = .080$).

The t-Tests for R were significant at t1 for both the mother and the father, at t2 only for the mother (for music-related involvement of the father: $p < .05$; $\eta^2 = .016$; of the mother: $p < .05$; $\eta^2 = .031$). For M a non-significant trend was visible at t1 and t2 for both the father and the mother.

(4) Familial home musical interactions:

Coding of the dichotomous variable: Median split for the items singing and playing music together in the family (never until twice per month vs. daily until once per week).

Although the results concerning the familial home musical interactions showed a clearly positive tendency in general, the t-Tests could not pass significance for all competencies (PA, R and M) at both t1 and t2.

(5) The child's frequency and duration of exposure to music:

Coding of the dichotomous variable: Median split for the items concerning the amount of time the child spends singing, dancing, playing and listening to music.

In contrast to the results of the other four HMEV, a non-significant trend was visible at t1 and t2 for PA, R and M for this variable.

Conclusions

We conclude that there are effects of the Home Musical Environment on phonological competencies in preschool children. A diverse Home Musical Environment consisting of (1) the child's formal participation in music-related hobbies (2) the availability of and access to audio equipment, (3) the value of music in the home and parents' music-related activities, (4) familial home musical interactions, (5) the child's frequency and duration of exposure to music exerts a positive influence on the development of preschoolers' musical competencies. Furthermore, it can also stimulate their phonological awareness, a precursor of literacy competencies. Our data could not clearly uncover a positive effect of familial home musical interactions such as singing or playing music together or the frequency and duration of exposure to music on phonological competencies of preschoolers. This should be subject of further research. Further analysis will also have to control for socio-economic status, social and migration background, and cultural environment. The investigated positive effect of the Home Musical Environment on phonological competencies supports the idea that there is a connection between musical and phonological basic learning mechanisms for sound categories. It appears that a rich Home Musical Environment facilitates the development of these common learning mechanisms.

Keywords

Home Musical Environment, Phonological Competencies, Music and Language, Musical Skills, Musical Development

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A survey exploration of the links between levels of musical training and music listening behaviour

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ABSTRACT

There is a growing body of literature on music listening behaviour but few studies have investigated how this differs according to levels of musical training. The current study explored similarities and differences in the music listening behaviour of people with varying levels of musical training (MT). An online questionnaire explored general levels of engagement with music; levels of MT; uses of music; cognitive listening styles; and musical preferences. 657 participants completed the survey (mean age=29.57; SD=12.43). High levels of engagement were found across the sample (mean=19.26 out of total 24) but levels of MT represented a bimodal distribution (mean=6.21 out of total 17). Results showed significant positive links between level of engagement and most other variables, but different patterns were obtained for MT. There were significant positive links between MT and the use of music listening for work, regulating emotions, and other people's pleasure, but negative links between MT and using music for relaxation or exercise. Those with a higher level of MT were more likely to listen to the structural features of music and rated instrumentation, keys/mode/chords, harmonic decorations, being a live (rather than recorded) performance, and the quality of a recording/performance more highly than those with lower levels of musical training. Overall, data support previous research on everyday music listening, but go beyond previous studies by making detailed comparisons according to varying levels of engagement and musical training. The findings highlight the need to recruit a representative sample in terms of ages and levels of musical training.

I. INTRODUCTION

Music is ubiquitous in everyday life and fulfills a wide range of functions for individuals (Greasley, 2008; Juslin & Sloboda, 2010; MacDonald, Kreutz & Mitchell, 2012; Shäfer & Sedlmeier, 2009). Using a variety of methods such as ethnography, questionnaires, interviewing and experience sampling methodology, studies demonstrate the ways in which people use music to regulate mood and emotions, accompany everyday tasks, create and maintain identities, remind them of past events, contexts, people and places, and for enjoyment (see Lamont, Greasley & Sloboda, 2015 for an overview). However, less is known about how music listening behaviour is influenced by differing levels of musical engagement and training.

Recent research shows that people respond to and use music differently according to their general level of engagement (e.g. Greasley, 2008) though studies are only just beginning to look at this as a means of exploring differences in music listening behaviour (Greasley & Lamont, 2011; Ter Bogt et al. 2011). In a sample of young adults (age range 18-30), Greasley and Lamont (2011) showed that those with higher engagement were more likely to listen to a greater variety of music, had large and comprehensive collections, expressed urgency over hearing self-chosen music, typically used music in active ways (e.g. helping with an activity, enhancing a mood) and were more likely to be engaged in musical activities (e.g. performing, attending concerts). By contrast, less engaged listeners spent less time listening to music, were content to listen to music chosen by others (whether friends' musical choices or radio presenters' choices), had smaller music collections and were more likely to choose to hear music for passive reasons (e.g. to pass the time). If these findings are compared to the results of research by Ter Bogt et al. (2011) in the Netherlands some patterns can be identified. In their study they sought to create a typology of listeners based on the importance of music and uses of music. Participants (age range 12-29 years old) completed a questionnaire that measured the importance of music, uses of music, time spent listening, musical preferences, emotions felt during music listening and internalizing problem behaviour (e.g. coping with stress and feelings of depression). Results indicated three groups of listeners representing different levels of musical involvement. The 'High-Involved' group (20% of the sample) spent the greatest amount of time listening to music, had a greater breadth of preference, and rated the importance of music and uses of music more highly than the other groups. Those in the 'Low-Involved' group (6%) were positive about their use of music for mood enhancement but neutral regarding the importance of music in their lives, and negative about their use of music to serve coping and identity functions. The 'Medium-Involved' group (two-thirds of the sample) lay somewhere in the middle giving moderate ratings for the importance of music and their use of music to enhance moods and cope with stress. These findings lend strength to Greasley and Lamont's (2011) findings; in particular, the link between high engagement and the use of music for mood-regulation which has been found elsewhere (Saarikallio, Nieminen & Brattico, 2013). However, the characteristics of engagement reported in Greasley and Lamont (2011) and Ter Bogt et al. (2011) are based on the experiences of young adults. Other research has shown that age is a strong predictor of music consumption (Chamorro-Premuzic, Swami & Cermakova, 2012) indicating a need to consider a broad range of ages in studies. Another limitation in the previous studies is that neither explored links between musical training and listening behaviour. Ter Bogt et al. (2010) suggest that the ways in which people use music may have more to do with their level of engagement with music, rather than level of musical training, but this was not explicitly investigated in the research.

A systematic attempt to explore differences in listening behaviour according to gender and levels of musical training was carried out by Kreutz, Schubert & Mitchell (2008). Kreutz

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et al. developed music sympathizing (MS) and music empathizing (ME) scales which were based on the empathizer-systemiser (E-S) theory by Baron-Cohen (2003). This theory proposes that males are more likely to consider systematic qualities important (e.g. an understanding of the physical characteristics and behaviours of objects) whilst females are more likely to consider emotional aspects important (e.g. perceiving other people's emotions, responding in empathetic ways). Having developed the scales for music listening, they hypothesized that there would be gender differences in the MS/ME scores, and that higher levels of musical training would be associated with higher scores on the MS scale. Results showed that untrained males listened to music in a more systematic way than females, and that formal musical training was linked to higher MS scores in females, but not males. However, there was contradictory evidence regarding the link between musical training and scores on the ME scale (the first study did not show a link between MT and ME, but the second study did). Whilst recent research has employed the MS/ME scales to investigate differences in the perceived expressiveness of computer-generated performances (Schubert, De Poli, Roda & Canazza, 2014), to our knowledge no research has used the scales to explore differences according to gender and levels of musical training further.

Another questionnaire study explored links between music researchers' musical backgrounds, preferences and listening habits, and enjoyment of practical musical activities (Wöllner, Ginsborg & Williamon, 2011). They recruited 103 music researchers (age range 25-70 years, mean=42.44, SD=12.75); over half the sample had a PhD and 80% were currently working in Higher Education (e.g. university music, education or psychology departments, conservatoires; 35%, 8%, 14% and 23% respectively). The vast majority played an instrument(s) (97% had received instrumental and/or voice lessons in the past, and 66% had learned between two and four instruments (including voice) with a teacher). Levels of practice were higher among young participants, and those in senior positions (e.g. lecturer, research fellow) reported that they found it difficult to find the time to practice regularly due to work commitments. Results pertaining to listening habits showed that participants enjoyed listening to music more than performing music; that preferences clustered around classical instrumental, vocal and opera, and jazz/blues/RnB; and that younger respondents were more likely to be engaged in passive listening (defined as 'listening in the background, while you do other things') than older respondents who were more likely to be spending time listening actively (defined as 'listening carefully or on purpose, instead of doing other things as well'). Qualitative responses suggested that the use of music in a professional capacity may be associated with a reduction in time spent listening attentively. Regarding uses of music, 'pleasure and enjoyment' and 'motivates, excites or calms' received the highest ratings, confirming previous research which has shown that enjoyment and mood-regulation are considered to be the most important functions of music (e.g. Greasley & Lamont, 2011; Schäfer & Sedlmeier, 2009). Finally, 'emotional listening' (i.e. experiencing personal emotional responses to music) was rated more highly than 'analytical listening/concentrating on the structure' among this group of music researchers. Whilst this study was one of the first of its kind to focus explicitly on people with a high level of music education and training, this was expressed more broadly as musical engagement. However, one can be musically engaged without formal musical training (Bigand & Poulin-Charronnat, 2006; Greasley, 2008).

Saarikallio et al. (2013) draw a distinction between musical engagement and training in their study exploring music-related emotional self-regulation and affective responding to music. Drawing on previous research demonstrating a correlation between musical engagement (measured using ratings of the importance of music and amount of music listening) and the use of music for mood-regulation (measured using the Music in Mood Regulation (MMR) questionnaire)(see Saarikallio, 2006), the researchers explored both links between music-related emotional self-regulation and in affective responding to music, and professional training or informal musical engagement. No significant differences were found between the professional musicians (n=20) and non-musicians (n=24) in any of the affective response style factors or in any of the MMR strategies. In contrast, engagement (measured using weekly amount of music listening) was positively linked to overall MMR sore, and three emotion-regulation strategies: *Entertainment* (creating an atmosphere and maintaining positive mood), *Revival* (relaxing and getting new energy when stressed or tired), and *Diversion* (forgetting unwanted feelings with pleasant music). Saarikallio et al. conclude that emotion-regulatory use of music is not necessarily linked to musical training, but to heightened affective reactivity to music and heightened personal musical engagement through listening. Parallels are drawn with Bigand and Poulin-Charronnat (2006) who, through a series of cognitive studies, provided evidence that non-musicians can become "expert listeners" through daily exposure to music. Further evidence stems from Müllensiefen, Gingras, Musil & Stewart (2014) who developed the Goldsmiths Musical Sophistication Index (Gold-MSI) to measure self-reported individual differences in the general (non-specialist) population. A main finding was that active engagement with music listening can train certain musical abilities in the absence of formal musical training.

In summary, previous studies suggest that level of musical engagement may account for much of the variation in people's music use and preferences. Studies also show that level of musical training is linked to particular listening habits, such as greater levels of music systemizing, and the use of music to regulate emotions. Yet further research is needed to establish the nature of these associations. One aspect of previous studies that could be improved is the measurement of key variables. For example, Saarikallio et al. (2013) use only the 'weekly amount of music listening' to measure engagement whilst Wöllner et al. (2011) measure musical engagement using a range of questions regarding musical training, current musical activities and the relationship of musical activities to the individual's research. The current study develops both musical engagement and training scales to explore links between cognitive listening

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styles, uses of music, stylistic preferences and the importance of musical characteristics.

II. METHOD

A. Participants

Pilot study: 14 participants (6 females, 8 males; age range 18-53; mean age=36.07, SD=11.28) were chosen from friends, family and work colleagues to reflect individuals with varying ages, and differing levels of musical engagement and training. This included two participants who stated that they had a low level of engagement with music and no musical training through to a professional singer, a music lecturer, and a sound engineer.

Main study: 657 participants (373 females, 57%; 284 males, 43%) age range 16-79 (mean age=29.57, SD=12.43) were recruited through on-line methods (e.g. emails to university lists, social networking sites), and comprised individuals from a wide range of vocations (e.g. university professor, physician, librarian, fire-fighter, retail sales assistant, vet, IT director), students, unemployed, and those who were retired. Participants were mainly from the UK (95%), with a small number from Europe (e.g. Germany, Sweden, The Netherlands, Spain) and further afield (e.g. USA, Canada, China).

B. Questionnaire design

The online questionnaire (copy available by contacting the first author) was hosted on eSurveysPro for several months. It consisted of eight sections which were designed to be relevant to both musically trained and non-trained participants.

Section 1 asked for demographic data including gender, age, geographical location, nationality, academic qualifications, employment status, and (where applicable) job title.

Section 2 explored levels of musical training. Participants were asked whether they had ever engaged in various activities (e.g. learned one or more instruments, performed in a musical ensemble, had singing lessons, composed music, improvised music, mixed on decks, conducted an ensemble). Scores ranged from 0 ('none of the above') to 7 (all activities). The second item asked participants to indicate the highest level of music education they had achieved or were currently studying for (e.g. GCSE, A-Level, Undergraduate degree). Scores ranged from 0 ('None') to 6 ('Doctorate in music'). The third item asked about performing experience (e.g. 'I used to play an instrument (or sing) years ago'). Scores ranged from 0 ('I have never played an instrument') to 5 ('I play several instruments to a high level e.g. Grade 8). Finally, participants were asked to expand on their responses in an open-ended way. Scores across the three quantitative items were summed (minimum = 0, maximum score = 17). Cronbach's alpha for the three musical training items showed good internal consistency (α=0.875).

Section 3 asked participants to rate their agreement with various music engagement statements derived from previous studies on music listening behaviour (Greasley, 2008; Greasley et al. 2011; Ter Bogt et al., 2011; Saarikallio et al., 2013). This included the importance of music, frequency of music listening, preferred level of control over music listening and size of music collection. Participants were also asked whether they usually acquire music as a result of other people, whether music was part of their job, and to rate their enthusiasm for talking to others about music they like. A principal components analysis (PCA) identified two components across the statements. Component 1 explained 46% of the variance (Eigenvalue 3.69) using all 8 engagement items and Component 2 explained 14% of the variance using 5 engagement items (Eigenvalue 1.18). The components plot highlighted two items that did not cluster with the other six ('I engage with music everyday as part of my job' and 'I tend to acquire music as a result of other people, rather than purchasing it myself', the latter being negatively scored in line with the findings of Greasley, 2008). PCA on the six items identified one factor which explained 61% of the variance (Eigenvalue 3.67) so the six items were used. Cronbach's alpha for the six engagement items showed good internal consistency (α=0.870).

Section 4 explored cognitive listening styles using the music-systemiser (MS) and music-empathiser (ME) scales developed by Kreutz et al. (2008) to explore preferred musical features and functions of music listening. MS items focused on systematic qualities (e.g. 'I like hearing the different layers of instruments and voices in a song/piece of music', 'I am interested in understanding the structure of a piece of music') whilst the ME items focused on emotional responses (e.g. 'I can easily sense how a performer feels while playing music', 'I am able to identify with the singers/writers of my favourite music'). Many of the MS/ME items were negatively worded (e.g. 'I am not intrigued about the physics and acoustics of musical instruments'). Several participants in the pilot study noted that this section had too many double negatives and did not flow well, however rather than adapting the wording the items were kept identical to allow for comparison with the previous study. Cronbach's alpha for the nine MS items showed good internal consistency (α=0.818; Kreutz et al., 2008, MS α=0.81). PCA showed one component that explained 44% of the variance (Eigenvalue 3.93). Cronbach's alpha for the ME scale was higher than in the original study (α=0.839; Kreutz et al., 2008, ME α=0.69). PCA revealed one component that explained 45% of the variance (Eigenvalue 4.01).

Section 5 asked participants to rate the extent to which they used music to fulfil a variety of functions in everyday life (e.g. 'to help me concentrate/think', 'to help me relax', 'to help me carry out daily activities', 'to help me exercise'). These were based on previous studies of listening in everyday life (e.g. Greasley & Lamont, 2011; North et al., 2004).

Section 6 explored the extent to which participants felt that musical features (e.g. voice, instrumentation, keys, chords, lyrics) influenced their musical preferences and listening behaviour. The pilot study highlighted that this section was biased towards classical music. To make it more representative of different musical styles, further items were added for the main study (e.g. 'rhythm/beat', 'tempo', 'synthesisers').

Section 7 asked participants about their musical preferences. Most studies of musical preferences have asked participants to rate their preferences from a list of predetermined styles (e.g. Bonneville-Roussy et al., 2013; Rentfrow, Goldberg & Levitin,

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2011) or to choose one style that most accurately describes them (e.g. North & Hargreaves, 2007). Yet qualitative research exploring the breadth, content and rationale of preferences has shown that people prefer a wide range of styles (rather than just one or two); experience difficulties in assigning stylistic categories to their preferences; and that the meaning of different style categories differ from person to person (Greasley, 2008). In light of these prior findings, participants in the current study were first asked to give as much detail as possible about the music they enjoyed listening to (e.g. styles, artists, composers). After this, participants responded to the question 'If you were asked to state your three most preferred styles of music, could you?', and statements ranged from 'Yes, I can easily pick three most preferred styles' through to 'I couldn't possibly choose because I like a wide range of styles and artists'. Those who were able to identify three preferred styles were asked to list them. Finally, another open-ended question asked participants to describe the ways in which they used their preferred music.

Section 8 explored personality using the 60 item NEO-FFI (Costa & MaCrae, 1992) which maps five traits: extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience. Results pertaining to personality traits will be written up elsewhere, and are not included in the current paper.

Ethical clearance was obtained (UoL, AREA 09-068) and the research was conducted in accordance with the British Psychological Society's Code of Ethics and Conduct (2009). The questionnaire took 40 minutes to complete, so an incentive (random prize draw; 2 x £50 cash) was provided. Analysis focused on similarities and differences in the music listening behaviour of people with differing levels of musical training.

III. RESULTS

Results report general trends in musical preferences and listening behaviour across all participants (including skewness, kurtosis and Kolmogorov-Smirnov (K-S) normality statistics) and compare the responses of participants with differing levels of musical training.

A. Age

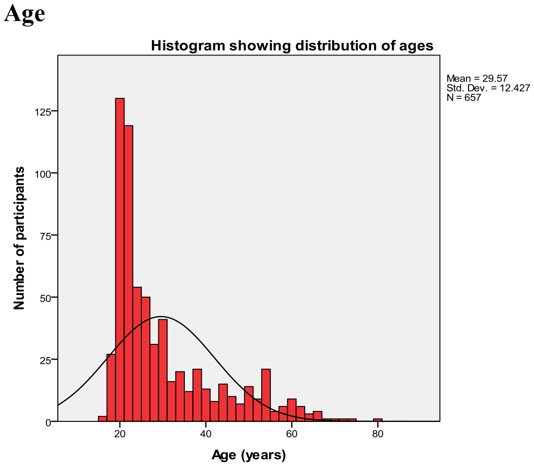

Figure 1. Age distribution

The age range was 16-79, with a mean of 29.57(SD=12.43). The distribution of age was positively skewed (skewness=1.377, kurtosis=1.058, K-S D(657)=.195, $p<.0001$); over 70% were under 30 years old (see Figure 1).

B. Levels of Musical Training

Scores ranged from 0 (no formal music education or prior engagement in any musical activities) to 18 (have engaged in a range of musical activities, pursued formal music education to a doctorate level, and play several instruments to a high standard). The mean score was 6.21(SD=4.51), and the mode was 3. Figure 2 shows a bimodal distribution (skewness=0.415, kurtosis=-1.081, K-S D(657)=.195, $p<.001$). 59 of the 657 participants scored 0 indicating (9% of the sample) whilst at the other end of the scale, only 1 participant (a PhD student from Canada studying music) scored 17 (0.002%). 345 participants scored between 0 and 5 (53%), whilst 123 scored 12-17 (19%). There was a negative correlation between age and level of musical training ($r=-.213$, $p<.0001$). Percentiles were used to split the sample into none/low (score 0-3 inclusive, n=247, 38% of the sample), moderate (n=198, 30%) and high training (n=212, 32%) for further analyses.

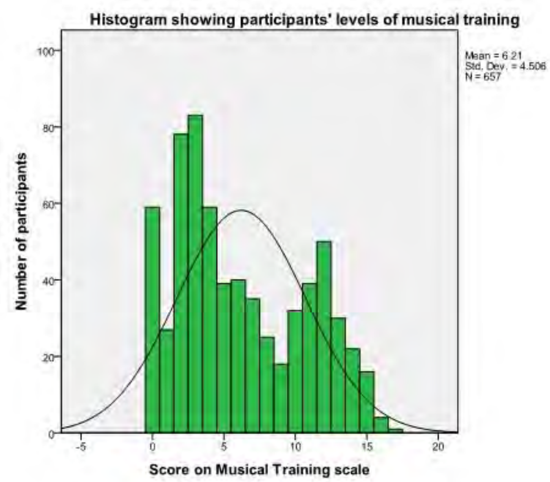

Figure 2. Participants' musical training scores

C. Levels of Musical Engagement

Scores on the six musical engagement items ranged from 6 (strongly disagree with statements regarding the importance of music, frequency of listening, amount owned etc.) to 24 (consider music very important, listen frequently, own a large collection etc.). Across all participants, the mean score was 19.26 (SD=4.16), and the mode 23. Figure 3 shows a negatively skewed distribution (skewness=-1.262, kurtosis=1.300, K-S D(649)=.147, $p<.0001$). Therefore whilst level of musical training varied greatly, most of the sample were highly engaged with music according to the measure developed in this study.

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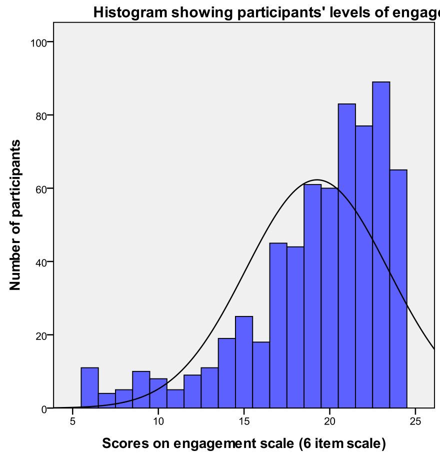

Figure 3. Participants' musical engagement scores

There was a negative link between age and level of engagement (r=-.130, p < .001) supporting research which has shown that musical engagement is highest in young adulthood and decreases with age (Bonneville-Roussy et al., 2013). Not surprisingly, there was a significant link between participants' levels of engagement and training (r=.172, p <.0001). Due to the data skew, it was not possible to split participants into groups of varying levels of engagement for further analyses.

D. Music Systemising and Empathising (MS/ME)

Scores on the MS scale (n=365) ranged from 9 to 36 (representing the full range of the scale), with an average of 25.51(SD=5.01) and a mode of 26 (skewness=-0.525, kurtosis=-0.059, K-S D(635)=.085, p<.0001)(see Figure 4). There was a significant difference (H(2)=88.79, p<.001) in MS scores between the musical training groups: none/low (mean=23.41, SD=4.68), moderate (mean=25.71, SD=5.04), high (mean=27.66, SD=4.36). This provides support for Kreutz et al. (2008) who found that professional musicians scored significantly higher on the MS scale than amateurs or non-musicians. Males (mean=26.22,SD=4.75) were more likely than females (mean=24.71, SD=5.02) to score highly on the MS scale (U=60,680, p<.001), again supporting the findings of the original study. There was a significant positive correlation between scores on the engagement and MS scales (r(635)=.468, p<.001). Significant positive correlations with engagement were found across every item on the MS scale.

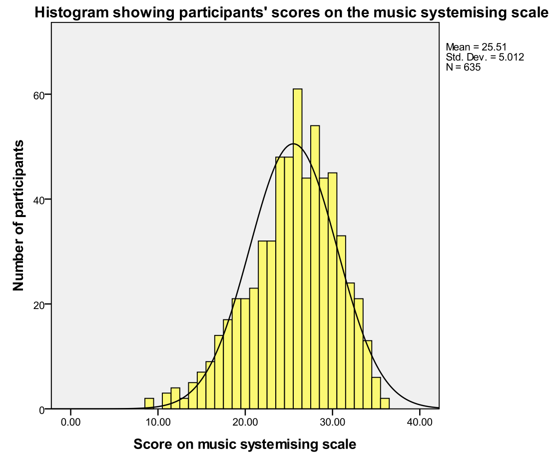

Figure 4. Participants' Music Systemising Scores

Scores on the music empathizing scale (n=365) ranged from 9 to 36 (representing the full range of the scale), with an average of 26.52 (SD=4.80) and a mode of 27 (skewness=-0.417, kurtosis=-0.150, K-S D(635)=.082, p<.0001)(see Figure 5). There was a significant difference between the musical training groups and ME scores (F(2,623)=9.12, p<.001); none/low (mean=25.55, SD=4.67), moderate (mean=26.67, SD=4.82), high (mean=27.46, SD=4.75) musical training. This supports Kreutz et al. (2008) who found that professional musicians scored significantly higher on the ME scale than amateurs or non-musicians. Contrary to the findings of Kreutz et al. (2008), there were no significant differences (t(633)=1.34, p=.180) in ME scores between males (mean=26.23, SD=4.75) and females (mean=26.74, SD=4.84). There was a significant positive correlation between total engagement score and ME score (r(635)=.500, p<.001). Significant positive correlations with engagement were found across every item on the ME scale.

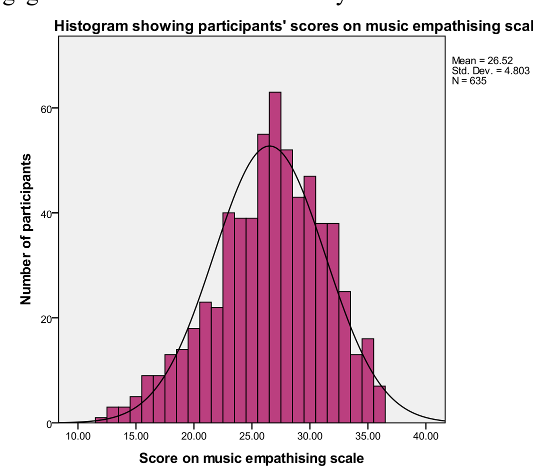

Figure 5. Participants' Music Empathising Scores

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E. Uses of music

Across all participants, the most prevalent function of music listening (n=625 respondents) was 'for pleasure' (97% ticked strongly agree or agree) followed by 'to help me relax' (92%) and 'to create, accentuate or change an emotion/mood' (88%). Other common functions were 'to help create the right atmosphere' (89%), 'to help me carry out daily activities' (85%) and 'to bring back certain memories' (84%). The modal response across these six functions was 'strongly agree'. The modal response for all other functions (e.g. 'for other people's pleasure', 'to pass time', 'to distract me', 'to help me exercise', 'out of habit', 'to feel less alone', and 'to help me think/concentrate') was 'agree' apart from 'for work-related purposes' for which the mode was 'strongly disagree'.

There were significant correlations between every use of music item and level of engagement (to the $p<.001$ level), suggesting that those who are more highly engaged use music to fulfil a variety of different functions in everyday life.

Table 1. Uses of music by level of musical training group

	Level of musical training (mean, SD)		
Uses of music	**None/low**	**Moderate**	**High**
Concentration	2.54(1.02)	2.48(1.01)	2.51(1.04)
Distraction	2.87(.95)	2.92(.88)	2.90(.99)
Relaxation	3.46(.72)	3.52(.65)	3.41(.76)
Daily activities	3.25(.83)	3.20(.85)	3.32(.82)
Work-related	1.72(.91)	1.87(.99)	3.02(1.04)
Exercise	2.82(1.09)	2.72(1.08)	2.71(1.08)
Atmosphere	3.29(.75)	3.36(.66)	3.31(.83)
Memories	3.27(.82)	3.28(.81)	3.24(.79)
Emotion/mood	3.25(.83)	3.39(.69)	3.42(.74)
Pleasure	3.73(.52)	3.82(.52)	3.74(.64)
Others' pleasure	2.98(.88)	3.14(.82)	3.24(.81)
Pass time	2.88(.93)	2.90(.94)	3.03(.95)
Feel less alone	2.48(1.04)	2.67(1.06)	2.75(1.00)
Out of habit	2.65(.93)	2.66(.98)	2.88(.98)

Differences in uses of music according to level of musical training were explored (see Table 1 for means and SDs). Those with a higher level of musical training were more likely to use music for work-related purposes ($F(2,622)=111.31$, $p<.001$), to change, accentuate or change an emotion/mood ($F(2,622)=3.09$, $p=.046$), for other people's pleasure ($F(2,622)=5.26$, $p=.005$), to help them feel less alone ($F(2,622)=3.92$, $p=.020$) and out of habit ($F(2,622)=4.09$, $p=.017$).

F. Musical preferences

Responses to the open-ended question 'What music do you like listening to?' resulted in over 50 pages of written text. Responses ranged from brief answers such as 'House, soul, jazz, blues, everything', 'Indie, Alternative, Rock, RnB, Electric' and 'Open to everything' to more detailed descriptions, such as:

"As much detail as possible, eh? This might turn into an essay... I like a very eclectic range of popular music, including but not limited to: indie, alternative rock, classic rock, folk, mainstream pop, hip hop, soul, funk, blues, country, reggae, dancehall, ska, punk and post-punk/new wave, disco, garage rock, rock'n'roll, psychedelia, etc., etc., etc. I'm less interested in, but have made more-or-less rewarding excursions into, jazz, classical music, dance music (e.g. house, techno). It's difficult to pick out unifying features of the music I listen to, but I think it's fair to say the following are quite common characteristics: 1. It almost always has interesting, preferably poetic, lyrics. Music that doesn't incorporate lyrics at all has to possess some other feature to an outstanding degree (e.g. inventiveness, emotional expressiveness), to overcome my instinctive indifference. 2. It features a voice that expresses, or appears to express, the personality of the singer. I hate voices that have had all personality trained out of them, like you get in musical theatre. I also find this off-putting in opera. Technical proficiency in singers is more-or-less completely unimportant to me, as long as they've got an expressive quality. 3. Not only in voices, but across the board, it prioritises expressiveness and inventiveness over technical proficiency. Not that I have anything against technical proficiency, but expressive, inventive music played by people who can barely play their instruments (e.g. The Slits) is infinitely preferable to boring, competent music played by soulless virtuosos (e.g. Eric Clapton). 4. Music is usually more interesting to me if it expresses an outsider's point of view to some extent. Five of my favourite artists: The Smiths, Bob Dylan, The Fall, The Pet Shop Boys, The Kinks."

Others focused on preferred artists/producers/composers rather than musical characteristics:

"Primarily electronic music: Drum & Bass, Jungle. Minimal Techno, Dub Reggae - plus 90s Hip Hop Artist examples: Teebee, Break, Photek, Calyx, Phace, Masheen, Spor, Noisia, Commix, Lifted Music, Citrus, Subtitles, DSCI4, Cyantific, Moving Shadow, Silent Witness, Quarantine, DNAudio, 31 Records, C4C, Jade, Mindscape, Corrupt Souls, BSE, Infiltrata, Hochi, Ewun, Chris SU, SKC, Stakka, Skynet, Optiv, Nphect, Dizplay, Upbeats, Dom & Roland, Ed Rush, Optical, Spirit, Fierce, Tactile, State of Mind, Raiden, Loxy, DKay, Unknown Error, Rascal & Klone, Future Prophecies, EBK, Identity, K, Polar, CLS, Mav, Icicle, Nymfo, Sasha, Digweed, Klute, Wu Tang, GZA, RZA, Method Man, A Tribe Called Quest, Prizna, Q-Project, Remarc, Capone, Firefox, Stanton Warriors, Si Begg, Richie Hawtin, Kompakt Records, Kemal, Konflict, Doc Scott, Lomax, Allied, Quadrant, Audio, Kryptic Minds, Spectrasoul, Sudden Def, Logistics, Trace, Telemetrik"

"Mainly classical composers. Tastes quite eclectic, from Renaissance (Vivaldi, Albinoni. Orlando Gibbons) through Baroque (Bach, Handel), classical (Mozart), Beethoven, Romantic (Tschaikovsky, Rachmaninov, etc etc etc). Songs by recents composers (Vaughan Williams, Benjamin Britten) Also voice such as Sophie von Otter and opera (I prefer to watch rather than just listen - for the overall theatrical experience). I like some modern artists and occasionally voice adaptations of orchestral/instrumental music (Bach for instance) I listen to CDs at home or Radio 3. I enjoy going to live performances of

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orchestral music or opera, and very occasionally modern artists (Jules Holland, Judith Durham)"

Many participants highlighted the difficulties in addressing this question within the context of a questionnaire:

"personally, I feel this is an impossible question to answer as I have a large and very eclectic collection which includes rock, punk, indie, soul, roots reggae, world music, psychedelic and folk, music both old and modern"

"variety is the most important factor for me, and different types of music are for different moods. I couldn't even possibly start to explain here as music is pretty much my life"

One participant simply wrote 'there is not space to answer this question', and another sent a link to his most recent Spotify playlist to save time. Mood and environmental factors (i.e. different context, presence/absence of others) were cited as key influences on preferences in the descriptions, for example:

"Depends on context - dance music (techno and pys trance) when out partying, indie music particularly female vocalists when at home (Florence and the Machine, Adele but also bands like The Script, Elbow, Muse). Ambient music late at night Instrumental music – electronic – when friends are over. Dolly Parton as a guilty pleasure!"

The second item asked participants to tick the statement that most closely applied to them. Some ticked more than one statement. Of those who ticked one (n=537), 25% could easily identify three most preferred styles, 27% felt they could pick three styles after some thought, 4% could only think of one most preferred style, 10% did not agree with categorizing preferences into styles, 29% said that they could not choose because they liked a wide range of styles and artists, and 5% indicated that their preferences changed on a daily basis. There were no significant differences (n=537) in musical preference statements according to musical training group $\chi^2(10)=17.83$, $p=.058$. Those who could identify three preferred styles were asked to note what these were. The final preference item was open-ended and asked participants to describe the ways in which they used their preferred music. Responses were as varied as the responses to the question of what music they liked, though the use of different music styles to accompany different activities (e.g. "depends on what I am doing at the time") and for mood-regulation (e.g. "choice of style depends entirely on my mood at the time") were recurrent themes.

G. Preference for musical characteristics

The most preferred musical characteristic across all participants was 'voice' followed closely by 'instrumentation' and 'rhythm/beat' (see Table 2). There were significant correlations between preference for all musical characteristics and modes of listening and musical engagement (at $p<.001$).

Table 2. Participants' ratings for musical characteristics and mode of listening

Musical characteristic	Mean (SD)
Lyrics	3.03(.86)
Voice	3.35(.76)
Instrumentation	3.32(.76)
Synthesisers	2.27(.87)
Keys/mode/chords	2.76(.89)
Harmonic decorations (e.g. cadences)	2.68(.91)
Rhythm/beat	3.29(.75)
Tempo	2.99(.85)
Being a live performance	2.32(.96)
Quality of recording/performance	3.08(.84)
Listening through a good sound system	2.83(.90)
Ability to listen on portable equipment	2.70(1.03)

Table 3. Preference for musical features and mode of listening by musical training group

	Level of musical training (mean, SD)		
Musical features	**None/low**	**Moderate**	**High**
Lyrics	3.18(.78)	3.08(.85)	2.81(.90)
Voice	3.36(.72)	3.41(.72)	3.29(.83)
Instrumentation	3.21(.78)	3.38(.73)	3.39(.76)
Synthesisers	2.36(.84)	2.24(.88)	2.20(.87)
Keys/mode/chords	2.54(.86)	2.78(.88)	2.97(.88)
Harmonic decorations	2.43(.89)	2.68(.91)	2.96(.86)
Rhythm/beat	3.29(.69)	3.33(.75)	3.24(.82)
Tempo	3.05(.77)	3.01(.85)	2.89(.91)
Being live perf.	2.19(.93)	2.28(.96)	2.51(.96)
Quality of record/perf	2.99(.81)	3.04(.85)	3.21(.84)
Good sound system	2.76(.89)	2.85(.90)	2.88(.92)
Portable equipment	2.74(1.05)	2.74(1.06)	2.63(.97)

Differences according to level of musical training were found (see Table 3 for means and SDs). Those with a higher level of musical training were more likely to rate instrumentation ($F(2,621)=3.63, p=.027$), keys/mode/chords ($F(2,621)=13.18$, $p<.001$), harmonic decorations ($H(2)=39.41, p<.001$), being a live performance ($F(2,621)=6.42, p=.002$), and the quality of the recording or performance ($F(2,621)=3.91, p=.021$) more highly. Those with a lower level of musical training were more likely to rate lyrics as important ($F(2,621)=11.08, p<.001$).

IV. DISCUSSION

The current study explored the music listening behaviour of people with varying levels of musical engagement and training. In order to achieve this, measures of musical engagement and musical training were developed drawing on previous research.

H. Development of scales

The musical engagement scale items included the importance of music, frequency of music listening, level of preferred choice over music listening, size of collection, encouraging others to

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listen to like music, and talking to others about preferred music. Two items that did not show internal consistency were 'I engage with music everyday as part of my job' and 'I tend to acquire music as a result of other people, rather than purchasing it myself'. The former may result from the fact that professional musicians and music educators and researchers form a relatively small portion of the UK population. Acquiring music from others was intended to tap into low engagement as studies show that those with low levels of engagement tend to listen to what others are playing (Greasley, 2008; Greasley & Lamont, 2011); however the same studies also provide evidence that highly engaged listeners also acquire music from other people (indeed, they actively seek new music from others) so the item was considered contradictory. The six item measure could be used in future studies given its high internal consistency, though an area for improvement would be to use 5- or 7-point Likert scales (the current study used a 4-point Likert scales for all variables to maintain consistency with the ME/MS scales, as 4-point Likert scales were used in Kreutz et al., 2008).

The musical training scale consisted of three quantitative items relating to the breadth of musical activities participants had engaged in, level of formal music education, and levels of performance expertise (ability to play one or more instruments, and to what level). A fourth musical training item asked participants to explain their answers in an open-ended way. Both authors attempted to code the biographical data into three groups to explore the degree to which these mapped onto the groups derived using percentiles but this was fruitless due to the complexities of the responses (e.g. does someone who learned the clarinet for two years and sang in an choir for two years have the same level of performance training as someone who learnt to play the violin for five years but never had singing lessons?). There was very high internal consistency across the three quantitative items, suggesting that this measure could be used in future studies, though as with the engagement scale, ratings should be 5- or 7-point Likert rather than 4-point.

I. Main findings

Results showed significant links between engagement and all other variables including scores on MS and ME scales, uses of music, and preference for particular musical characteristics. This suggests that highly engaged individuals are more likely to use music to fulfil a variety of functions, and enjoy a wide range of styles and characteristics, in line with previous research (Greasley & Lamont, 2011; Ter Bogt et al., 2011).

Different patterns were obtained for levels of musical training. There were significant positive links between musical training and use of music for work-related reasons (as would be expected), regulating emotions, and for other people's pleasure, but negative links between musical training and using music for relaxation or exercise. Those with a higher level of musical training were more likely to listen to the structural features of music and to rate instrumentation, keys/mode/chords, and harmonic decorations as important. They were also more concerned with performances being live (rather than recorded), and the quality of a recording/performance than those with lower levels of training. These findings support Kreutz et al. (2008) who found a link between high levels of musical training and music systemising, though contrary to the results of the original study, musical training was also significantly linked to music empathising. This suggests that those with high levels of musical training who are more likely to focus on the structural features of music are highly likely to be engaging in emotional listening as well. This latter result supports the findings of Wöllner et al.'s (2011) with music researchers and Saarikallio et al.'s (2013) with professional musicians and non-musicians.

Gender comparisons showed that males scored significantly higher on MS, as found in Kreutz et al. (2008), but no significant differences were found between males and females in ME scores which is in contrast to the findings of the original study. The ME and MS scales showed high levels of internal consistency. However, when asked to feedback on the design of the questionnaire at the end, many participants wrote that the MS and ME scales were frustrating because of the prevalence of double negatives. It would be useful to reword items on the scales and use 5- or 7-point Likert ratings in future research.

Explorations of musical preferences presented a challenge in the current study. The complexities of responses given by the participants underlined the need to ask about preferences in an open-ended way, however the responses were too difficult to interpret thematically and thus conclusions about differences according to levels of engagement or training could not be drawn. Using predetermined style categories would have enabled systematic comparisons but would have been restrictive and may have resulted in objections from highly engaged individuals, as has been found in previous research studies (e.g. Greasley, Lamont & Sloboda, 2013). Measuring preferences in a meaningful way presents an enduring challenge for the field of music psychology (Greasley & Lamont, 2015).

Over 70% of the participants were under 30 years old. It was unsurprising therefore that general levels of engagement were high across the sample. Recruiting a greater number of older participants is likely to result in a greater distribution of engagement scores, facilitating more detailed comparisons.

In summary, the current study has developed musical engagement and training scales to measure links between cognitive listening styles, uses of music, style preferences and musical characteristics. Data support established trends in music listening, such as the link between high engagement and the use of music to fulfil various functions, and the link between high levels of musical training and music systemising, but add to literature on listening behaviour by highlighting differences in uses of music and preferred musical characteristics among people of differing levels of musical training.

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Hearing aids for music: Exploring initial findings from questionnaire and interview studies

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ABSTRACT

Background

Research has shown that music is an important part of people's lives which can have significant health and well-being benefits (Greasley, 2008; Greasley, Lamont & Sloboda, 2013; Macdonald, Kreutz & Mitchell, 2012), including those with mild, moderate, severe or even profound deafness (Fulford, 2013). However little is known about the music listening experiences and behaviour of this subset of the population because existing studies have focused on 'normally' hearing participants.

There are over 10 million deaf and hearing impaired people in the UK (AoHL, 2011) and this figure is rising, largely because people are living longer resulting in a higher incidence of (age-related) presbycusis (DoH, 2015), but also due to a lack of awareness among people (both young and old) of the damage that can be caused through prolongued exposure to loud music (Bennett, 2007). It is estimated that 20% of the UK population will have a hearing impairment by 2031, and those affected are more likely to experience social isolation and increased mental and physical problems (AoHL, 2011; Commission on Hearing Loss, 2014). Given the prevalence and known benefits of music listening, it is important that studies start exploring how hearing impairments and the use of hearing aid (HA) technology affect music experiences and behaviour.

For those with a hearing impairment, digital HAs are the most common technological tool used to assist verbal-aural communication with other people. Recent estimates suggest that there are around two million HA users in the UK but that nearly three times this number would benefit from wearing HAs (Commission on Hearing Loss, 2014). HAs include complex signal processing algorithms such as frequency compression, automatic gain control and non-linear amplification to selectively amplify speech sounds, yet such complex digital signal processing can have a negative effect on music listening. This is because musical acoustics are significantly different from those of speech in a number of ways, including dynamic range and intensity levels; crest factors; and frequency range (Chasin & Hockley, 2014; Tozer & Crook, 2012).

A recent survey of HA users by Madsen and Moore (2014) was designed to assess whether HAs improve or worsen music listening experiences and to establish the nature and prevalence of any problems. Results showed that whilst HAs were helpful for listening to both reproduced and live music, making sounds clearer and enhancing a person's ability to hear individual instruments, more than 33% of HA users reported experiencing feedback during music listening and more than 50% reported experiencing distortion. Furthermore, 25% reported that HAs made the louder parts of music too loud and those with low frequency hearing loss reported they did not receive sufficient gain from their HAs. Qualitative evidence from interviews with musicians has shown that digital HAs can cause distortions to pitch and volume in music listening and performing contexts over which the HA wearer has little control (Fulford, Ginsborg & Greasley, 2015).

There are ways of optimising HAs for music, including the adjustment of peak input and output-limiting levels, frequency compression, feedback cancellation, noise reduction and microphone directionality (Chasin & Hockley, 2014; Tozer & Crook, 2012). Some HAs include programs designed to aid music perception, yet there is evidence that these are not very effective. Madsen and Moore (2014) found that out of 523 participants, only 198 had a special program for music. Having a music program was positively associated with being able to hear individual instruments, but no other group differences were found, indicating a need to improve music programs on HAs. Furthermore, Leek et al. (2008) explored the prevalence of music-listening difficulties among a sample of elderly HA wearers and showed that whilst developments in HA technology had gone some way to reducing problems in music enjoyment, between 25-30% still experienced problems.

In addition to the issues relating to the amplification of music using digital HAs, another key issue is that audiologists and teachers of the Deaf do not typically receive formal training on fitting HAs for music. The majority of audiology courses are four years in duration with little, if any, instruction on music perception. An audiology student might be able to access a module on music perception at Master's level in select institutions. Accessing practical advice may therefore be a problem for HA users. There is also anecdotal evidence that audiologists have low confidence in fitting HAs for music, although further research is needed.

The UK-based charity Music and the Deaf regularly receives emails requesting advice about the best HAs for music and Musician's Hearing Service in London provides a specialist audiology service. Furthermore, organisations such as the Association of Adult Musicians with Hearing Loss (US) and the Musicians' Clinics of Canada exist to provide advice and support. Yet the provision of, and access to, HAs varies by healthcare system and country. A new, AHRC-funded, UK-based project entitled 'Hearing aids for music: exploring the music listening behaviour of people with hearing

impairments' aims to explore how music listening behaviour is shaped by deafness, hearing impairments and, specifically, the use of HA technology in order to identify ways in which users of HA technology can improve their music listening experiences. The methodology for two initial studies is introduced here.

Method

The first study is a questionnaire distributed to NHS patients attending the Sheffield Hospitals Hearing Service and one private audiology clinic in London, Harley Street Hearing. The questionnaire contains only four questions with both a rating scale and an open-ended response for each, asking participants whether they experience any problems with music listening, the extent to which this affects their quality of life, whether they have discussed music listening with their audiologist and the degree to which this has improved their musical experiences. Participants are asked to leave their contact details if they are willing to take part in a follow-up interview. The second study will employ interviews to explore music listening experiences of people using HA technology in greater depth. The sample will include people who have been i) deaf since birth or childhood and ii) those with presbycusis in proportions that are representative of the population. It will also include musicians and non-musicians to allow for an in-depth exploration of differences between people according to age, specific HA technology used, and levels of musical training. Recruitment channels include participants from the first study, word of mouth, and via the charity, Music and the Deaf. Participants will be asked about their past and current music listening practices, how their hearing impairment has influenced their music listening behaviour over time and their experiences of using HAs in musical settings. They will also be asked about their experiences of HA fitting with audiologists to explore the different techniques and strategies used, successes and/or problems, and support received from their audiology professional or HA fitter with regard to music listening. Audiometric data will also be gathered, either from existing records (if less than 2 years old) or new tests, to facilitate the interpretation of the qualitative accounts.

Analysis and Results

Questionnaire data will indicate the prevalence of music listening issues among HA users and the extent to which this impacts on quality of life. The degree to which participants have discussed music listening with their audiologists and the degree to which this has been useful will also be explored. Responses will be analysed using thematic analysis and QSR NVivo software to detect the frequency of recurring themes within the data. Descriptive statistics will also be used to summarise Likert-scale responses. Interview data will further explore how hearing levels affect participants' listening behaviour over time and their experiences of using HA technology in everyday and musical settings. Audio recordings will be transcribed, entered into NVivo and coded. A hierarchical network may also be applied to facilitate a visual representation and organisation of the data. Approaches such as Interpretative Phenomenological Analysis may be applied to a limited number of case studies that warrant a more in-depth approach. The interpretation of participants' verbal accounts will be facilitated by audiometric data summarising the type, level and nature of their hearing loss.

Conclusions

The present studies aim to address a lack of systematic data collection around the subject of HA use for music listening by applying methodologies from social and music psychology to the examination of behaviour and perceptual processes. The results of the first two studies will inform the design of a large-scale, national survey which will identify wider trends in the music listening behaviour of HA users. As part of the project's wider aims, these data will be used to create a website, online discussion forum and advice leaflet for users of HA technology of all ages to improve their access to music.

Keywords

Music listening behaviour, hearing impairment, musical training, hearing aid technology

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Rules of engagement: The structure of musical engagement and its personality underpinnings

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ABSTRACT

Background

There is clear anecdotal evidence for individual differences in musical engagement. For some listeners, music is like 'sonic wallpaper' (a feature that remains in the periphery in everyday life), while for others music is like a religion (their favourite musicians become their heroes and they go to music for an enlightened emotional or spiritual experience). People also vary in the style in which they engage with music. Some listen to music with deep intellectual concentration and little physical movement. Some become nostalgic and are moved to tears. Others move physically to music: they tap their foot, nod their head, dance, and in some cases jump up and down as seen in mosh pits at heavy metal concerts.

We identified six previous measures that examine individual differences in musical engagement or related constructs. These include the Uses of Music Inventory (15-item self-report) by Chamorro-Premuzic & Furnham (2007); Music Use Questionnaire (MUSE: 58 or 32-item self-report) by Chin & Rickard (2012); Barcelona Music Reward Questionnaire (BMRQ: 20-item self-report) by Mas-Herrero, et al. (2013); Goldsmiths Musical Sophistication Index (Gold-MSI: 38-item self-report) by Müllensiefen, Gingras, Musil, & Stewart (2014); Absorption in music scale (AIMS: 34-item self-report) by Sandstrom & Russo (2011); a 19-item uses of music scale that examines listener typology by Ter Bogt, Mulder, Raaijmakers, & Gabhainn (2010). Many of these report structures that contain four or five factors, and quite a few overlap with each other. There appears to be convergence on an a) emotion-based component (present in five of the six studies); b) cognitive-based component (present in three of the studies); c) physical-based component (present in two of the studies); d) social-based component (present in three of the studies); e) performance-based component (present in two of the studies); and f) consumption-based component that refers to the quantity of engagement, and whether music is in the foreground or background.

Though there is convergence, these common components are fragmented across studies. That is, none of the studies report all of the factors simultaneously. For example, Chamarro-Premuzic & Furnham (2007), and Müllensiefen, Gingras, Musil, & Stewart (2014) identified emotion- and cognitive-based components, but not social- or physical-based components; Ter Bogt, Mulder, Raaijmakers, & Gabhainn (2010) identified social- and emotion-based components, but not physical- or cognitive-based components; and Mas-Herrero, Marco-Pallares, Lorenzo-Seva, Zatorre, & Rodriguez-Fornells (2013) identified emotion-, social-, and physical-based components, but not a cognitive-based component.

The cause of this fragmentation is not only variation in scope, but also differences in the conceptualization of engagement. For example, some of these measures include items that assess both engagement during listening and performance. However, the processes involved in both listening and performance are vastly different, and it would be more beneficial if the two are studied independently of each other. Indeed, research on other topics has adopted this approach, for example in the study of strong experiences of music (Lamont, 2011; 2012).

To address these issues, we have developed a novel self-report measure of individual differences in musical engagement that concentrates solely on the processes present during musical listening. Further, we investigate the underlying structure of musical engagement and explore its links to a musical preferences and personality.

Aims

The aims of this study were to:

a) develop a measure of musical engagement that examines individual differences during music-listening;

b) examine its structure, reliability, and generalizability across samples;

c) test its test-retest reliability and convergent validity;

d) examine its correlates with musical preferences and personality.

Method

234 participants from four geographic regions (US, UK, Middle East, and Asia: mean per region = 58.5) provided open-ended responses about their everyday and strongest musical experiences. A thematic analysis was used to generate 352 items. Several pilot studies were conducted to remove redundant items; items that were too difficult to answer; items that were unclear; and items that did not describe aspects of everyday musical engagement (e.g. crying). This resulted in 23 items that remained for the final measure: the Musical Engagement Test (MET).

Three samples completed the 23-item MET (*N*s = 1,012, 1,070, and 146). Samples 1 and 2 were from the United States and Sample 3 was predominately from Europe. A subsample of 310 participants from S1 completed the MET for a second time approximately three weeks after the initial testing session. A subsample of 401 participants from S1 completed additional measures of musical engagement or related constructs to test for convergent validity. Specifically, these participants completed the a) 24-item musical engagement scale of the MUSE (Chin, & Rickard, 2012), b) 19-item scale measuring music typology

(Ter Bogt, Mulder, Raaijmakers, & Gabhainn, 2010), c) 20-item Barcelona Musical Reward Questionnaire (BMRQ: Mas-Herrero, et al., 2013), and d) 34-item Absorption in Music Scale (AIMS: Sandstorm & Russo, 2013).

Further, S1 and S3 completed the Short Test of Musical Preferences (STOMP: Rentfrow & Gosling, 2003), which is a genre-based self-report measure and S2 indicated their preferential reactions to each of 25 musical excerpts that have been used in previous research to assess musical preferences as conceptualized by the MUSIC Model (Rentfrow et al., 2011; 2012).

In terms of personality, all participants from S1 completed the Ten Item Personality Inventory (TIPI: Gosling, Rentfrow, & Swann, 2003); 343 participants from S2 completed the 120-item IPIP proxy of the NEO-PI-R (Johnson, 2014). 378 participants from S2 completed the 44-item Big Five Inventory (BFI: John, Donahue, & Kentle, 1999). 349 participants from S2 completed the 10-item BFI-short (Rammstedt & John, 2007).

Results

The structure of musical engagement. Findings across samples revealed a robust five-factor structure underlying musical engagement. These engagement factors are interpreted as: **Cognitive**, defined by intellectual processes related to perceiving sonic and surficial features in music; **Affective**, defined by emotional processes involved with cathartic and expressive engagement; **Physical**, defined by physiological processes related to movement, dance, and energetic responses to music; **Narrative**, defined by a perceptual focus on the symbolism, lyrical, and story-like features in music; and **Social**, defined by group bonding and identification processes with the musician(s) and fellow music listeners.

Results from test re-test sessions revealed high reliability with *r*s = .80, .75, .73, .74, and .75, for Cognitive, Narrative, Affective, Physical, and Social, respectively. Scale scores were used to examine between factor correlations between measurements. We only make note of correlations where *r* = .50 or above. Specifically, the Cognitive factor of the MET was positively correlated with scores on the AIMS (*r* = .52), and the Engaged Production factor of the M-USE (*r* = .56). The Affective factor of the MET factor was positively correlated with the Mood Enhancement and Coping dimensions of the music typology questionnaire (*rs* = .55 and .64), the Cognitive and Mood Regulation dimension of the M-USE (*r* = .62), and the Emotion Evocation and Mood Regulation dimensions of the BMRQ (*rs* = .54 and .54). The Physical dimension of the MET was positively correlated with the Dance dimension of the M-USE (*r* = .63) and the Sensory Motor dimension of the BMRQ (*r* = .72). The Narrative dimension of the MET was positively correlated with the Identity dimension of the music typology questionnaire (*r* = .59). The Social dimension of the MET was positively correlated with the Identity dimension of the music typology questionnaire (*r* = .59) and the Social Reward dimension of the BMRQ (*r* = .59).

Correlates with musical preferences. Cognitive Engagement was positively linked to the Sophisticated music-preference dimension and negatively linked to the Unpretentious and Contemporary dimensions of the MUSIC model. These trends were replicated within the genre-based measure: Cognitive engagement was positively correlated with the *Reflective* & *Complex* dimension (*r* = .30). Affective engagement was positively linked to the Intense music-preference dimension. Physical engagement was positively linked to the Contemporary dimension and negatively linked to the Intense and Sophisticated dimensions. Similar trends were observed with from the genre-based measure: physical engagement was positively correlated with the *Energetic* & *Rhythmic* dimension (*r* = .27). Narrative engagement was positively linked to the Mellow and Unpretentious dimensions of the MUSIC model. These trends were also observed within the genre-based measure: narrative engagement was positively correlated with the *Upbeat* & *Conventional* dimension (*r* = .10). Finally, social engagement was positively linked to the Intense dimension and negatively linked to the Mellow and Sophisticated dimensions. These same trends were also observed in the genre-based measure: social engagement was positively linked to *Intense* & *Rebellious* dimension (*r* = .17) and negatively linked to *Upbeat* & *Conventional* dimension (*r* = -.09).

Correlates with personality. Here we only make note if there were significant findings in at least three of the four samples. Cognitive engagement was most highly correlated (positively) with Openness and also negatively linked to Neuroticism. Affective engagement was positively linked to Neuroticism and Openness. Physical engagement was most highly correlated (positively) with Extraversion, and was also positively correlated with Openness and Agreeableness. Narrative engagement was positively linked to Openness. And Social engagement was positively linked to both Extraversion and Agreeableness.

Conclusions

The MET is a new measure that overcomes limitations by previous research and which can be useful for researchers investigating music-related phenomena. Results reveal a robust five-factor structure underlying musical engagement that is replicable and generalizable across geographic regions. The MET shows strong reliability and convergent validity across measures. Notably, it is the first musical engagement measure that captures Cognitive, Affective, Physical, and Social dimensions with a single measure. Further, the MET revealed a new dimension that has been underrepresented in the literature: narrative engagement. Importantly, we showed that musical engagement is linked to musical preferences and personality across samples, measurements, and methods.

Keywords

Musical Engagement, Preferences, Personality.

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APPENDIX

Musical Engagement Test (MET)

Below is a list of statements that may or may not describe your **music listening** experience. Please read each item very carefully, and indicate how characteristic each statement is of your musical engagement.

1 = Not at all characteristic
2 =
3 =
4 = Neutral
5 =
6 =
7 = Extremely characteristic

1.____Music makes me want to dance.
2.____Music magnifies my emotions.
3.____I feel a deep connection with my favorite musicians.
4.____When listening to live music, I feel in-tune with the musicians.
5.____When listening to music, my attention is often drawn to just a single instrument or section in the band or orchestra.
6.____Music pumps me up.
7.____When listening to music, I try to understand the underlying meaning of the lyrics or sounds.
8.____I am able to vent my frustrations through music.
9.____I focus on the instrumental or musical techniques that the musician or band is using.
10.____Music creates a story or narrative in my mind.
11.____My attention is drawn to the story or messages that are unfolding in the music.
12.____When listening to music, I try to deconstruct the different elements of the song or composition.
13.____When listening to music, I focus on the lyrics or sounds to understand the emotional content.
14.____Music makes me want to jump up and down.
15.____Music helps me to emotionally heal.
16.____I am drawn to the symbolism expressed in music.
17.____I can overcome painful emotions when I listen to music.
18.____I identify with the musicians that I listen to.
19.____When listening to music, I tend to concentrate on the melodies and counter-melodies.
20.____The rhythm in music gets my body moving.
21.____When listening to music, I pay attention to the blends of musical instruments mixing together.
22.____At a live concert I feel as if the entire audience and I are one.
23.____Music evokes a deep surge of emotion in me.

Scoring for the five musical engagement dimensions:

Cognitive: 5, 9, 12, 19, 21
Affective: 2, 8, 15, 17, 23
Physical: 1, 6, 14, 20
Narrative: 7, 10, 11, 13, 16
Social: 3, 4, 18, 22

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Music and autism in everyday life

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ABSTRACT

Background

Today, autism diagnoses are on the rise with about 1 in 68 children being diagnosed. Although research has shown that people with autism display unique musical abilities and talents, little is known about the role that music plays in their day-to-day lives.

Aims

The aims of this study were to:

a) examine ratings of importance and frequency for a variety of daily activities.

b) examine daily music-listening consumption;

c) examine scores on five musical engagement domains (Cognitive, Affective, Physical, Narrative, and Social);

d) examine how musical engagement correlates with autistic traits.

Method

We used data from an ASC group (N = 152) and a control group (N = 146). Participants were asked to indicate the level importance for 22 different leisurely activities, including music listening and musical performance. Specifically, using a slider, participants were asked to indicate how important each item is to them on a scale ranging from 0 (not at all important) to 100 (extremely important). Participants were then presented with the same list of 22 leisurely activities, and were asked to indicate how frequently they engaged with each activity on a scale from 1 (never) to 7 (all the time).

Participants were asked to select from one of the following options which measures self-rated musical importance (see Bonneville-Roussy et al., 2013): a) Music means a lot to me, and is a passion of mine b) Music is important to me, but not necessarily as important as other hobbies or interests, c) I like music but it does not feature heavily in my life, d) Music is no longer as important as it used to be to me, e) Music has no particular interest for me. Participants were also asked four questions about their music-listening consumption throughout the week and which have been used in previous research (ibid.): a)Please estimate the number of hours you spend during an average weekday listening to music that you have bought/chosen; b)Please estimate the number of hours you spend during an average weekday listening to music that may have been in the background; c)Please estimate the number of hours you spend during an average weekend listening to music that you have bought/chosen.; and d)Please estimate the number of hours you spend during an average weekend listening to music that may have been in the background. For each question, participants were given options that ranged from 0 to 24 with half-hour increments (e.g. 3.0, 3,5, 4.0, 4.5). Responses to these four questions were used to generate three variables: a) weekly consumption of self-selected music, b) weekly consumption of background music, and c) total weekly consumption (including both self-selected and background music).

All participants completed the 23-item Musical Engagement Test (MET: Greenberg & Rentfrow, see these proceedings). The MET examine five dimensions of music-listening engagement: Cognitive (defined by intellectual processes and detailed attention to the sonic and structural elements in music), Affective (defined by emotional processes related to mood regulation and expression), Physical (defined by physiological processes related to movement and dance), Narrative (defined by perceptual processes related to the lyrical, and story-telling content in music), and Social (defined by group processes related to identity and interpersonal bonding).

In addition, subsamples from both groups (Ns = 111 and 107 for the autism and control groups, respectively), had completed the 50-item Adult Autism Spectrum Quotient (AQ: Baron-Cohen et al., 2001) during previous testing sessions at the Autism Research Centre (ARC). The test date of the AQ ranged from October 2004 to December 2014.

Results

Results showed that adults with autism rated music-listening (along with reading non-fiction books) as the most important and frequently engaged with activity in daily life, and on average they indicated they listened to nearly six hours of music per day (M = 5.8 hours, SD = 5.20). There were no significant differences between ASC and control groups in ratings of importance or consumption. Based on their scores on the 23-item MET, results showed that the ASC group scored significantly higher on Cognitive engagement (defined by intellectual processes and detailed attention to the sonic and structural elements in music), but lower on Physical engagement (defined by physiological processes related to dance and movement). These results were reflected in correlations between AQ scores and MET scores in both the ASC and control groups.

Conclusions

Findings from this research show that music is an important feature in lives of people with autism. Importantly, the ASC group scored higher on Cognitive engagement than the control group, but lower on Physical engagement. These results replicate and extend previous findings in the field that has

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shown that people with autism have enhanced musical abilities (e.g. heightened pitch perception). Future research should continue to explore the role of music in the everyday lives of people with ASC and how such information can help parents, teachers, and clinicians.

Keywords

Autism, Musical Engagement, Everyday life, AQ

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The adaptive functions of music listening: Theory & measurement

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ABSTRACT

Background

The Adaptive Functions of Music Listening (AFML) model draws upon psychological theory (e.g. positive psychology, well-being, personality) to explain the selection and impact of music listening functions. Current measures are limited by failing to consider both hedonic and eudaimonic motivations in music listening, which may have differential associations with well-being.

Aims

The current study aims to develop a scale to measure functions of music listening (FML) that is suitable for analysing theoretically-driven research questions in relation to the hedonic and eudaimonic consequences of different music listening strategies.

Method

Study 1: Item generation was on the basis of an exhaustive literature review and four focus group sessions, two with younger adults (N = 25, M = 22.49 years, SD = 2.25) and two with older adults (N = 19, M = 65.86, SD = 4.46).150 items were administered to a sample of 673 undergraduate students for exploratory factor analysis.

Study 2: The revised AFML scale was administered to a sample of 641 university students (Females = 420, Males = 221) completed the online questionnaire along with a battery of well-being and personality measures. The factor structure will be confirmed, and the validity of the AFML theoretical model will be evaluated using multi-group Structural Equation Modelling.

Results

Study 1: The Kaiser Meyer-Olkin measure (KMO = .95), and a significant Bartlett's test of sphericity ($X^2_{(1035)}$ = 17454.06, p < .001) indicated suitability for factor analysis. An Exploratory Factory Analysis (Principal Axis Factoring with oblique rotation - Direct Oblimin) was carried out using SPSS 20. Based on the Kaiser criterion, analysis of the Scree plot, and acceptable levels of internal consistency a 19 factor solution was found. 87 items were retained on the basis of factor loadings greater than .40, no cross-loadings above .32, and inter-item correlations between .30-.90. A higher-order factor structure is proposed with Affective, Social, and Eudaimonic functions, Music-Focused listening, Music-facilitated goal-attainment, and Sleep Aide accounting for 69% of the variance in FML.

Study 2: Construct validity will be evaluated by testing a series of hypotheses. For example, it is hypothesized that listening to music for affect regulation will be positively associated with subjective well-being (SWB). Eudaimonic and Social FML will be associated with higher levels of eudaimonic well-being. Listening to music for social functions will be predicted by extraversion. Eudaimonic FML will be predicted by openness to experience. Data analysis is ongoing and results will be presented in August. Preliminary analyses suggest that, listening to music for anxiety regulation predicted higher levels of SWB. In contrast stress reduction and rumination in music listening predicted higher negative affect. Findings are discussed in relation to theories of affect regulation and wellbeing.

Conclusions

Understanding the functions of music listening may help explain why music is of value in certain contexts and for some individuals. Music listening motivations vary within and between individuals, and may have important implications for outcomes in research and clinical practice.

Keywords

Well-Being, Functions of Music Listening, Psychometrics

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Music learning and the developing brain- Report from an ongoing longitudinal study

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ABSTRACT

Background

Music occupies an important role in everyday life. Human beings engage with music in a wide range of ways: from incidental listening activities to self-initiated musical practices like playing a musical instrument, composing a song for a loved one, or dancing to one's favorite hit (DeNora, 2000). Playing music is a complex task that requires the concurrent recruitment of distinct sensory systems, as well as the interplay of these sensory systems with the motor and executive systems. Mastering of this rich and demanding process requires regular and intense practice and is likely to influence the development of the underlying brain structures and their function. Although there is some agreement that musical development occurs across the lifespan, most research conducted to date centers on changes that occur as children develop and grow. In spite of many recent developments in the field, some serious gaps still exist. First, there is a lack of recent longitudinal studies on musical development, as most studies tend to adopt cross-sectional designs. Second, little research exists concerning children from diverse social, ethnic and cultural groups, and this is also true for rich, industrialized and democratic societies where developmental research in music has a strong tradition (e.g., United States, UK). Furthermore, how children develop musically through systematic training following specific teaching and learning approaches or in community-based programs remains largely unexplored.

Aims

The aim of this 5 year longitudinal study is to investigate the effects of music training on brain, cognitive, musical and social development in children from an underserved community who were taking part in an *El Sistema* (Majno, 2012) inspired program in the United States. The project is intended to contribute to the ongoing debate on the role of nature versus nurture on the previously reported changes in adult musicians. Here, we present findings on development of musical skills in respect to four main categories – auditory perception, pitch matching, singing, and rhythmic synchronization – over the course of one year.

Method

Seventy six 6- to 7- year-olds were recruited over the course of two years, from public elementary schools and community music and sports programs in the greater Los Angeles area. Twenty five children were training with the Youth Orchestra of Los Angeles at Heart of Los Angeles, YOLA at HOLA, for short. The program is based on the Venezuelan approach known as El Sistema and offers free instruction five days a week to children from underserved areas of Los Angeles. The children are involved in a systematic musical training that emphasizes ensemble practice and group performances. As comparison groups, we included a group of children involved in sports training (n=25) and a third group with no systematic, organized post-school activity (n=26). To date, all children have been tested twice, once at the start of the study (prior to training for the music and sports groups) and again one year later with a series of behavioral assessments including melody and rhythm discrimination of *Gordon's Primary Measures of Music Audiation,* beat perception and production, and singing using *AIRS Test Battery of Singing Skills.* They also underwent electroencephalography (EEG) during which we measured auditory evoked potentials to piano, violin and pure tones.

Results

Analysis of the age and SES matched sample data at baseline (prior to training) revealed no significant differences between the groups on performance of any of the musical assessments (Habibi et al., 2014). After one year of training, significant differences, between the music group and two control groups, were observed in the pitch perception task and the sung rendition task of the singing skills assessment. No differences were observed between the groups in the rhythm perception or production tasks.

Conclusions

Results from the performance on musical measures will be presented, along with a discussion on the variable development of different musical skills and on how such skills may relate to the development of synaptic connections in the auditory cortex as expressed by auditory evoked potentials.

Keywords

Electroencephalography, Music training, El Sistema, Development

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Putting yourself in someone else's shoes (or at someone else's piano): A TMS study of the use of simulation for temporally accurate musical turn-taking in duets

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ABSTRACT

Background

Recent behavioural and neurophysiological experiments have revealed strong coupling between sensory and motor representations for familiar actions such as speaking, dancing, or playing a musical instrument (Meister et al., 2007; Calvo-Merino et al., 2006; Novembre & Keller, 2014). This coupling occurs most strongly for action sequences within our repertoire (Lahav et al., 2007), with one explanation being the use of internal motor simulations to predict the outcome of perceived acts (Gallese, 1998). Within an interaction such predictions may help determine when to initiate one's own behaviour to fit with that of others.

Two regions that have been implicated in the simulation network are the dorsal premotor cortex (dPMC), which encodes motor plans during passive action observation especially when actions are familiar (Lahav et al., 2007); and the supplementary motor area (SMA), which suppresses overt movement during motor imagery (Kasess et al., 2008). We investigate the involvement of these regions for simulation of a partner within turn-taking musical interactions.

Aims

In this study we aim to investigate the role of motor simulation in musical interaction, focusing on its involvement in turn-taking timing.

Method

In this experiment 16 pianists with least 8 years of piano experience played a series of duets with a videoed partner. Our duet stimuli were adapted from Bach chorales and involved each pianist using only one of their hands to play a short series of alternating solos. Participants had one week before the experiment to memorise the duets, half of which included their partner's part as well as their own. In the experiment session pianists played the right hand of these duets with the videoed partner, during which we temporarily disrupted the right dorsal premotor cortex (dPMC) or the supplementary motor area (SMA) using double-pulse transcranial magnetic stimulation around the turn-switch point (randomised at 650ms, 500ms, or 350ms prior to turn entry).

Only turns in which the participant played their entire solo phrase correctly were analyzed (defined as all notes in the right order with no insertions). The accuracy of pianists' first keystroke was analyzed in relation to the unheard metronome underlying the videoed partner's performance. Prior to analysis the differences between these two timings were converted into absolute values, which therefore designated early entries and late entries as equally erroneous.

Results

When pianists had previously practiced their co-performer's part, stimulation of either the dPMC significantly reduced the absolute accuracy with which they entered for their own part in relation to sham (regardless of stimulation timing). There was no such difference in performance accuracy for SMA stimulation, or for dPMC stimulation when the co-performer's part had not been practiced.

Conclusions

Our results indicate that motor simulation of a partner during observation of their turn is causally involved in planning the accurate entry timing for one's own part. This strongly suggests that simulation is used to predict the trajectory of heard stimuli and facilitate turn-taking coordination. As turn-taking is common to both verbal (speech) and non-verbal (music) behaviour, we suggest that the use of simulation for prediction may generalise across domains.

Keywords

Motor simulation, performance timing, musical interaction.

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Are there gender differences in instrumental music practice?

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ABSTRACT

Background

Practice is central to the development of all aspects of musical expertise. Accumulated practice has been demonstrated to be a key variable in determining the level of musical expertise attained. Expert performers invest several thousand hours of practice over a lengthy period of time to attain high levels of accomplishment, although there are substantial individual differences. The quality of the practice undertaken is also important with strategy use changing as expertise develops. Although there has been considerable research on practice there has been relatively little taking account of gender differences, although research has addressed gender differences in relation to other aspects of music learning.

Aims

This paper aims to address the gap in the literature exploring whether there are gender differences in the amount of practice undertaken, the nature of the practice strategies adopted, the organization of practice, perceived levels of concentration and enjoyment of practice.

Method

The present study used a self-report questionnaire as a means of collecting data from a large sample of learners. The questionnaire was devised based on existing research evidence. The questionnaire sought information about the level of expertise attained as assessed by the highest examination grade achieved in graded independent instrumental examinations from preliminary to grade 8. Respondents were also asked to indicate the number and length of practice sessions in a typical week. The questionnaire included a range of statements relating to: the practising strategies adopted; the organization and management of practice; and motivation to practise. Respondents were requested to respond to these on a 7 point Likert scale with 7 indicating the strongest agreement, 1 the strongest disagreement. The questionnaire was piloted on a small group of young musicians to ensure that the statements were easy to understand. Their feedback indicated that no changes were required.

Respondents

Data were collected by a team of researchers from young people playing all of the common classical and popular musical instruments in a variety of settings including two junior conservatoires, two Local Authority youth orchestras, two Local Authority Saturday Music schools, a conservatoire for popular music and three state comprehensive schools. The children who participated were receiving tuition on their instruments individually or in small groups of no more than four children.

A total of 3325 children ranging in level of expertise from beginner through to Grade 8 level (minimum required for conservatoire entrance in the UK) participated in the research. The age range was from 6 to 19 years. The instruments that they played were representative of the classical and popular instruments played in the UK. 2027 (61%) of the sample were girls; 1225 (37%) were boys with some not indicating their sex.

Procedure

The researchers administered the questionnaires to students in the various learning environments. The exact procedures for this varied depending on the environment. For instance, in schools, the children completed the questionnaires during music lessons, while in the extra-curricular environments questionnaires were distributed and collected during break periods between musical activities.

Results

A. Gender differences in the frequency and amount of practice

The boys reported practising slightly more days each week than the girls (4.7 days as opposed to 4.5 days). This difference was statistically significant ($\chi^2 = 14.23$, 7, $p = .047$). The boys also reported practising for slightly longer on each day (43 minutes per day as opposed to 41 minutes). This difference was not statistically significant. Combining these two data sources led to the boys on average reporting 230 minutes of weekly practice as opposed to 209 minutes for the girls. This difference was not statistically significant neither was there a significant interaction between gender and level of expertise.

B. Are there gender differences in practising strategies, levels of concentration and the organisation of practice? Do any gender differences interact with level of expertise?

To explore the relationships between the practice variables, factor analysis was undertaken. A Principal Components analysis was selected. Eigenvalues were retained if they were greater than 1. The scree plot was used to identify those factors

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before the breaking point of the elbow of the plot. Following examination of the scree plot a seven factor solution was deemed to be the most appropriate. Full details of the factor analysis are provided in Hallam et al. (2012). Multivariate analysis of variance was undertaken taking account of gender and level of expertise in relation to the factors. The analysis was highly significant for gender (F (7,2421) = 7.85, p < .0001), for level of expertise (F (56, 16989) = 14.5, p < .0001) and for the interaction between gender and level of expertise (F (56, 16989) = 1.53, p< .007).

Factor 1 had an eigen value of 2.9 accounting for 10.7% of the variance. This factor had high weightings for practising sections slowly when having made a mistake (.737); practising difficult sections over and over again (.68); slow practice (.649); gradually speeding up when learning fast passages (.585); and recognising errors (.558). There was a significant effect of level of expertise on Factor 1 (*F* (4,2492) = 4.09, *p* < .0001) with a statistically significant linear trend (*F* (1, 2492) = 6.79, *p* < .01) indicating that as the level of expertise increased the adoption of systematic practice strategies increased. There was a statistically significant gender difference in relation to the use of systematic practice strategies (F (1, 3045) = 23.28, p = .0001). The girls were more likely to adopt systematic practice strategies (mean factor score .069) as opposed to the boys (mean factor score -.069). There was no statistically significant interaction between gender and level of expertise.

Factor 2 had an eigen value of 2.073 accounting for 7.7% of the variance. This factor related to the organisation of practice including starting practice with scales (.734); making a list of what had to be practised (.621); starting with warm up exercises (.546); starting with studies (.444); setting targets to achieve in each practice session (.381); and marking things on the part (.302). There was a significant effect of level of expertise on Factor 2 (*F* = (8,2492) 4.92, *p* < .0001) but no statistically significant linear trend indicating that as level of expertise increased there was no systematic increase in the organisation of practice. There were no statistically significant gender differences and no interactions between gender and level of expertise.

Factor 3 had an eigen value of 2.048 accounting for 7.6% of the variance. It had high weightings for recording self playing and listening to the recording (.738); listening to other recordings of the piece to be learnt (.671); and practising with the metronome (.639). There was a significant effect of level of expertise on Factor 3 (*F* = (8, 2492) 29.48, p < .0001) and a highly statistically significant linear trend (*F* (1,2492) = 184.5, *p* < .0001). There were no statistically significant gender differences or interactions between gender and level of expertise.

Factor 4 had an eigen value of 1.98 accounting for 7.3% of the variance. The factor had high weightings for: trying to find out what a piece sounds like before trying to play it (.759); getting an overall idea of a piece before practising it (.663); identifying difficult sections (.516); analysing the structure of a piece before playing it (.427); thinking about interpretation (.324); and working things out just by looking at the music and not playing (.318). The only statistically significant effect was in relation to level of expertise (*F* (8,2492) = 3.249, *p* < .001).

Factor 5 had an eigen value of 1.87 accounting for 6.9% of the variance. There were high loadings on only playing pieces from beginning to end without stopping when practising (.7); and going back to the beginning and starting again when making a mistake (.644). This factor was conceptualised as referring to ineffective practising strategies supported by the negative loadings on identifying difficult sections (-.222); thinking about interpretation (-.266); marking things on the part (-302); and practising small sections (-.403). There was a significant effect of expertise on Factor 5 (*F* (8,2492) = 75.72, *p* < .0001) and a highly statistically significant linear trend (*F* (1,2492) = 462.3, *p* = .0001). Although there were no statistically significant gender differences there was a statistically significant interaction between gender and level of expertise (F = (8) 2.39 < .015).

Factor 6 had an eigen value of 1.48 accounting for 5.5% of the variance. The factor had high weightings on finding it easy to concentrate (.699) and negatively on being easily distracted when practising (-.773). There was a significant effect of level of expertise on Factor 6 (*F* (8,2492) = 3.218, *p*< .001) but no significant linear trend. There was a statistically significant gender difference in perceived concentration with the males perceiving that they concentrated better (mean for males .095, for females -.051) (F = (1) 9.059. p < .003) but no statistically significant interaction between gender and level of expertise.

Factor 7 had an eigen value of 1.34 accounting for 5.0% of the variance and high weightings in relation to 'When making a mistake the wrong note is corrected and then I carry on' (.705); 'When I make a mistake I carry on without correcting it' (-.795). There was a statistically significant effect of level of expertise on Factor 7 (*F* (8,2492) = 2.54, *p* < .01) and statistically significant gender differences with the female students reporting more immediate correction of errors (mean for males = -.119, for females .064) but no significant interaction between gender and level of expertise.

Conclusions

There were no gender differences in the overall time spent practising, however, the girls were more likely to adopt systematic practice strategies than boys also reporting correction of errors more frequently than the boys. These gender differences may have been mediated by the instruments played. This is an area for future research. The findings have implications for education. Instrumental teachers may need to spend more time when working with boys in discussing available practice strategies and how to implement them effectively.

Keywords

Gender, musical practice, expertise, strategy use, concentration

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Changes in motivation as expertise develops: Relationships with musical aspirations

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ABSTRACT

Background

Human motivation is complex. Recent reviews have acknowledged this and models have been developed which recognise the interactions which occur between environmental (cultural, institutional, familial, educational) and internal factors (cognition and affect) enhancing or reducing motivation. There are considerable differences in the level of commitment that individuals make to music. For many children playing an instrument is viewed no differently from other activities which they undertake in their free time. For some however, career planning is in evidence in the very earliest stages of learning to play an instrument along with dedication, commitment, determination and a willingness to make sacrifices. There is relatively little research which explores how motivation changes as expertise develops and what predicts musical aspirations.

Aims

The current study aimed to explore the relationships between the different elements of motivation, levels of musical expertise and musical aspirations.

Method

The present study adopted a self-report questionnaire as a means of collecting data from a large sample of learners. The questionnaire was devised based on the research evidence outlined above. It sought information about the level of expertise attained as assessed by the highest examination grade achieved in independent graded instrumental examinations from preliminary to Grade 8. The questionnaire also included a range of statements relating to various elements of motivation including support of family and friends; enjoyment of performing; enjoying playing an instrument and having lessons; listening to music; music as a social activity; enjoyment of practice; self-beliefs about musical ability and potential; beliefs about self-efficacy, effort and the importance of musical ability; and social affirmation. Respondents were requested to respond to these on a 7 point Likert scale with 7 indicating the strongest agreement, 1 the strongest disagreement. Three statements relating to musical aspirations were included which concerned aspirations to always engage with music, wanting to be a musician and perceiving that playing an instrument would be useful to any future career.

Respondents

Data were collected by a team of researchers from young people playing all of the common classical and popular musical instruments in a variety of settings including two junior conservatoires, two Local Authority youth orchestras, two Local Authority Saturday Music schools, a conservatoire for popular music and three state comprehensive schools. The children who participated were receiving tuition on their instruments individually or in small groups of no more than four children. A total of 3325 children ranging in level of expertise from beginner through to Grade 8 level (minimum required for conservatoire entrance in the UK) participated in the research. The age range was from 6 to 19 years. The instruments that they played were representative of the common classical and popular instruments played in the UK.

Procedure

The researchers administered the questionnaires to students in the various learning environments. The exact procedures for this varied depending on the environment. For instance, in schools, the children completed the questionnaires during music lessons, while in the extra-curricular environments questionnaires were distributed and collected during break periods between musical activities.

Results

To explore the relationships between the variables, factor analysis was undertaken. A Principal Components analysis was selected as it affords an empirical analysis of the data set (Tabachnick & Fidell, 2001). Eigenvalues were retained if they were greater than 1 and the scree plot was used to identify those factors before the breaking point of the elbow of the plot. Following examination of the scree plot a six factor solution was deemed to be the most appropriate.

Factor 1, support and social affirmation, had an eigenvalue of 7.3 and explained 30.47% of the variance. This factor had high weightings for parents wanting the participant to play an instrument (.74), relations liking them playing a musical instrument (.66), most people thinking that they played their instrument well (.63), teachers at school liking them to play a musical instrument (.49) and brothers and sisters liking them playing a musical instrument (.46). Analysis of variance showed that there was a statistically significant relationship between Factor 1 and level of expertise ($F(1,8) = 9.24$, $p < .0001$) with support and social affirmation being important in

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the early stages of developing expertise declining as expertise developed.

Factor 2, social life and enjoyment of musical activities, had an eigenvalue of 1.91 accounting for 7.95% of the variance. This factor had high weightings for having lots of friends who played musical instruments (.72), enjoying going to concerts to listen (.61), believing it was valuable to play a musical instrument (.59), playing an instrument being an important part of participants' social life (.548) and enjoying playing in musical groups, orchestras and bands (.44). Analysis of variance revealed statistically significant relationships between Factor 2 and levels of expertise ($F(1,8) = 23.49$, $p < .0001$). Enjoying music and it becoming a part of young people's social life was increasingly important as expertise developed.

Factor 3, enjoyment of performing had an eigenvalue of 1.43 accounting for 5.97% of the variance. This factor had very high weightings for statements relating to finding it very satisfying to play in concerts (.79) and playing in concerts giving participants a real thrill (.83). Analysis of variance showed statistically significant relationships between this factor and levels of expertise ($F(1,8) = 18.22$, $p < .0001$). There was an increase in enjoyment of performing up to grade level 2, a decline to level 4 and then a steady increase up to the highest level of expertise.

Factor 4, self-belief in musical ability, had an eigenvalue of 1.25 accounting for 5.19% of the variance. This factor focused on self-beliefs with a very high weighting for the statements relating to needing musical ability to succeed in playing an instrument (.74) and participants having musical ability (.64). There were also high weightings for statements relating to participants having the potential to be a good musician (.56), and usually being successful in what they attempted to do on their instrument (.49). Analysis of variance showed that there was a statistically significant relationship between Factor 4 and level of expertise ($F(1,8) = 5.37$, $p < .0001$). There was a dip in self-belief at grade 2 and then a generally upward trend to the higher levels of expertise.

Factor 5, enjoyment of playing, lessons and practice, had an eigenvalue of 1.03 accounting for 4.31% of the variance. This factor had high negative weightings for hating having to play an instrument (-.84) and finding practice boring (-.56) and positive weightings for enjoying instrumental lessons (.72). Analysis of variance showed that there was a statistically significant relationship between Factor 5 and levels of expertise $F(1,8) = 6.29$, $p < .0001$). Overall, there was a gradual increase in positive responses to the statements in this factor although there were some inconsistencies.

Factor 6, disliking practice, had an eigenvalue of 1.01 accounting for 4.2% of the variance. This factor had a high weighting for not wanting to practice on some days (.73), finding practice boring (.64) and a negative weighting for liking practice (-.66). Analysis of variance showed that there was a statistically significant relationship between level of expertise and disliking practice $F(1,8) = 17.49$, $p < .0001$) and also a statistically significant linear relationship $F(1,8) = 70.27$, $p < .0001$). Dislike of practising increased up to Grade 4 diminishing slightly after that.

Three statements measured participant's aspirations: 'I would like to become a musician' (mean = 4.74); 'I will always want to be involved in musical activities' (mean = 5.5); and 'I think it will be useful to my future career to play a musical instrument' (mean = 5.03). These measures were correlated with the correlations ranging from .38 to .55. An overall aspiration score was calculated by summing the responses to the three separate statements. Analysis of variance showed that there was a statistically significant relationship between the level of expertise and the combined aspirational measure ($F(8,2802) = 13.51$, $p <.0001$) and a statistical significant linear relationship ($F(8,2802) = 77.91$, $p <.0001$). There were low levels of aspiration during the early grades increasing from Grade 4 onwards with a dip at Grade 6.

A series of multiple regression analyses were undertaken exploring the relationships between each aspirational statement and the six motivational factors. The highest level of prediction for an individual statement was for always wanting to be involved in musical activities ($R = .67$). Slightly different variables predicted the different aspirational variables but typically social music making, enjoyment of musical activities, enjoyment of performing and self-belief in musical ability were common albeit with different weightings.

Conclusions

The findings show that different motivational elements are more or less important at different stages of expertise. Musical aspirations showed an increase as expertise developed remaining relatively low in the early levels of expertise with the lowest point at Grade 4 with another slight decrease at Grade 6. There were also subtle differences in the importance of the different motivational elements depending on the specific aspiration. The findings support much earlier research but also highlight the complexity of musical motivation and how it can change over time. Models of musical motivation may need to take greater account of the extent to which musical activity, whether through listening or making music, is pleasurable and satisfies emotional needs.

The findings have implications for education. Teachers need to be aware of the points in the development of expertise when learners may experience dips in motivation and take action to sustain interest. Teachers need to acknowledge that learners do not always enjoy individual practice and that if they are to continue to actively engage with making music throughout the lifespan other opportunities for making music need to be made available.

Keywords

Motivation, music, instruments, aspirations, expertise, development

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A longitudinal study of the effects of pre-exercise music and non-music interventions on exercise adherence

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ABSTRACT

Background

Regular exercise improves both physical and mental health, but many people struggle to adhere to exercise programmes. In England, 60% of men and 70% of women are physically active less than once a week (Sport England, 2013). Music is widely used during exercise as a motivational aid to increase arousal levels (Hallett & Lamont, 2014; Laukka & Quick, 2013), and its use in pre-event preparation in sport (Bishop, Karageorghis & Loizou, 2007), and to 'get in the mood' for non-exercise activities such as housework (DeNora, 1999), suggests a possible role for music played before exercise in helping adherence. Karageorghis, Priest and Lane presented a theoretical model of music and motivation in exercise, suggesting a link with adherence (1999), but this has not been empirically tested.

Aims

In this study, the links between adherence and listening to music before exercise were explored. A pre-exercise, self-selected music intervention was compared with an established non-music method and a control condition. The design of the study sought to use field-based activities in order to draw on a 'real life' context, with exercise activities and music selected by participants

Much of the previous research into music use in exerciser has utilised researcher- or peer-selected music choices, although DeNora (1999) focused on self-selection. Mitchell and MacDonald (2012) argue in favour of self-selected music stimuli in research because of the effects of individual tastes rendering the same effect in different pieces of music for different individuals.

Implementation intentions were used as a non-music intervention; these involve participants composing 'if…then…' sentences to develop strategies to overcome psychological barriers. The method has been used in a wide range of health psychology studies (see Gollwitzer & Sheeran, 2006, for an overview).

It was hypothesized that those using interventions would (a) exercise more than a control group and (b) meet a higher proportion of their pre-set exercise goals.

Method

The study was a longitudinal, randomized, controlled, between-participants, field-based design. Participants (N = 99, 77 female and 22 male, mean age 40.90 years, SD = 13.29, with n = 50 completing the study) were recruited through social media, handing out fliers at gyms and parkruns (www.parkrun.org.uk), local press coverage, and by word of mouth. Recruitment was carried out on a rolling basis, with participants beginning the study between January and October 2013. They completed an initial survey which included outlining the exercise activities they planned to do and the number of sessions each week.

On completion of the survey, each participant was allocated to a condition; the first received survey was allocated to the music condition, the second to implementation intentions and the third to the control group, and this was repeated throughout recruitment. Participants with interventions were instructed to apply them intervention at the point they would take (or fail to take) action to convent intention into behaviour.

Data was collected using SmartSurvey for one week in four, using a slightly different survey for each condition to collect information regarding interventions where applicable. Participants were emailed the Thursday prior to their data collection week, asked to record their exercise and to report it at the end of the week. They were supplied with a link to a survey and had an identifying code: this provided researcher information on their start date, condition and participant number.

Although a range of data on individual differences and fitness changes was collected, the focus in this presentation is on adherence, measured in absolute terms (Duration per week, in minutes; number of Days exercised on per week; and number of Sessions per week) and as a proportion of intended exercise (Goal Achievement). Measurements were collected across up to 7 surveys, and averaged across the surveys. ANOVAs were carried out on the absolute measurements, while Goal Achievement, being a proportional measurement, was analysed using Kruskal-Wallis tests. Arcsine transformations were not feasible, since some participants exercised more than they had planned to, thus had Goal Achievement scores of over 100%.

Results

A Kruskal-Wallis test showed a significant difference in Goal Achievement across the three conditions: (Group 1, n = 15: music, Group 2, n = 19: implementation intentions, Group 3, n = 16: control group), χ^2 (2, n = 50) = 9.043, p = .011. The implementation intentions group (Md = 78.57%) recorded higher scores than the music group (Md = 71.43%), with the control group scoring lowest (Md = 48.61%). Post-hoc Mann-Whitney U tests showed effects between the implementation intentions and control groups (p = .008, r = .45, medium effect size), and between the music and control groups (p = .022, r = .41, medium effect size).

For Duration, outcomes (in minutes) were slightly better for the implementation intentions group (*M* = 284.10, *SD* = 207.31) than the music group (*M* = 282.02, *SD* = 111.97), with the control group achieving the shortest durations (*M* = 220.31, *SD* = 121.33). The effect was small, however, and there was no statistically significant difference when analysis of variance was carried out: F (2,47) = .865, p = .428, η^2 = .04.

Those with the music intervention had the best outcomes for Days per week (*M* = 4.76, *SD* = 1.26), followed by the implementation intentions group (*M* = 4.13, *SD* = 1.70), with the control group exercising on the fewest days (*M* = 3.94, *SD* = 1.44). Differences were marginal: F (2,47) = 2.691, p = .078, η^2 = .10.

The music group had the best outcome for Sessions per week (*M* = 5.65, *SD* = 1.84), followed by the implementation intentions group (*M* = 5.35, *SD* = 2.97), with the control group carrying out the fewest (*M* = 3.94, *SD* = 1.44). There was a significant difference between groups. Levene's test was significant (p = .034) indicating a violation of the assumption of equality of variances, so the Welch statistic was used: F_{Welch}(2, 30.22) = 4.603, p = .018, η^2 = .10. The effect was between the music and control groups (Games-Howell: p = .030).

It was notable that the participants in the implementation intentions group who completed the study had set lower goals than completing participants from the music group and control group, hence the group's superior outcome for goal achievement in comparison with days exercised on and number of sessions.

Conclusions

Both intervention groups achieved significantly better outcomes than the control group, meeting a higher proportion of their exercise goals. The music group also achieved significantly more frequent exercise sessions than the control group. There were no significant differences between the outcomes of the two intervention groups. These results demonstrate that a music intervention performs similarly to an established and widely-used health behaviour intervention, and provide the first empirical evidence that a pre-exercise music intervention can help achieve exercise adherence.

Although all groups achieved, on average, less than 80% of their exercise goals, this quantity of exercise still met or exceeded the official recommendations for cardiovascular activity for the vast majority of participants; only four were identified as failing to meet the recommended quantity.

The limitations of the study were primarily in the powering: the attrition rate was almost 50%. However, there were still important findings regarding the efficacy of music as a pre-exercise intervention. It would have been useful to have a measure of intensity and as mobile apps improve and take-up becomes more widespread, there are many options to collect data remotely. This is important since researcher-measured intensity data requires participants to take part in prescribed programmes at prescribed times, which is inconsistent with 'real world' exercising where there may be an ad hoc element (e.g. going to the gym rather than a class if finishing work later than anticipated).

These findings support pre-exercise music listening as a strategy to help adherence, showing music to be comparable to an established, non-musical intervention. Music offers the potential to bridge the intention-behaviour gap in exercise behaviours, and pre-exercise music listening offers a simple, enjoyable tool to help the general public meet their exercise aims. This research opens up a potentially fruitful field combining music psychology and the psychology of health behaviours.

Keywords

Exercise, music, intervention, adherence, motivation

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Constructing Adaptive Tests of Musical Ability

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ABSTRACT

Background

The Goldsmiths Musical Sophistication Index (Gold-MSI; Müllensiefen, Gingras, Musil, & Stewart, 2014) is a research tool recently developed to address the multi-faceted nature of musical skill and expertise. In its current form, it comprises a 38-item self-report questionnaire, assessing five different dimensions of musical engagement and ability, and a battery of listening tests that assess a variety of listening skills, including melodic memory and beat perception.

The present study is concerned with the further development of these Gold-MSI listening tests. While the current listening tests have been calibrated on a large number of participants (*N* = 134,984), they are non-adaptive, meaning that every participant is presented with the same set of items. In contrast, adaptive tests tailor the difficulty of each test item to the individual, a technique which can substantially improve measurement accuracy and/or shorten test length (Ayala, 2009). The next generation of the Gold-MSI listening tests are therefore planned to be adaptive.

Item Response Theory (IRT) provides a powerful theoretical framework for the construction of adaptive tests. Under IRT, every test item is characterised by a small number of variables, such as difficulty, discriminability, and guessing probability. If these parameters are known, then participant ability becomes a test-independent metric: even if different participants are administered completely different sets of items, their estimated abilities will still be directly comparable. This test property is essential for adaptive testing. However, the accurate estimation of item parameters is a costly procedure. Traditionally, item parameters are estimated for each item individually, so each item needs to be tested on hundreds of participants. Since adaptive tests require large item banks, they are particularly expensive to calibrate. As a result, adaptive testing has yet to become standard in music cognition research.

Aims

This study therefore presents a novel and more efficient approach to the calibration of adaptive musical ability tests. Test items are constructed to vary along several controllable dimensions that are known to influence item difficulty. The exact relationship between these dimensions and item difficulty is then quantified in a calibration study. The resulting information allows the generation of a potentially infinite number of automatically calibrated test items. The aim of the present study was to trial this new methodology through the construction of an adaptive beat perception test.

Method

Stimuli for the beat perception test took a similar format to the original Gold-MSI stimuli (Müllensiefen et al., 2014), themselves inspired by Iversen and Patel's (2008) Beat Alignment test. Each stimulus comprised a short instrumental excerpt (c. 5 seconds) overlaid with a metronome-like beep track. This beep track always took the correct tempo, but could be displaced to varying degrees, ahead or behind the beat. For each test item, two such stimuli were presented in a two-alternative forced choice paradigm. Both stimuli would derive from the same instrumental excerpt, but in one the beep track would be perfectly aligned with the instrumental excerpt, while in the other the beep track would be displaced. The participants' task was to determine which stimulus is the perfectly aligned version.

It was predicted that the primary contributor to item difficulty would be beep-track displacement, with other predictors playing only secondary roles. Beep-track displacement was scored using a measure derived from circular statistics, producing a variable termed *beep-track accuracy,* after Musil, Frieler, & Müllensiefen (in preparation). The viability of *beep-track accuracy* as a predictor of item difficulty was confirmed in a pilot study, where a 32-item non-adaptive beat perception test was administered online to 198 participants. On the basis of this study, a number of unreliable instrumental excerpts were discarded, and a suitable *beep-track accuracy* range was chosen for testing purposes.

The relationship between item difficulty and its potential predictors was then quantified in a full calibration experiment, administered online to 229 participants. The first predictor was *beep-track accuracy*, which took 27 levels, spanning a range determined by the pilot study. The second predictor was *track*, denoting the choice of instrumental excerpt, and also taking 27 levels. The third predictor was the dichotomous variable *error.type*, corresponding to whether the displaced beep track was ahead or behind the beat. These three predictors were combined factorially to produce 1,458 different items. Each participant responded to 27 randomly selected items, with the constraint that each level of *beep-track accuracy* and each level of *track* appeared exactly once.

Results

Two statistical models were constructed to investigate the prediction of item difficulty. The first model investigated how well item difficulty could be predicted solely by accuracy, using a traditional IRT approach. For this model, test responses were collapsed over the variables *track* and *error.type*, while each level of *beep-track accuracy* was treated as a unique item, whose difficulty was to be estimated by standard IRT techniques. These responses were modelled by a modified one-parameter logistic IRT model, with the lower asymptote fixed to 0.5 to account for guessing performance. The resulting

item difficulties were significantly predicted by *beep-track accuracy*, $p < 0.001$, Pearson's $r = 0.94$.

Next, we investigated further predictors that influence participants' responses, using a logistic mixed effects model to decompose item difficulty into a linear combination of stimulus properties. Fixed effects were *beep-track accuracy* and *error.type*, and random effects were *track* and *participant*. As expected, responses were significantly predicted by *accuracy* ($p < 0.001$, *fixef* = 1.22); in addition, *error.type* contributed a smaller effect ($p < 0.001$, *fixef* = 0.32), with behind-beat errors being easier to notice than ahead-of-beat errors. Responses were also influenced substantially by *track*, with *stdev(ranef)* = 1.02.

The parameters estimated by the logistic mixed effects model can now serve to estimate item difficulty for new and automatically generated test items, taking into account the degree of displacement of the beep track, the direction of displacement of the beep track, and the instrumental excerpt being played. Using this procedure it is possible to generate an infinite number of pre-calibrated items for the item bank of the adaptive test.

This adaptive beat perception test can be implemented with a variable number of items, up to a maximum of 25, depending on the requirements of the individual experiment. More items will give more precise estimations of participant ability, but fewer items can be used if a short test is required. After each item is administered, participant ability is estimated based on the previous responses and the difficulty of the administered questions, using Bayes modal estimation (Birnbaum, 1969). The next item is then chosen so that its difficulty is maximally similar to the estimated participant ability, according to Urry's (1970) procedure. At the end of the test, the test estimates the participant's ability on a standardised beat perception ability scale. Including instruction and practice trials, the full 25-item test takes approximately eight minutes for each participant. The test is currently being validated experimentally.

Conclusions

The approach outlined in this paper has enabled the efficient construction of a new adaptive beat perception test for the Gold-MSI battery. As a next step, we intend to employ the same principles of test construction and automatic item generation to create a new adaptive version of the Gold-MSI melodic memory test. Applied to other listening tests, the methodology described here should allow the powerful technique of adaptive testing to benefit many parts of music cognition research.

Keywords

Goldsmiths Musical Sophistication Index (Gold-MSI); musical ability; beat perception; psychometrics; item response theory; adaptive testing; automatic test item generation

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Effects of musicianship and experimental task on perceptual segmentation

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ABSTRACT

The perceptual structure of music is a fundamental issue in music psychology that can be systematically addressed via computational models. This study estimated the contribution of spectral, rhythmic and tonal descriptors for prediction of perceptual segmentation across stimuli. In a real-time task, 18 musicians and 18 non-musicians indicated perceived instants of significant change for six ongoing musical stimuli. In a second task, 18 musicians parsed the same stimuli using audio editing software to provide non-real-time segmentation annotations. We built computational models based on a non-linear fuzzy integration of basic and interaction descriptors of local musical novelty. We found that musicianship of listeners and segmentation task had an effect on model prediction rate, dimensionality and components. Changes in tonality and rhythm, as well as simultaneous change of these aspects were important to predict segmentation by listeners. Our results suggest that musicians pay attention to more features than non-musicians, including more high-level structure interactions. Prediction of non-real-time annotations involved more features, particularly interactions thereof, suggesting high context dependency. The role of interactions on perception of musical change has an impact on the study of neural, kinetic and speech stream processing.

I. BACKGROUND

While listening to music, we spontaneously parse musical structure based on our perception of significant changes and repetitions. This dual process of grouping and segmenting music involves high-level cognitive functions such as memory, attention, and decision-making. Since music listening is a temporally unfolding process, real-time indications of musical boundaries are of great interest for music perception. However, the real-time perception of a succession of events may not guarantee a complete understanding of an underlying structure. Moreover, experience and musicianship in particular might guide our attention towards different characteristics of the musical stream. On top of that, the hierarchical grouping structure of music affords multiple levels for segmentation, such as notes, beats, motifs, phrases, melodies and sectional forms. In this study, we mainly investigate phrase-level musical boundaries, which are understood in this article as instants of significant change in the music. We aimed to systematically investigate the role of timbre, rhythm, and tonality on segmentation by musicians and non-musicians in different tasks. To this end, we proposed a method for polyphonic audio-based computational modeling of perceptual segmentation based on optimal musical feature subsets.

The tendency towards perceptual grouping of musical and other temporal sensory information into streams of events has been well studied. This Gestalt phenomenon has been of particular interest for auditory scene analysis (ASA) psychophysical models (Bregman, 1994), as well as within music theory, for melodic expectation models (Narmour, 1992) and generative theory of tonal music (GTTM) formal descriptions (Lerdahl & Jackendoff, 1983).

Within music cognition, MIDI-based data- and model-driven methods (Wiering, de Nooijer, Volk, and Tabachneck-Schijf, 2009) have been suggested for boundary prediction in score-based monophonic musical examples. Few works have been carried out on validation of segmentation systems and rules via music listening studies (Wiering et al., 2009; Bruderer, 2008; Frankland & Cohen, 2004; Clarke & Krumhansl, 1990; Peretz, 1989; Deliège, 1987). Changes in timbre and harmonic progression are melodic description cues that listeners frequently used to justify segmentation decisions (Bruderer, 2008). Also rhythmic attributes, particularly changes in note duration, have been found to be crucial in several melodic segmentation systems (Temperley, 2007). Complex musical changes combining grouping preference rules might also be important boundary candidates, as temporal pauses of melodies are more likely to be perceived as boundaries by both musicians and non-musicians when reinforced with other determinants such as musical parallelism (Peretz, 1989).

Within music information retrieval (MIR), a number of audio-based systems for segmentation have been evaluated against perceptual ground truth, usually for polyphonic popular music. Recent studies (McFee and Ellis, 2014; Nieto & Jehan 2013) focused mainly on timbre-based features and chromagram-based (Fujishima, 1999) tonal features. 'Repetition features' are often derived from these (McFee and Ellis, 2014), yielding good results for Western popular music. Rhythmic features such as fluctuation patterns (Pampalk, Rauber & Merkl, 2002) have also shown good results in this domain (Turnbull, Lanckriet, Pampalk & Goto 2007; Jensen, 2007).

In regards to algorithms for audio-based computational modeling, the novelty approach (Foote, 2000) is still considered state-of-the-art. It is based on the computation of a feature-based self-similarity matrix, which is convolved with a Gaussian Checkerboard kernel along the diagonal to obtain a novelty curve representing transitions characterized by high dissimilarity between neighboring feature frames.

Music perception studies showed some interesting trends regarding listeners and segmentation tasks. Several studies using naturalistic stimuli (Hartmann, Lartillot & Toiviainen, 2014; Bruderer, 2008; Deliège, 1987) reported no clear effects of musicianship on segmentation, although non-musicians tend to segment more often than musicians. Effects of data collection

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dynamics, instrumentation, and key). Since perceptual segmentation is multidimensional, novelty detection should increase prediction if interactions of musical features were aggregated. Another hypothesis is that tonal and other high-level features predict segmentation better for musicians than for non-musicians. Probably both groups pay attention to the musical surface (dynamics, texture, instrumentation, register, pace), but musicians might focus relatively more on harmonic and other deeper relationships. We also assumed that

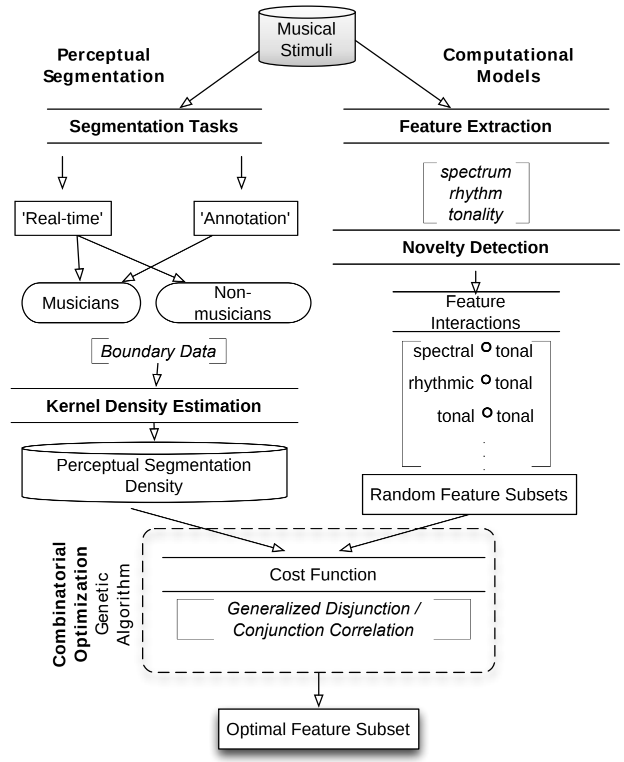

Figure 1. General design of the study.

incomplete understanding of the musical structure during segmentation of ongoing stimuli.

Our approach was implemented via an assessment of model predictability for different groups, tasks, and conjoint features. We examined the predictability of boundary density using audio-based computational approaches and diverse stimuli. We aim to contribute to music perception and MIR literature via a systematic assessment of musical features for different perceptual data.

III. METHODS

We conducted two listening experiments to gather perceptual segmentation responses, and extracted musical features from the audio to computationally model the task. Figure 1 illustrates the approach described below and in the next section. The materials were six instrumental musical audio stimuli that were around two minutes in duration and of diverse styles (see Appendix). We chose these pieces because they are relatively unfamiliar and rather diverse; we searched for music whose segmentation would rely on multiple complex processes such as textural change and similarity instead of basic "Gestalt" boundaries (long inter-onset intervals, pitch jumps, etc.). For instance, some boundaries may be unexpected or perceived as blurry transition regions, delivering uncertainty and ambiguity.

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1) Perceptual segmentation experiment

The subjects of the study were 36 participants, 18 of whom (11 males, 7 females) were musicians with an average of 14 years of training (SD = 7.49). All the musicians considered themselves either to be semi-professional or professional musicians specialized in classical (12 participants) or other (6 participants) styles. The remaining 18 participants (10 females, 8 males) reported being musically untrained, and none of them reported having skills in dance or sound engineering. The subjects were local or exchange students and graduates from the University of Jyväskylä and Jyväskylä University of Applied Sciences. The groups were matched in terms of their age distribution; the mean age was 27 years ($SD = 4.5$) for both musicians and non-musicians.

Table 1. Correlations between segmentation density and basic features.

Type	Basic Feature	NMrt	Mrt	Ma	Maw
Spectral	Subband Flux	.16	.18	.13	.23
Rhythmic	Fluctuation Patterns	**.32**	**.25**	.29	**.36**
Tonal	Chromagram (1s)	.24	.22	**.32**	.29
	Chromagram (3s)	.25	.24	.30	.29
	Key Strength (1s)	.15	.13	.19	.21
	Key Strength (3s)	.12	.12	.17	.17
	Tonal Centroid (1s)	.17	.14	.22	.24
	Tonal Centroid (3s)	.14	.14	.23	.22

Table 2. Best correlations between segmentation density and feature interactions.

Segmentation	Feature Interaction	*r*
NMrt	Fluctuation Patterns ∘ Chromagram (3s)	**.37**
	Fluctuation Patterns ∘ Chromagram (1s)	.35
	Fluctuation Patterns ∘ Tonal Centroid (3s)	.32
Mrt	Subband Flux ∘ Chromagram (3s)	.29
	Fluctuation Patterns ∘ Chromagram (3s)	**.30**
	Fluctuation Patterns ∘ Chromagram (1s)	.29
Ma	Fluctuation Patterns ∘ Chromagram (1s)	.39
	Fluctuation Patterns ∘ Chromagram (3s)	.39
	Fluctuation Patterns ∘ Tonal Centroid (3s)	**.41**
Maw	Fluctuation Patterns ∘ Chromagram (1s)	**.45**
	Fluctuation Patterns ∘ Chromagram (3s)	.44
	Fluctuation Patterns ∘ Tonal Centroid (3s)	.44

Two listening experiments were conducted to collect sets of boundary indications from 18 non-musicians and 18 musicians via different tasks.

2) Real-time task

Participants were asked to indicate instants of significant change as they listened to the music by pressing the space bar key of a computer. After reading instructions and completing a trial, they segmented each of the musical stimuli presented in randomized order. The listeners were requested to offer their "first impression" as they did not have a chance to listen to the whole stimulus beforehand or change their choice afterwards. The interface included a playbar that offered the beginning, current and end time position of the ongoing stimuli as visual-spatial cue. The real-time task segmentation density is abbreviated in Tables 1, 2, and 3 as NMrt for non-musicians and as Mrt for musicians.

3) Annotation task

We conducted a second experiment with the purpose of obtaining a more comprehensive and precise set of segmentations from participants. Audio editing skills were needed for this task, so we collected data only from musicians as they reported familiarity with this software. The same 18 musicians of the first task took part in this experiment, which we call Annotation task as it resembles structure annotation.

We collected boundaries and perceived boundary strength via an editing interface that allowed playback, marking, reposition, and labeling (Sonic Visualizer, see Cannam, Landone & Sandler, 2010). Participants were requested to listen to the complete stimulus, and at the same time mark instants of significant change over a waveform. The next step was to freely playback the music from desired time points and reposition or remove boundaries that were added by mistake. Finally, listeners were asked to mark the perceived strength of each boundary with a value between 1 (not strong at all) and 10 (very strong). We abbreviated segmentation density of the annotation task as Ma, and segmentation density considering perceived strength weights as Maw for Tables 1, 2, and 3.

4) Segmentation density

For each participant, we concatenated the obtained boundaries across all six stimuli in order to investigate general segmentation principles across stimuli. Subsequently, we constructed an estimate of the boundary indications within each task and group with normalized Kernel Density Estimation to obtain a smooth curve of boundary density over time. Following previous work (Bruderer 2008, Hartmann et al., 2014), we used a kernel width of 1.5 seconds. The upper plot of Figure 2 shows indications by non-musicians as rug marks and the perceptual segmentation density as a curve for *Aus Böhmens Hain und Flur* (B. Smetana).

A. Computational segmentation models

In addition, we obtained computational segmentation profiles via detection of novelty points over time based on local changes of 36 musical descriptors.

We extracted musical features describing spectral (Subband Flux, see Alluri & Toiviainen, 2010), rhythmic (Fluctuation Patterns, see Pampalk, et al., 2002) and tonal (Chromagram; Key Strength, see Krumhansl, 1990; Tonal Centroid, see Harte,

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Sandler & Gasser) attributes of the audio stimuli. We utilized conventional extraction parameters for rhythmic and spectral features (Fluctuation Patterns: 1 s and hop size of .1 s; Subband Flux: .025 s and hop size of .0125 s). As regards tonal features, we utilized two different window lengths to capture the chord-level (1 s, hop size .1 s) and model the tonal context (3 s, hop size .1 s). We computed novelty curves with a kernel of 16 s from these eight features to represent spectral, rhythmic and tonal dissimilarity over time. This kernel size was found to provide temporal smoothness comparable to the perceptual segmentation density.

Since we also focused on the interaction of musical features, we merged each pair of basic novelty curves to obtain all 28 possible combinations. Each interaction feature was computed as pairwise multiplication of two novelty curves, symbolized as ∘ and illustrated in Figure 1.

correlations obtained for each perceptual segmentation density are shown; the highest correlation for each segmentation density is indicated in bold font. The interaction features also exhibited weak to moderately low correlations, which peaked for rhythmic-tonal interactions regardless of the perceptual task.

B. Perceptual segmentation vs. multidimensional novelty

Next, we investigated how the perceptual data could be predicted using combinations of novelty curves. We deemed multiple regression to be inadequate for this purpose, since it would assume a constant contribution of each feature across stimuli and time. Therefore, we combined the novelty features via ranking-based aggregation. Roughly, our computational modelling approach involved obtaining a percentile across an optimal subset of novelty features for each time point.

Table 3. Correlations between segmentation density and percentile-based computational models

	NMrt	Mrt	Ma	Maw
Subset	Fluct. Pat.	Sub. Flux	Fluct. Pat.	Fluct. Pat.
	Tonal Centr. (1s)	Fluct. Pat.	Tonal Centr. (1s)	Tonal Centr. (1s)
	Sub. Flux ∘ Fluct. Pat.	Sub. Flux ∘ Fluct. Pat.	Sub. Flux ∘ Chromag. (1s)	Sub. Flux ∘ Fluct. Pat.
	Sub. Flux ∘ Tonal Centr. (3s)	Sub. Flux ∘ Key Strength (3s)	Sub. Flux ∘ Chromag. (3s)	Sub. Flux ∘ Key Strength (3s)
	Fluct. Pat. ∘ Chromag. (3s)	Sub. Flux ∘ Tonal Centr. (3s)	Sub. Flux ∘ Tonal Centr. (3s)	Sub. Flux ∘ Tonal Centr. (3s)
		Fluct. Pat. ∘ Chromag. (1s)	Fluct. Pat. ∘ Chromag. (3s)	Fluct. Pat. ∘ Chromag. (1s)
		Fluct. Pat. ∘ Chromag. (3s)	Fluct. Pat. ∘ Tonal Centr. (1s)	Fluct. Pat. ∘ Chromag. (3s)
			Fluct. Pat. ∘ Tonal Centr. (3s)	
Type	Rhythmic	Spectral	Rhythmic	Rhythmic
	Tonal	Rhythmic	Tonal	Tonal
	Spectral ∘ Rhythmic	Spectral ∘ Rhythmic	Spectral ∘ Tonal (3x)	Spectral ∘ Rhythmic
	Spectral ∘ Tonal	Spectral ∘ Tonal (2x)	Rhythmic ∘ Tonal (3x)	Spectral ∘ Tonal (2x)
	Rhythmic ∘ Tonal	Rhythmic ∘ Tonal (2x)		Rhythmic ∘ Tonal (2x)
r	.41***	.38***	.44***	.52***

*: p < .001

IV. RESULTS

The perceptual segmentations were compared with the novelty curves and also with computational segmentation models derived from optimal feature subsets.

A. Baseline: Perceptual segmentation vs. novelty

Each perceptual segmentation density curve was correlated with each basic novelty feature and each interaction feature. Table 1 shows the correlations for each of the eight basic novelty features; values in bold show the best correlation obtained for each perceptual segmentation density. Correlations ranged from weak to moderately low; the features yielding the highest similarity with perceptual segmentation density curves were rhythmic (Fluctuation Patterns) and tonal (Chromagram). Tonal features were better predictors in the Annotation task than in the Real-time task.

The highest correlations between segmentation density and interaction features are presented in Table 2. The three highest

1) *Combining novelty curves*

The used model is inspired by soft computing and describes musical change based on a flexible operation to aggregate features. The features are integrated using a percentile measure, which can be considered as a generalized conjunction/disjunction function (Dujmović, 2007). This can be understood as a 'majority voting' that is neither based on all the features nor on only one feature. For example, the 50th percentile across features will be high if at least half of the considered features exhibit high musical change. We found that the 50th percentile (median ordinal position) yielded computational segmentation models that provided the best fit to the perceptual segmentations.

2) *Optimal feature subset via combinatorial optimization*

Based on the correlation between perceptual and computational models, we selected an optimal feature subset to compute the aggregate feature. Due to the high number of possible feature

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combinations per perceptual segmentation (2^{36}), we used Genetic Algorithm optimization to find the optimal subset. The optimization cost function was initialized with random subsets of all 36 features and evaluated using correlation as criterion.

The middle plot of Figure 2 displays the optimal set of novelty features for non-musicians, and the respective aggregate feature.

We found that the feature aggregation method increased the prediction rate over the individual novelty features. Table 3 shows the best correlations found via the percentile-based computational model, and their p-values (obtained via Monte Carlo simulation). The correlations were moderately high, reaching $r = .52$ for the prediction of segmentation by musicians in the Annotation task (with strength weights). The lowest plot of Figure 2 compares the computational model with the perceptual segmentation density obtained for non-musicians. Notably, Tables 1, 2, and 3 show increased computational model prediction rates for segmentation for non-musicians over musicians. Moreover, prediction rates are overall higher for the annotation task than for the real-time task.

In regards to selected features, we found a general trend with rhythm and rhythmic-tonal interactions contributing to higher correlations. For both participant groups, rhythmic (Fluctuation Patterns) and rhythmic-tonal interactions (Fluctuation Patterns ∘ Chromagram 3s) were included in the optimal model. The computational model of the segmentation by musicians (Table 3), however, involved more features, especially feature interactions. For both segmentation tasks, rhythmic-tonal interactions as well as rhythmic and tonal basic features exhibited the highest correlations. The number of aggregated features, particularly feature interactions, was higher in the optimal computational model of the Annotation task (Table 3).

V. DISCUSSION

Our results indicate that, despite differences between groups and tasks, rhythm and tonality are the most important features in segmentation modeling. In particular, we found that spectral-tonal and rhythmic-tonal interactions were crucial for segmentation prediction. The role of high-level features in prediction via computational modeling increased both for musicians and for the annotation task.

One general finding is that the prediction rate of the computational models does depend on the musicianship level and segmentation task. The obtained correlations suggest that computational segmentation models can yield better prediction for non-musicians than for musicians. Perhaps this is because segmentation by musicians relies on more complex musical knowledge and involves conceptually driven processing. Moreover, the results show increased prediction of computational segmentation models for the Annotation task than for the Real-time task. One explanation for this could be that perceptual delays were corrected in the Annotation task since participants had the possibility to reposition their indications. Boundary density weighted with strength ratings further increased the prediction rate in the Annotation task, suggesting that the height of novelty peaks is predictive of the perceived salience.

We also found differences between groups and segmentation tasks in the size and composition of feature subsets selected for the optimal computational models. Our results show that more

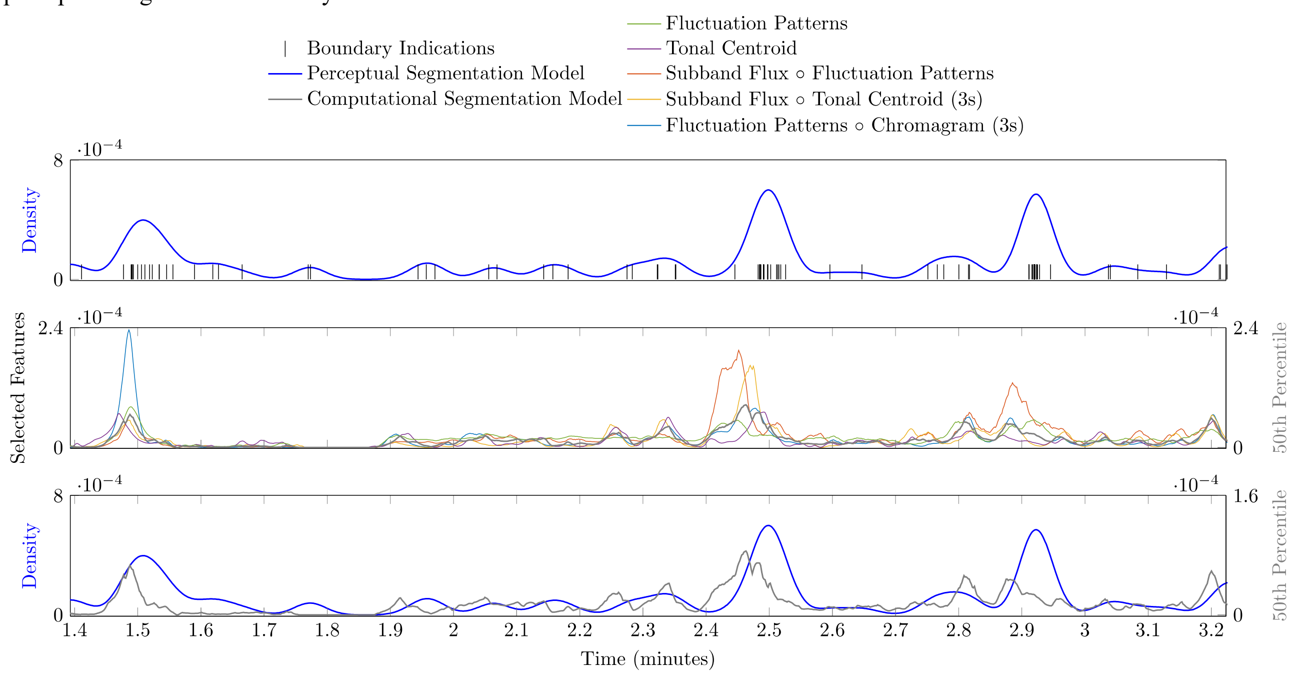

Figure 2. Perceptual segmentation density and computational segmentation model for non-musicians in the Real-time task (*Aus Böhmens Hain und Flur*, B. Smetana). Upper plot: Perceptual boundary data and segmentation density. Middle plot: Optimal feature subset and computational model. Lower plot: Segmentation density and computational model.

features were needed to predict musical change indicated by musicians, suggesting that they pay attention to more features. Compared to non-musicians, musicians followed a more complex pattern, as their optimal models were derived from more feature interactions. Since musicians relied on more interaction features, they might process musical structure with more emphasis on simultaneous change of multiple attributes. Interaction features can be considered high-level or structural features, because they represent simultaneous change in two dimensions. Previous findings (Hartmann et al., 2014; Bruderer, 2008; Deliège, 1987) showing fewer boundary indications by musicians than non-musicians are in the same vein, suggesting that musicians pay attention to higher levels of the structural hierarchy.

Comparing tasks, we found that the optimal models for the Annotation task are larger in feature subset size and more diverse in composition than for the Real-time task. Probably the Annotation task involved more high-level features because non-real-time contexts prompt deeper structure representations and include retrospective aspects of segmentation.

In regards to our proposed percentile-based computational model, it provided better prediction than correlation with individual novelty features. The 'majority voting' logic described musical change as a trend across features, whose relative contribution varied over time and stimuli.

Our results expand previous evidence (Pearce and Wiggins, 2006) on the influence of harmonic, metrical, and rhythmic pattern changes on melodic boundary perception. We suggest the importance of simultaneous change of these aspects in phrase-level segmentation of polyphonic audio. Hence, chord boundaries that are isochronous with rhythmic or metrical pattern change might constitute important cues for boundary perception.

VI. CONCLUSIONS

This study focused on the contribution of spectral, rhythmic, and tonal features for prediction of segmentation using six diverse stimuli. Moreover, we estimated the effects of musicianship and task upon perceived segmentation of naturalistic stimuli in real-time and non-real-time listening contexts. Using a novel approach, we built computational segmentation models based on optimal subsets of basic and interaction of musical features. We found that simultaneous change in rhythmic patterns and tonal context had an important role in prediction of perceptual segmentation. More features, particularly high-level interactions, were important for prediction of segmentation by musicians compared to non-musicians. Similarly, optimal prediction of segmentation in a non-real-time task required more features, mainly high-level, than in a real-time task. Implications for music education include development of listening and expressive skills regarding simultaneous rhythmic and tonal changes. Our results also make an impact on digital music retail for music streaming services and on other applications such as audio software. Our bottom-up model, however, did not take into consideration top-down aspects, such as violations of musical expectation, and our focus on instants of change disregarded the contribution of other aspects of segmentation such as repetition. Another shortcoming is the lack of qualitative analysis of the stimuli, which would allow a better understanding of the segmentation process. We consider completing the block design in future work by collecting segmentation indications by non-musicians in the Annotation task. In regards to the stimuli, the repertoire is biased towards common practice piano music. It is expected that the outcomes of this study will encourage work in music perception and MIR on the contribution of high-level interaction for music segmentation.

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APPENDIX

Musical Stimuli

Banks, T., Collins, P. & Rutherford, M. (1986). The Brazilian. [Recorded by Genesis]. On Invisible Touch [CD]. Virgin Records. (1986).
Spotify link:
http://open.spotify.com/track/7s4hAEJupZLpJEaOel5SwV
Excerpt: 01:10.200-02:58.143.

Smetana, B. (1875). Aus Böhmens Hain und Flur. [Recorded by Gewandhausorchester Leipzig - Václav Neumann]. On Smetana: Mein Vaterland [CD]. BC - Eterna Collection. (2002).
Spotify link:
http://open.spotify.com/track/2115JFwiNvHxB6mJPkVtbp
Excerpt: 04:06.137-06:02.419.

Morton, F. (1915). Original Jelly Roll Blues. On The Piano Rolls [CD]. Nonesuch Records. (1997).
Spotify link:
http://open.spotify.com/track/6XtCierLPd6qg9QLcbmj61
Excerpt: 0-02:00.104.

Ravel, M. (1901). Jeux d'Eau. [Recorded by Martha Argerich]. On Martha Argerich, The Collection, Vol. 1: The Solo Recordings [CD]. Deutsche Grammophon. (2008).
Spotify link:
http://open.spotify.com/track/27oSfz8DKHs66IM12zejKf
Excerpt: 03:27.449-05:21.884

Couperin, F. (1717). Douzième Ordre / VIII. L'Atalante. [Recorded by Claudio Colombo]. On François Couperin : Les 27 Ordres pour piano, vol. 3 (Ordres 10-17) [CD]. Claudio Colombo. (2011).
Spotify link:
http://open.spotify.com/track/6wJyTK8SJAmtqhcRnaIpKr
Excerpt: 0-02:00

Dvořák, A. (1878). Slavonic Dances, Op. 46 / Slavonic Dance No. 4 in F Major. [Recorded by Philharmonia Orchestra - Sir Andrew Davis]. On Andrew Davis Conducts Dvořák [CD]. Sony Music. (2012).
Spotify link:
http://open.spotify.com/track/5xna3brB1AqGW7zEuoYks4
Excerpt: 00:57.964-03:23.145

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Asymmetrical meter in Scandinavian folk music and dance: A case study of Norwegian Telespringar

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ABSTRACT

Certain traditional Norwegian and Swedish dance tunes in triple meter are referred to as being in so-called *asymmetrical meter*—that is, the three beats in the measure are of uneven duration. Norwegian telespringar is recognized for a type of asymmetrical meter featuring a systematic *long–medium–short* duration pattern at beat level. These systematic microtiming patterns are often described in terms of deviations from an underlying isochronous pulse. However, it has been argued that performers' body motion may offer a more perceptually relevant structure of reference than an abstract fixed clock pulse. This study investigates whether the asymmetrical beat patterns previously shown in telespringar music are also represented in the body motion of performers who are playing and dancing. It is reported from two motion capture studies: first, a fiddler playing telespringar on a traditional Hardanger fiddle; second, a couple dancing telespringar. Motion analysis of the fiddler's foot stamping indicates a very regular *long–medium–short* beat pattern. In addition, the fiddler's upper-body swaying and the vertical motion of the body's center of gravity in telespringar dancing are in synchrony with the bar level of the music. The fiddler's foot stamping confirm the *long–medium–short* beat duration hypothesis and support the view that the systematic microtiming features in telespringar are not a matter of deviation from an underlying isochronous pulse. Instead, they actually constitute an essential feature of telespringar.

I. INTRODUCTION

The *pulse* level in music is considered a fundamental temporal structure for rhythm perception (Parncutt, 1994; Danielsen, 2010; London, 2012). Although the underlying pulse can be represented by actual sonic events in the music, it can also exist without the sound, which is the case with, for example, syncopation or a rests in the music, (Snyder, 2001; Sethares, 2007; Honing, 2013). The internal counterpart to this pulse in performers and perceivers, the internal beat, is often described as the level of musical rhythm that we nod our head or tap our feet to (Su and Pöppel, 2012). This underlying pulse is often assumed to consist of isochronous beats. Systematic microtiming features are often conceptualized as deviations from a pulse of isochronous beats. However, it has been pointed out that in many music styles the underlying pulse seems to consist of non-isochronous beats, meaning that systematic microtiming may not be perceived as deviations from underlying isochronous beats, but actually represent the pulse reference of the music (Hopkins, 1966; Kvifte, 2004; Polak, 2010). This seems to be the case with a considerable part of traditional folk music and dance of Sweden and Norway often referred to as being in so-called *asymmetrical meter* – that is, music in triple meter, where the three beats in a measure are of different duration (see e.g., Bakka et al. 1995; Kvifte, 1999). The intimate relationship with the dance is often emphasized in rhythm studies of folk music in asymmetrical meter, and it has been suggested that the rhythmical patterns in the music may be conditioned by a particular way of dancing. In accordance with the view that an underlying perceived pulse, that is, an internal beat, often is explicated through body motion, it has been suggested that performers' body motion should be incorporated in investigations of rhythm structures in music featuring asymmetrical meter (see, e.g., Blom, 1981; Bengtsson, 1987; Kvifte, 2004; Ahlbäck 2003).

A. Telespringar

In this paper we focus on the rhythmical structures in music and motion of traditional Norwegian folk music from the region of Telemark called *telespringar. Springar* tunes are considered one of the older types of Norwegian folk music, called *bygdedans* (regional dance*)* (Bakka et al., 1995). Springar tunes are normally notated in ¾, however, it is pointed out that while ¾ meter normally refers to measures of even beats, this is not the case with springar. In telespringar a systematic *long – medium – short* beat duration pattern seems to be a prominent feature (see, e.g., Groven, 1971; Kvifte 1999).

Telespringar can be played on several musical instruments, e.g. Jew's harp, flutes and accordion, but it is commonly played on the *Hardanger fiddle*. The Hardanger fiddle is slightly smaller than a regular violin, with a shorter neck and a flatter bridge. In addition to the bowed strings, there are four or five sympathetic strings that run under the board (Blom & Kvifte, 1986). Although the style and patterns can differ between fiddlers, foot stamping seems to be an integrated part of telespringar playing, (Kvifte, 1999; Ahlbäck, 2003; Johansson, 2009). In telespringar fiddlers usually stamp their feet on the first and the second beat (Kvifte, 1999).

B. Telespringar dancing

Telespringar dance is a coupled dance that is usually danced in a ring formation. Most variants of the springer consists of a *winding part*, where the dancers turn under each others arms wile moving forward or backwards in the line of dance, an *unfastened part,* where the dancers dance independently along the line of dance, and a *couple turning part*, where the dancers turn around together (Bakka et al., 1995). The dance patterns in folk dance are often described based on the footwork, which foot is carrying the body weight, and the *svikt* pattern. The svikt pattern is the vertical movement of the body caused by bending knees and ankles, combined with hinging on the ball of the foot (ibid.). The Norwegian anthropologist and ethnomusicologist

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Jan-Petter Blom (1981, 1993, 2006) emphasizes that the musical meter in telespringar should be understood in relation to the corresponding dance. Blom illustrates how the svikt pattern in telespringar results in a *patterned libration of the body's center of gravity* (*libration pattern*). The libration pattern in telespringar consists of two down/up motions in each measure, and Blom argues that the first down/up motion corresponds to the duration of the first beat, the next down motion corresponds to the second beat and the following up motion corresponds to the third.

In this paper we wanted to investigate whether the asymmetrical beat pattern in telespringar is present in performers' body motions.

II. METHOD

Three telespringar performers, a fiddler and two dancers, participated in the study. Two separate recordings were carried out: first, a fiddler playing telespringar on Hardanger fiddle; second, a couple dancing telespringar. The recordings were carried out in the fourMs Motion Lab at the Department of Musicology at the University of Oslo. The participants' body motions were recorded at 100 Hz using a nine-camera motion capture system from Qualisys. A total of 27 reflective markers were attached to the fiddler's body (Figure 1a). In order to

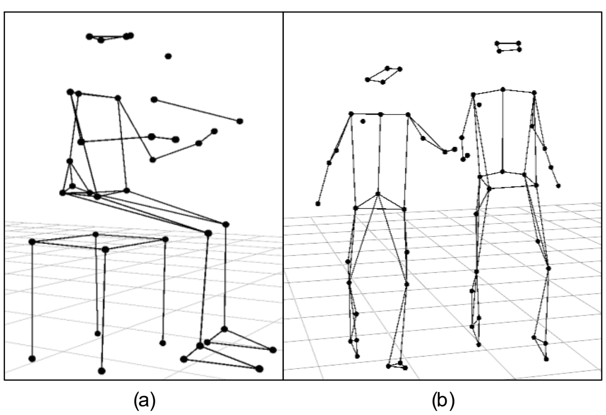

Figure 1. Placement of the markers attached to (a) the fiddler's and (b) the dancers' bodies. The markers were placed slightly different from dancer 1 to dancer 2 in order to distinguish them.

Since the recordings of the fiddler and the dancers did not take place on the same day, the dancers were dancing to the music that had been recorded in the fiddler's session, allowing the dance recording to be perfectly synchronized with the fiddler's session. The music was played back from a custom-built MAX/MSP patch running on a Macintosh computer.

III. AUDIO ANALYSIS

The sound data from the recordings were analysed using the MIR Toolbox for MatLab (Lartillot & Toiviainen, 2007). One way to analyse sound is by looking at its waveform (signal strength over time). A sudden increase in signal energy, for example, can indicate a new sound event (Collins, 2010). We used the *onset detection* function in the MIR Toolbox that performs peak detection on the audio signal in order to estimate the positions of the notes. However, the sound of Hardanger fiddle is complex and it is difficult to determine which, if any, of the peaks in the fiddler performance's waveform that is likely to represent the beginning of notes.

In his work on asymmetrical grooves in Norwegian folk music, Mats Johansson (2009) concludes that the best method for sound analysis investigating rhythmical structures in telespringar is to combine auditory cues with visual clues. Johansson recorded the music of interest into a computer program displaying the music's waveform and playing back the sound at the same time. By moving the cursor back and fourth, Johansson tried to determine where one sound unit seemed to stop and the next start. Here we combined the method described by Johansson with the onset data from the onset detection, that is we moved the cursor back and forth in order to manually pick the onsets that were closest to a beat (Figure 2).

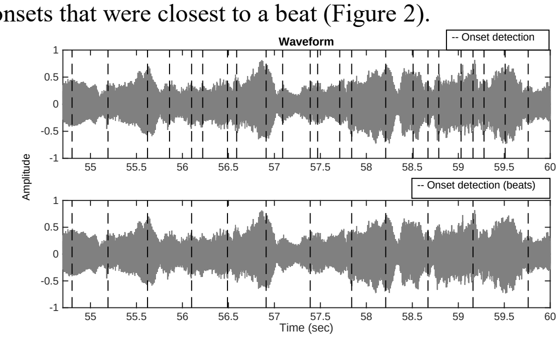

Figure 2. Visualization of the sound of four measures of telespringar playing. The audio waveform with all the onset data estimated using the onset detection function indicated as dotted lines (top), and the manually selected beat positions based on the onset detection indicated as dotted lines (bottom).

The beat durations based on the selected onsets were calculated as inter-onset-intervals. The durations of the beats were measured in seconds and subsequently converted to percentages according to their percentage of the measure, in a total of 36 measures. The calculated duration of the first beat was on average 41 % (SD=2.1) of a measure, the second beat 34 %, (SD=2.4) and the third beat 25 % (SD=1.6). Our audio analysis thus confirmed the *long – medium – short* beat duration pattern. However, these results should be interpreted with caution since the waveform may not be the best point of departure for estimating the position of sound events in telespringar playing.

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IV. MOTION ANALYSIS

The motion data, obtained from the motion capture recordings, were analysed using the MoCap Toolbox for Matlab (Burger & Toiviainen, 2013) and custom-made script.

According to previous research the fiddler's foot stamping (Kvifte, 1999; Ahlbäck, 2003) and the dancers' libration pattern (Blom, 2006) are of particular interest in rhythm studies of traditional dance music in asymmetrical triple meter. Consequently, we focus on the fiddler's ancillary body motions, namely foot stamping and upper body swaying, and the vertical movements of the dancers' centre of gravity (libration pattern).

C. The fiddler's foot stamping

In order to analyze the foot stamping of the fiddler in present study, we plotted the vertical motions of the markers attached on the fiddler's heels and toes on both feet (Figure 3). The plots indicate that the right heel stamps on every beat, the left heel stamps on every first beat and the left toe stamps on every third beat. Since the right heel seems to stamp on every beat in a bar, we calculated the beat duration pattern based on the vertical motion of the right heel. Each foot stamp resulted in an unambiguous downward spike in the motion data that could easily be measured. The beat duration were estimated by calculating the interval between the foot stamps in seconds. Subsequently the beat durations were converted into percentages of the measure. A total of 120 beat durations (40 measures) were measured. The calculated duration of the first beat was on average 41 % (SD=0.2) of a measure, the second beat 34 % (SD=0.2), and the third beat 25 % (SD=0.2). Analysis of variance showed significant differences between beat durations ($p<0.001$), and Bonferroni-corrected post-hoc tests showed significant differences between the durations of the first, second, and third beat (all $p<0.001$), showing that the duration pattern of the foot stamping is *long – medium – short*. In addition, the standard deviations for the mean duration values are all 0.02, which indicates that the *long – medium – short* pattern in the foot stamping is very steady. Considering that foot stamping is an integrated part of telespringar playing, and given the stability of the pattern, these results suggest that the beats of the foot stamping may represent an underlying beat pattern of telespringar.

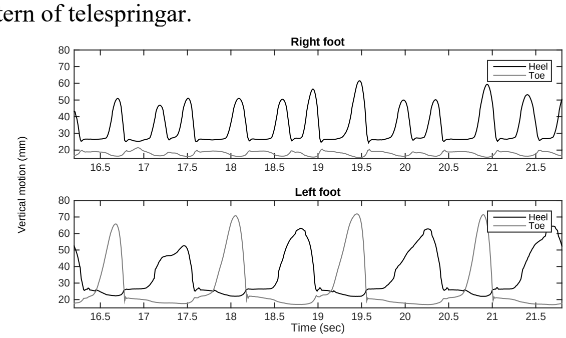

Figure 3. Plots of the vertical movements of the markers placed on the fiddler's right heel, right toe, left heel and left toe for four measures.

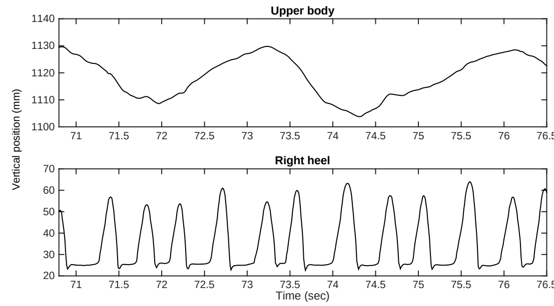

Figure 4. Plots showing the vertical motions of the markers placed on the fiddler's neck (upper body) and right heel for four measures. The upper body motion seems to be in synchrony with bar level.

D. The fiddler's upper body motion

The fiddler in the present study swayed his upper body back and forth in a regular pattern and we wanted to investigate whether this upper body swaying corresponded to a metric layer. The vertical position of the marker attached to the fiddler's neck was plotted over time. The visualization of this marker indicates that this swaying is synchronized with the measure level of the telespringar determined by the vertical movements of the foot stamping (Figure 4).

E. The *libration pattern* of telespringar dancing

As mentioned previously, Blom (1981) argues that the up/down pattern of telespringar dancing (*libration pattern*) is related to the musical meter in telespringar. In a motion capture study carried out by Turid Mårds (1999) the libration curves and force used in different types of Norwegian folk dancing were analysed. The libration curves were estimated based on the vertical position of a reflecting marker placed on the dancers' head. In addition, the dancers' steps were registered using rectangular force plates. The motion curves based on the telespringar dancers' heads showed that the duration of the first down/up motion was approximately one half of the measure, while the remaining down and up motion lasted approximately a quarter of the measure each. There are, however, some issues regarding these results. First, the libration curves are based on the motion of the dancers' heads, not the movement of what Blom referred to as the body's center of gravity. Second, the dancers' steps were measured using rectangular force plates forcing the dancers to dance in a straight line, and not in a circle, as they would normally do. One might wonder whether the use of rectangular force plates might have restrained the execution of the dance and skewed the motion-capture results.

Here then, the motion analysis was based on the markers placed on the dancers' lower back, rather than the ones placed on their heads, and the dancers were dancing in a circle. In order to investigate the correspondence between the up/down pattern of telespringar dancing (*libration pattern*) and the musical meter, we plotted the vertical position of the markers attached to the dancers' lower back and the fiddler's foot beats (Figure 5).

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The visualization of the dancers' lower back seems to confirm that dancers perform two down/up motions in every measure, as suggested by Blom (1981).

Next, we wanted to investigate whether the dancers' libration pattern corresponds with musical meter in telespringar as identified in the audio analysis, that is the first down/up motion in the dance corresponds to the first beat, the second down movement in the dance corresponds to the second beat and the last up motion in the dance corresponds to the third beat. A Butterworth smoothing filter was applied to reduce the noise in the motion data and a custom made script for picking the *peaks* and the *troughs* in a graph. The beat durations based on the libration curve was estimated by calculating the interval between the first peak and the second peak in the libration curve (beat 1), the second peak and the second thought (beat 2), and the second trough and the first peak in the following measure (beat 3). The durations were measured in seconds and subsequently converted into percentages of the measure. The result revealed a ratio of 48 – 27 – 25 (%) for dancer 1 and 46 – 27 – 27 (%) for dancer 2. Analysis of variance showed significant differences between beat durations ($p<0.001$), and Bonferroni-corrected post-hoc tests showed significant differences between the durations of the first and the second beats and the first and the third beats (both $p<0.001$), but no significant differences between the second and the third beats ($p>0.70$ for dancer 1 and $p>0.99$ for dancer 2). This indicates that the libration pattern in this study differs from the music meter being *long – short – short* rather than *long – medium – short*. This is, however, similar to Mårds' (1999) findings.

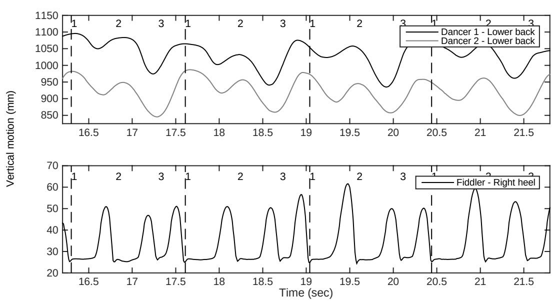

Figure 5. Plots showing the vertical motions of the markers attached to the dancers' lower back and the fiddler's right heel for four measures. The positions of the first beat in every measure, estimated from the fiddler's foot stamping, are indicated by dotted lines.

V. DISCUSSION

In this paper we wanted to investigate the asymmetrical meter of telespringar by including the body motions of performers playing and dancing telespringar. Our motion analysis of the fiddler's foot stamping confirmed a stable *long – medium – short* beat duration pattern. We interpret these findings in support of this pattern being an essential rhythmic structure in telespringar.

The patterns identified through visualization of the vertical motions of the dancers' lower back confirm Blom's libration pattern hypothesis, that is, the assumption that the dancers make two down/up motion in every measure. However, the estimated beat durations, based on the libration curves' peaks and troughs, revealed a *long – short – short* duration pattern, which differs from Blom's (1981) hypothesis, but is similar to Mårds' (1999) findings. A possible explanation can be that while Blom's model is based on his own practical experience and close observation, Mårds' and our findings are based on motion capture recordings. One may argue that since motion capture systems provide high position position data, motion analysis based on motion capture offers a more precise representation of the dance motions than motion analysis based on observations. On the other hand, since motion capture recordings often are carried out in a motion capture lab, the dancers may feel awkward and restricted when dancing. However, some previous studies have concluded that the participant's professional experience can balance the influence of the artificial environment (Nevada & Leman, 2008; Haugen & Godøy, 2014).

The dancers' libration curves should probably be analysed in relation to the corresponding dance steps. The position data of the markers placed on the dancers' feet in this study were quite noisy, and a rhythm pattern was not easily detected by looking at the position plots. However, the video recording indicates that the dancers perform three steps in each measure. Our motion analysis of the vertical motion of the dancer's lower back indicates a *long – short – short* beat duration pattern corresponding to the dancers' down/up – down – up motion pattern, with beat ratio 47 – 27 – 26 % when averaging the results from the two dancers. However, instead of understanding the libration pattern as consisting of three parts, one may look at it as two down/up motions, that divides the measure into two parts. In that case the libration pattern may represent an additional metrical layer that interacts with the dancers' steps, as well as an underlying asymmetrical triple meter. However, more telespringar recordings have to be carried out in order to decide whether this is a general rhythm pattern in telespringar dance or only represents the motion patters of the dancers in this study.

VI. CONCLUSION

The results from this study indicate that prominent rhythm features of telespringar are present in performers' body motion. Motion analysis of the fiddler's foot stamping confirms the *long–medium–short* hypothesis regarding the underlying pattern of beat durations in telespringar. In addition, the fiddler's upper-body movements and the dancers' libration pattern seem to be in synchrony with the bar level. Our results suggest that rather than considering the asymmetrical musical beats in telespringar as deviating from an underlying isochronous pulse, the underlying pulse should be understood as asymmetrical in and of itself, that is, as consisting of beats with uneven duration.

VII. LIMITATIONS AND FUTURE RESEARCH

Our audio analysis based on onset detection showed a *long – medium – short* beat duration pattern. However, the audio signal of a Hardanger fiddle is complex and using onset detection alone is probably not the best method for analysing rhythm structure in telespringar music. In future studies a combination of feature extractors should be included in the audio analysis.

Since the results presented in this paper are based on only one recording of a fiddler and one recording of two dancers, it should be considered as preliminary. If more general conclusions are to be drawn, more telespringar performance recordings should be included. In addition, future studies should also incorporate recordings of dancers and fiddler performing simultaneously, rather than separately. There is undoubtedly an intimate relation between the music and the dance in telespringar, however, the link between their rhythmical patterns remain to be understood.

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Tweens' and teens' engagement with music in daily life: Individual differences and psychological characteristics of subjective experience

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ABSTRACT

Background

Music is a pervasive presence in the lives of many children and adolescents. The everyday functions of music and the association between aspects of young people's musical engagement (e.g. uses of music, duration of musical training) and individual differences in personality (e.g. openness, conscientiousness) have attracted increasing research attention. Yet, the subjective experiences of this age group are little understood; few studies have tapped the phenomenology of unfolding, lived encounters with music - particularly with reference to prepubescent and early adolescent experience. Additionally, to date no study has examined the relationship between personality and musical engagement as a multifaceted phenomenon (encompassing production *and* reception).

Aims

This paper reports findings from stages one and two of a mixed method nationwide UK study of young people's subjective experiences of music. The aims were to: 1) explore the phenomenology of young people's everyday interactions with music (both listening and playing; 2) examine the relationship between musical engagement and age, gender and personality characteristics.

Method

Stage 1: 34 participants (aged 10-18) took part in semi-structured interviews, completed a battery of established measures related to personality and engagement (Music USE (MUSE) questionnaire (Chin & Rickard, 2012); Modified Tellegen Absorption Scale (MODTAS) (Jamieson, 2005); Big Five Inventory (BFI-46-A) (John & Srivastava, 1999); Creative Experiences Questionnaire (CEQ) (Merckelbach et al., 2001); Short Test of Music Preferences-Revised (STOMPR) (Rentfrow & Gosling, 2009) and kept unstructured diaries of music-listening experiences for 14 days. Stage 2: 511 participants (aged 10-18) completed a web-based questionnaire on musical engagement (production and reception), which was informed by findings from quantitative and qualitative findings from Stage 1, also incorporating the Ten Item Personality Inventory (TIPI) (Gosling, Rentfrow & Swann, 2003) and an adapted form of the MUSE questionnaire appropriate for children and adolescents. Interview and diary data were analysed using Interpretative Phenomenological Analysis (IPA) (Smith et. al., 2009). Ordinal logistic regression models (Hardin & Hilbe, 2007) were employed to investigate the univariable and multivariable associations of socio-demographic characteristics, personality characteristics and MUSE engagement indices and styles.

Results

Analysis of qualitative data confirmed that music affords an important means of self-regulation for young people, and that the adoption of strategies to manage aspects of self and identity is evident from prepubescence. Individuals favoured particular modes of experiencing music (e.g. a tendency towards imaginative involvement or dissociative experience), some of which appeared age-related. Analysis of quantitative data indicated that openness to experience, conscientiousness and instability were associated with high involvement/attainment in playing an instrument. Imagination/fantasy proneness was associated with certain styles of engaged listening (particularly cognitive/emotional) and with engaged production. Frequency of listening, amount of self-chosen music and dissociative listening increased mid-adolescence, with girls more likely than boys to use music for self-regulatory purposes.

Conclusions

This enquiry extends understanding of the phenomenology of young people's musical experiences and individual differences in musical engagement. It offers new findings concerning associations between personality, styles of listening and uses of music that complement studies of the relationship between personality and musical training. Age and gender emerge as additional factors impacting upon ways music is subjectively experienced.

Keywords

Adolescence; subjective experience; personality; openness; engagement; dissociation.

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Making sense of music: Meanings children and adolescents perceive in musical materials

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ABSTRACT

Background

What do young people hear when listening to music? The importance of music within the lives of young people has long been recognised (Thomson et. al., 2014; Zillman & Gan, 1997; North & Hargreaves & O'Neill, 2000) and the detailed study of young people's engagement with music, including musical interaction as a means of self-regulation, is a burgeoning area (Larson, 1995; Miranda & Claes, 2009; Saarikallio and Erkkilä, 2007). However, researchers have often privileged uses and functions of music in daily life, rather than exploring how children and adolescents understand music when they listen.

Aims

The study reported is the third stage of a mixed-method nationwide UK enquiry concerning young people's subjective experiences of music. The aims were to: 1) explore listening modes used and meanings perceived in musical materials; 2) examine whether age, gender and level of musical involvement affect music listening experiences.

Method

84 students (aged 10-18, F=42, M=42) with varying levels of formal musical training completed a web-based listening study. Participants were presented with 20 short musical extracts (30s or less), heard through headphones, to which they gave free written responses. Prior general level of musical involvement (in terms of listening, playing and training) was assessed via completion of section A of the Music USE questionnaire (Chin & Rickard, 2012). Free responses were analysed thematically, and associations between the thematic analysis and factors of musical training, age and gender were analysed using analytical statistics.

Results

Data indicated young people made sense of music in relation to other media experiences, with a large visual component evident. Age-specific listening/reporting characteristics were apparent. Specifically, free responses from younger participants (10 - c.13) were more likely to show evidence of induced affect, to use first-person pronouns, include self-in-scenario visualisations often demonstrating vicarious experience through music. By contrast, responses from older participants (c.16-18) often featured a more objective, detached mode of reporting characterised by a sense of connoisseurship. Across the age range, participant responses highlighted perceived meanings indirectly related or detached from original source specifications, commonly demonstrated filmic literacy, referenced a generic 'otherness' with relation to non-Western musics. The mediating cognitive/evaluative effect of formal music education was apparent, both in technical vocabulary used and in an association between self-in-scenario fantasies and less exposure to musical training.

Conclusions

This novel focus on meanings 10-18 year olds perceive when listening to music reveals that age, media exposure and musical training impact on the ways young people make sense of music, with multimodal listening particularly common. Understanding the ways in which young people's engagement with music alters across the age span has the potential to enhance the way music education professionals and music therapy practitioners work with young people.

Keywords

Musical meaning; adolescence; pre-pubescence; subjective experience; enculturation.

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Working memory updating executive function and music training

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ABSTRACT

The main aim of our study was to examine whether musical training is associated with improvements in updating information in WM both in children and adolescents, as well as to analyze which updating subprocesses—inhibition or maintenance— are more affected by musical experience. 69 musicians (37 children aged between 10-11 years and 32 adolescents between 15-16 years) and 69 non-musicians (37 children aged between 10-11 years and 32 adolescents between 15-16 years) participated in the study, matched in academic level and in fluid intelligence. Updating function was measured by the updating task developed by De Beni and Palladino (2004), which allowed differentiating scores for maintenance and inhibition processes: maintenance, suppression of information in WM, and proactive interference. Results showed that musicians outperformed non-musicians both in maintenance and in inhibitory processes, specifically in resistance to proactive interference.

I. INTRODUCTION

Musical performance is a complex activity requiring a high cognitive demand. Playing an instrument involves the integration and processing of stimuli linked to auditory and visual perception, kinesthetic control, pattern recognition, and memory, all in real time (Barrett, Ashley, Strait, & Kraus, 2013). For this reason, musical performance has been considered to require high levels of attentional control: selective attention, inhibition, shifting, updating and monitoring (Bialystok & DePape, 2009), processes that are linked to executive control, which essentially involves cognitive flexibility, updating, and inhibition of information (Miyake, Friedman, Emerson, Witzki, Howerter, & Wager, 2000).

Some authors have considered that musical training may be associated with improvements in general domain cognitive abilities such as intelligence (Schellenberg, 2004, 2011), or with different executive functions, such as inhibition (Bialystok & DePape, 2009; Dowsett & Livesey, 2000; Hou, Chen, Wang, Liu, He, Li, & Dong, 2014; Moreno, Bialystok, Barac, Schellenberg, Cepeda, & Chau, 2011) or updating (Bialystok & DePape, 2009; Bugos, Perlstein, McCrae, Brophy, & Bedenbaugh, 2007; Franklin, Moore, Yip, Jonides, Rattray, & Moher, 2008; George & Coch, 2011; Hou et al., 2014; Lee, Lu & Ko, 2007; Ramachandra, Meighan, & Gradzki, 2012; Roden, Grobe, Bongard, & Kreutz, 2014).

In this context, the main objective of our study was to determine whether continued musical practice could generate cognitive advantages in one of those executive functions: updating information in working memory (WM). The function of updating information in WM has been considered to be a significant predictor of individual differences in abilities such as fluid intelligence (Chen & Li, 2007), mathematical reasoning (Bull & Lee, 2014; Passolunghi & Pazzaglia, 2005), or reading comprehension (Daneman & Carpenter, 1980; Palladino, Cornoldi, De Beni, & Pazzaglia, 2001). However, updating information in WM is not a unitary process. Different studies underlined the existence of two processes or basic mechanisms involved in updating: a process of maintenance/manipulation of information in a temporary store of limited capacity (Baddeley, 1996, 2000), which would analyze incoming information and select the relevant information for the ongoing task (Palladino et al., 2001), and a process of inhibition or suppression, which would eliminate information, that is no longer relevant to the task, from the temporary memory store and replace it with new, relevant information (Carretti, Cornoldi, & Pellegrina, 2007; Kessler & Meiran, 2008; Palladino et al., 2001). The latter process of inhibition or suppression has been pointed out as the most specific process of the updating function (Friedman & Miyake, 2004; Palldino et al., 2001), which differentiates it from Working Memory Capacity (Ecker, Lewandowsky, Oberauer, & Chee, 2010 Ecker, Lewandowsky & Oberauer, 2014).

Some studies have examined the influence of the component of maintenance/manipulation of information in WM in musicians, using different complex WM tasks both in children (Lee et al., 2007; Roden et al., 2014) and in adults (Bialystok & DePape, 2009; George & Coch, 2011; Lee et al., 2007; Ramachandra, Meighan, & Gradzki, 2012). The results are not entirely conclusive but seem to suggest that, when controlling for intelligence, WM could be an indicator of individual differences between musicians and non-musicians. Other authors have found a significant relationship in young adults between music training and classic updating tasks such as the n-back task (Hou et al., 2014).

However, to our knowledge, the different processes involved in updating—that is, maintenance/manipulation and inhibition processes—not have been jointly explored. Therefore, we proposed to explore the influence of music training in the development of the processes of maintenance and inhibition underlying the function of updating information in WM in different age groups. For this purpose, we carried out a study with children and adolescent musicians and non-musicians matched in academic level and fluid intelligence, using the updating task developed by De Beni and Palladino (2004). This updating task allows differentiating these two components of the updating process —maintenance and inhibition—, posing variable demands on memory and suppression, which permits the study of the interaction of the two processes. Importantly, this task also taxes different inhibition/interference processes —suppression of information in WM, that is, the ability to

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inhibit in WM stimuli that are irrelevant to the goals of the task, and proactive interference, understood as the capacity to inhibit the items stored in the long-term memory (LTM) that are no longer relevant for the ongoing task — providing different indexes of them.

This task was selected because it has been shown to be a reliable measure in the study of individual differences in various areas, such as arithmetic problem-solving (Passolunghi & Pazzaglia, 2005), reading comprehension (Carretti, Borella, Coprnoldi, & De Beni, 2009), and in the description of cognitive changes associated with age (Carriedo, Corral, Montoro, Herrero & Rucián, submitted; De Beni & Palladino, 2004; Lechuga, Moreno, Pelegrina, Gómez-Ariza, & Bajo, 2006).

We hypothesized that musicians will outperform non-musicians in the updating information in WM task, which will be reflected both in the processes of maintenance/manipulation and in those of inhibition: suppression of information and resistance to proactive interference. This improvement in the musicians' performance will be independent of their level of development.

II. METHOD

A. Participants

The sample for this study consisted of 138 students: 74 children of 3rd and 4th grade of Primary Education and 64 adolescents of 3rd and 4th grade of Secondary Education. Of the 74 children in Primary Education, 37 (26 girls,11 boys; *M* = 10.9, *SD* = .44) had been studying music since at least 2 years (range 2.5-3.5; *M* = 2.9, *SD* = .32) and received individual music training 30 minutes per week, and 37 children (15 girls, 21 boys; *M* = 11, *SD* = .40) had no formal music training; 32 adolescents (21 girls, 11 boys; *M* = 15.2, *SD* = .49) had been studying music since at least 6 years (range 6.5- 7.5; *M* = 6.8, *SD* = .28), and received individual music training 60 minutes per week, and 32 adolescents (21 girls, 11 boys; *M* =15, *SD* = .40) had no formal music training. All participants were matched in fluid intelligence by age (Raven Progressive Matrix; Raven, 1960). Parents' consent was obtained in all cases.

B. Materials

We used an adaptation to the Spanish of the updating information in WM task (Carriedo et al., submitted) developed by De Beni and Palladino, (2004). The task had a total of 24 lists (20 experimental lists and 4 practice lists), each one containing 12 words. The words were names of objects, animals, or body parts of different sizes, and abstract common nouns. Each list included words to be recalled (relevant words), words to be discarded (irrelevant words), and filler words. The number of each kind of word in each list varied depending on the experimental condition. Thus, the number of relevant words in each list varied between 3 (low memory load) and 5 (high memory load). The number of irrelevant words varied between 2 (low suppression) and 5 (high suppression). Finally, the number of abstract filler words varied from 2 to 7. The composition of lists as a function of memory load and suppression can be seen in Table 1. Target words (relevant and irrelevant) were familiar concrete nouns, which referred to body parts, objects, or animals that can be classified by size. Filler words were abstract nouns. The final 24 lists were distributed in 4 experimental conditions of 6 lists each. One list of each experimental condition was considered as practice list. Thus, each experimental condition was composed of 5 lists. The total words to be recalled across all condition lists were 80 (practice lists were excluded), 25 in the case of each high load condition, and 15 in the case of each low load condition. In 10 of the lists, the participants were asked to remember the 3 smallest items (low load condition), whereas in the remaining 10 lists, they had to remember the 5 smallest items (high load condition). Likewise, in 10 of the lists, participants had to suppress the previously presented items that were no longer the smallest items: 2 items for the 10 lists included in the low suppression condition, and 5 items for the 10 lists included in the high suppression condition (see Table 1). A list example is: *árbol (tree), autobús (bus), piscina (pool), sofá (couch), cesta (basket), tema (matter), acto (act), flor (flower), dedo (finger), lápiz (pencil), oreja (ear), patata (potato)*.

Table 1. Composition of the lists as a function of the experimental conditions.

Low load/low suppression (5 Lists)	Low load/high suppression (5 Lists)	High load/low suppression (5 Lists)	High load/high suppression (5 Lists)
3 Relevant items	3 Relevant items	5 Relevant items	5 Relevant items
2 Irrelevant items	5 Irrelevant items	2 Irrelevant items	5 Irrelevant items
7 Filler items	4 Filler items	5 Filler items	2 Filler items

C. Procedure

All the participants were tested individually. Twenty-four lists, each comprising twelve auditory words, were presented to participants. Within each list, the auditory stimuli lasted less than 1000 ms and were presented at a constant speed with a 2-s interval between words. Presentation order of the lists was randomized and, additionally, within each list, item presentation was also randomized. Randomization and time were controlled by E-Prime software, version 2.0 (Psychology Software Tools Inc; www.pst-net.com/eprime).

Participants were instructed to carefully listen to the list and when it finished, they had to recall the 3 or 5 smallest animals or objects of the list. At the beginning of each list, a text message was displayed on a computer screen to indicate the concrete number of smallest items to remember (3 or 5). Then, a beep

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preceded the first word of the list. At the end of each list of 12 items, a different beep and a big question mark on the screen asked the participants to recall the 3 or 5 smallest items of the current list by verbal response. To continue with the next list, participants had to press the space bar. Thus, during the task, participants had to update words according to a semantic criteria (size) that implies substituting and inhibiting previously presented words that are no longer relevant under variable conditions of maintenance (words to be recalled) and inhibition (words to be discarded or inhibited).

III. RESULTS

Participants' performance was analyzed in terms of proportion of recall of relevant items (as maintenance index) and proportion of intrusions (as inhibition index). In order to analyze different sources of inhibitory/interference processes, we followed the differentiation performed by De Beni and Palladino, (2004) among: (a) same-list intrusions, related to suppression mechanisms that control activation/suppression of information in WM; (b) previous-list intrusions, related to the control of proactive interference in LTM; and (c) inventions, recall of items never presented, related to the control of intrusive irrelevant thoughts coming from LTM. Proportion of recall of relevant items and proportion of all the intrusion types were calculated over the total number of words to be recalled. It should be borne in mind that, depending on the experimental condition, the number of words to be recalled varied: 25 for the high memory load conditions and 15 for the low memory load conditions. A mixed ANOVA 2 x 2 (2 x 2), with age and musical training as between-subject factors, and memory load (high and low) and level of suppression (high and low) as within-subject factors for all the dependent variables was conducted. Bonferroni correction was applied in multiple comparisons. Given the scarce number of inventions provided, the data associated with this variable were not analyzed. Figure 1 shows the mean proportion of correct answers and errors by group (musicians/non-musicians).

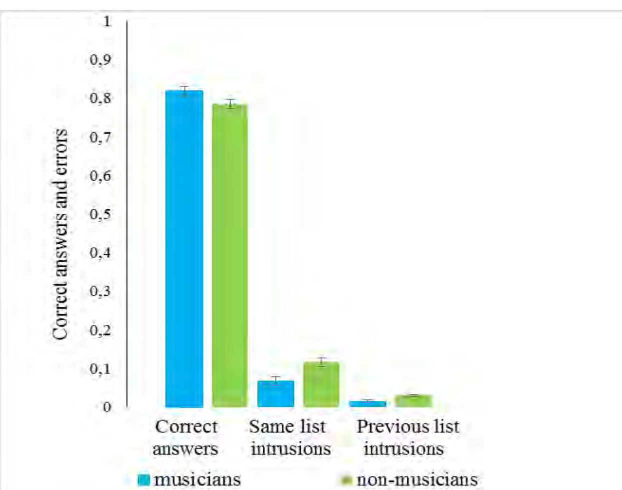

Figure 1. Mean proportion of correct answers and errors.

1) Proportion of recall of critical items.

Table 2 shows the mean proportion of recall in each one of the experimental conditions for each age and group (musicians/non-musicians). Results showed a significant effect of musical training, F (1, 134) = 3.28, p < .05, ηp^2 = .02, one tailed, which means that the proportion of correct responses was higher in musicians (82%) than in non-musicians (79%). There was also significant effect of age, F (1, 134) = 37.12, p < .001, ηp^2 = .22. The number of correct responses was lower in the 11-year-old participants (75%) than in the 15-year-olds (86%).

Table 2. Mean proportion (and standard deviation) of correct answers.

Recall of critical words					
	Low Load		High Load		Overall
	Low supression	High Supression	Low Supression	High supression	
11years Non musicians	.84 (.19)	.81 (.20)	.67 (.12)	.64 (.15)	.74
11 years musicians	.87 (.14)	.85 (.14)	.65 (.13)	.65 (.16)	.76
Overall 11 years	.86 (.16)	.83 (.17)	.66 (.12)	.65 (.15)	.75
15 years Non musicians	.92 (.07)	.86 (.10)	.77 (.11)	.78 (.11)	.83
15 years musicians	.96 (.06)	.93 (.07)	.82 (.11)	.81 (.12)	.89
Overall 15 years	.94 (.07)	.90 (.09)	.79 (.11)	.79 (.12)	.86
Non musicians	.88 (.15)	.83 (.16)	.71 (.12)	.70 (.15)	.79
Musicians	.91 (.12)	.89 (.12)	.73 (.15)	.72 (.16)	.82
Overall	.89 (.13)	.86 (.15)	.72 (.14)	.71 (.16)	.80

In addition, there was also a significant effect of load, F (1, 134) = 329.28, p < .001, ηp^2 = .71, and suppression, F (1, 134) = 6.50, p < .05, ηp^2 =. 05. The proportion of correct responses was lower in the high load condition (72%) than in the low load condition (88%), and in the high suppression condition (79%) than in low suppression condition (81%) in all groups of participants. Finally, there was also a significant interaction Load x Age, F (1, 134) = 14.58, p <. 001, ηp^2 = .10. This interaction analysis revealed that the effect of memory load was greater for the children (84% of correct responses in low load, 65% of correct responses in high load) than for the adolescents

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(92% of correct responses in low load, 79% of correct responses in high load.

2) Proportion of same-lists intrusions.

Table 3 shows the mean proportion of same list intrusion errors in each one of the experimental conditions for each age and group (musicians/non-musicians).

Results showed a significant effect of musical training, F (1, 134) = 10.04, p < .05, ηp^2 = .07, which means that musicians committed less intrusions due to efficient suppression of information in WM (7%) than non-musicians (12%). There was also a significant effect of age, F (1, 134) = 2.64, p < .05, ηp^2 = .02; one-tailed: 11 year-olds committed more same-list intrusions (10%) than 15 year-olds (8%). In addition, there was also a significant effect of load, F (1, 134) = 15.68, p < .001, ηp^2 = .10, and suppression, F (1, 134) = 58.80, p < .001, ηp^2 = .30. The proportion of same-list intrusions was greater in the high load condition (11%) compared with the low load condition (8%), and in the high suppression condition (11%) with regard to the low suppression condition (7%) for all participants

Table 3. Mean proportion (and standard deviation) of same list intrusion errors.

Same list intrusions	Low Load		High Load		Overall
	Low supression	High supression	Low supression	High supression	
11years Non musicians	.11 (.18)	.14 (.18)	.10 (.09)	.17 (.16)	.13
11 years musicians	.04 (.07)	.08 (.11)	.06 (.07)	.12 (.11)	.08
Overall 11 years	.08 (.14)	.11 (.15)	.08 (.08)	.15 (.14)	.10
15 years Non musicians	.06 (.07)	.11 (.09)	.10 (.07)	.14 (.11)	.10
15 years musicians	.02 (.04)	.06 (.06)	.06 (.05)	.09 (.08)	.06
Overall 15 years	.04 (.06)	.08 (.08)	.08 (.06)	.12 (.10)	.08
Non musicians	.09 (.14)	.12 (.16)	.10 (08)	.16 (.14)	.12
Musician s	.03 (.06)	.07 (.09)	.06 (.06)	.11 (.10)	.07
Overall	.06 (.11)	.10 (.12)	.08 (.07)	.13 (.12)	.09

3) Proportion of previous-lists intrusions.

Table 4 shows the mean proportion of previous lists intrusion errors in each one of the experimental conditions for each age and group (musicians/non-musicians).

Results showed a significant effect of musical training, F (1, 134) = 11.05, p < .001, ηp^2 = .08, and of age, F (1, 134) = 5.90, p < .05, ηp^2 = .04: children (3%) committed more previous-list intrusions than adolescents (2%), and non-musicians (3%) than musicians (1.5%). There was also a significant effect of load, F (1, 134) = 48.31, p < .001, ηp^2 = .26: the proportion of other-list intrusions was greater in the high load condition (3%) compared with the low load condition (1%). Results also showed a significant effect of the interaction Load x Musical training, F (1, 134) = 3.98, p < .05, ηp^2 = .03: musicians committed fewer other-list intrusions in the two load conditions (musicians low load: 0.8%, musicians high load: 2%; non-musicians low load 2%, non-musicians high load 4%).

Table 4. Mean proportion (and standard deviation) of previous lists intrusion errors.

Previous lists intrusions	Low Load		High Load		Overall
	Low supression	High supression	Low supression	High supression	
11years Non musicians	.02 (.05)	.02 (.05)	.05 (.07)	.05 (.05)	.04
11 years musicians	.02 (.04)	.01 (.03)	.03 (.05)	.03 (.03)	.02
Overall 11 years	.02 (.04)	.02 (.04)	.04 (.06)	.04 (.04)	.03
15 years Non musicians	.01 (.03)	.01 (.04)	.05 (.06)	.03 (.04)	.03
15 years musicians	.01 (.02)	.00 (.00)	.02 (.03)	.02 (.03)	.01
Overall 15 years	.01 (.03)	.01 (.03)	.03 (.05)	.02 (.04)	.02
Non musicians	.01 (.04)	.02 (.04)	.05 (.06)	.04 (.04)	.03
Musicians	.01 (.03)	.01 (.02)	.02 (.04)	.02 (.03)	.01
Overall	.01 (.04)	.01 (.03)	.03 (.05)	.03 (.04)	.02

Finally, results showed a significant effect of the interaction Load x Suppression x Musical Training, F (1, 134) = 3.80, p < .05, ηp^2 = .03. The analysis of this interaction confirmed that the difference between low and high memory load was only significant in the group of non-musicians in the conditions of low suppression, whereas in the conditions of high suppression, the effect of memory load affected both groups equally.

IV. DISCUSSION

The aim of our study was to explore possible individual differences associated with music training in the development of the maintenance/manipulation and inhibition processes underlying the executive function of updating information in WM. We hypothesized that the practice of playing an instrument would be associated with the musicians' better performance in updating information, and that this performance would manifest in improvements in the development of the processes of maintenance/manipulation and inhibition.

Our results showed, that, globally, musicians outperformed non-musician regardless of the participants' level of development. However, music training showed differential effects on the processes of maintenance and inhibition.

As expected, the maintenance process was affected both by the increase in memory load demands and by suppression demands, in all participants. However, the effect caused by load was different depending on age. The 11-year-old participants were observed to be significantly less efficient maintaining information in WM than the 15-year-olds, results that were similar to those found in previous studies (Carriedo et al., submitted). Regarding the effect of musical training, our results showed that the musicians had a greater capacity for maintaining information in WM than non-musicians, regardless of their level of cognitive development and of the variable demands on memory load and suppression, results that corroborate those obtained in adults by Franklin et al. (2008), George and Coch (2011), and Ramachandra et al. (2012), and in children (between 7 and 10 years) by Roden et al. (2014), using complex memory span tasks.

In relation to the suppression of information in WM, results showed that the increase in load and suppression demands affected all participants equally, regardless of their level of development and the years of musical training received. As in the case of maintenance, and according to the findings of previous studies (Carriedo et al., submitted), the 11-year-olds were less efficient than the 15-year-old adolescents. In addition, in accordance with our hypothesis, the musicians—regardless of age — showed greater efficiency in the ability to suppress the irrelevant items from WM, under all experimental conditions.

Finally, in relation to proactive interference, results showed that the increase in the number of items to be recalled affected the group of musicians to a lesser extent, especially in the conditions with low inhibitory demand. These results could be interpreted from the theory of executive attention of Engle (2002), according to which, efficient inhibition would depend on the available attentional resources (Engle, Conway, Tuholski, & Shisler, 1995). Accordingly, conditions of low suppression would consume less attentional resources, which would free resources to focus on the selected relevant information, preventing attention from returning to the previously rejected, irrelevant items.

Therefore, the musicians' higher efficiency in the low suppression conditions would mean that, given their greater inhibitory efficiency, this condition would not demand many attentional resources, enabling them to be more resistant than non-musicians to proactive interference, especially in high load conditions, because their attentional resources would not be overwhelmed.

In conclusion, music training seems to be associated with improvements in updating information in WM, both with regard to information maintenance processes and to inhibition processes. In addition, these improvements seem to be independent of the level of cognitive development — at least for the ages studied and the years of music instruction analyzed in our study—, an aspect that had already been suggested in other studies (Ellis, Norton, Overy, Winner, Alsop, & Schlaug, 2012). However, more research is required to explore the possible association between music training and the processes underlying updating information in WM throughout development.

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Trombone players seem to use different tongue positions while playing sustained notes, depending on their native languages

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ABSTRACT

We used ultrasound imaging of the tongue to record midsagittal tongue contours of eight trombone players with different native languages while producing sustained notes on an identical 'pBone' plastic trombone and during speech production in their First Language. While speakers of New Zealand English seem to have the option of using a tongue shape close the central unstressed schwa vowel /ə/ or in the vicinity of the cardinal vowel /o/, players whose native languages do not include centralized vowel positions seem to be constrained to using the higher and more retracted position close to /o/. Furthermore, while both highly proficient and less experienced players seem to change the height of the back of their tongue when rising throughout the trombone's register, the directions of these changes are the opposite. This paper discusses possible reasons for these differences and relates them to earlier empirical research on the function of the tongue in brass instrument playing.

I. BACKGROUND

To the best of our knowledge, no other researchers have carried out systematic empirical research on First Language (L1) influence on playing brass instruments. However, several anecdotal accounts of this hypothesized influence have been exchanged within the brass community, for example, speculation about why players of some nationalities are 'better' than others at certain facets of brass playing or why learners may have specific problems related to their language background. An old, but classic, example of the former is Fitzgerald's (1946) report of the great Herbert Clarke's thoughts about 'Latin' brass players: "their language may help them to be more decisive, besides guiding them with greater certainty as to the attack for the different varieties of tongueing." Fitzgerald himself tried to add credibility to this by stating that "this opinion is well founded since the Latin language and those closely related to it employ a much greater variety of vowel sounds than the average American uses in his speech and requires both extreme flexibility and velocity in lingual movement, particularly in the use of the tip of the tongue" (p. 5-6); though note that linguists agree that Latin languages (understood here to be Spanish and other closely related languages) have *fewer* vowel phonemes than American English.

Focusing on the problems of certain populations of players, one can find some more recent and linguistically grounded accounts such as Joseph Bowman sharing his experience of teaching trumpet to Thai students in the International Trumpet Guild Journal (2011): "Looking at the Thai language specifically, the wonderful tonal language contains very few hard consonants. A hard "taa", "kaa," or "gaa" sound doesn't exist, so introducing those takes time and persistence" (p. 90). As any brass player would know, these are the kinds of syllables that most teachers and methods advocate to use when articulating on a brass instrument.

Only a few brass players have looked at the issue through a more scientific lens, however. Two recent DMA dissertations (Cox, 2014; Mounger, 2012) attempted to find evidence for language influence by examining the vowel inventories as a measure of timbre of different languages and varieties thereof, and employing quantitative and qualitative methods. Additionally, empirical research starting with studies using x-ray imaging conducted from 1954 to 1975 has documented the function of the articulators during brass playing; more recent research has made use of magnetic resonance imaging (MRI) and ultrasound imaging of the tongue (UTI).

A. Prior Research on First Language Influence on Brass Instrument Playing

The most comprehensive study on the topic that we are aware of is Cox's D.M.A. dissertation (2014), in which the author calculated average formants of the vowels used in speech (F1 & F2) and the timbre produced during trombone playing (the 2nd and 3rd harmonics, corresponding to F1 & F2 in speech) for 18 British (BE) versus 12 American English (AE)-speaking amateur trombonists. The author found differences at the large group (BE vs. AE), dialect subgroup (different dialects of BE) and individual levels, although no statistical tests were performed to determine whether these differences were significant (visual inspection of the graphs included in the dissertation suggests they are). Interestingly, participants in this study were not able to correctly identify the nationality of professional players on different recordings of the same piece of music but some participants performed better than chance when asked which rendition they preferred, more often than not selecting recordings of players from their own language background.

Another study that used a combination of qualitative and quantitative data is Mounger's D.M.A. dissertation (2012), in which the author aimed to analyze "the orchestral trombone sound of France, Germany, and the United States … through the lens of language" (p. ii). The dissertation includes an analysis of "representative audio recordings of trombonists from France, Germany, and the United States" and tries to explain its impressionistic account of differences in sound by looking at the frequency of each vowel in the 500 most common words in these languages. While the author tried to describe the trombone playing on selected recordings (including both solo and orchestra settings) "as succinctly and

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in the most objective terms possible" (p. 82), several problems exist with the qualitative part of her research, not least that a native speaker of Italian was included as an exponent of American playing based on the fact that he is the principal trombonist of a renowned American Orchestra. Underlying the quantitative part of this and Cox's study seems to be the widely-held, but empirically non-tenable belief that brass players use the full range of vowel tongue positions during playing (we will discuss some of the relevant studies disproving this notion in the following section). Both authors certainly are not alone in making this assumption as a survey of the brass pedagogical literature will attest (Larson, n. d.; Reinhardt, 1973; but see Irvine, 2003; Loubriel, 2011; and Steenstrup, 2004 for critiques). Even if brass players used a wider range of tongue positions than empirical research attests, simply looking at the relative frequency of the tongue positions correlated with these sounds across different languages could provide only a weak chain of evidence. Thus, while Cox seems to have been able to uncover some evidence for the hypothesis of language influence (although lacking statistical validation), Mounger writes in her conclusion that "the quantitative data for this research does not fully support the concept that language can affect one's natural sound production on the instrument." We contend that both studies leave considerable room for improvement in terms of statistical validation, and participant classification and linguistic analysis, respectively.

Another study that explicitly mentions the possibility of L1 influence on brass playing is Budde's Ph.D. thesis (2011) on "Methods for Teaching Middle School Band Students to Articulate." The author provides a comprehensive survey of the syllables that have traditionally been used to teach articulation on wind instruments and subsequently provides a careful account of the possible phonetic realizations of the consonants and vowels contained in these syllables within different languages. This leads him to state that "these differences manifest themselves in various ways as performers articulate on wind instruments" and to formulate the requirement that these "be taken into account when devising a method for teaching articulation to young musicians" (p. 5). No evaluation of language background is included in the comparison of students assigned to certain treatment groups, however, other than creating an 'articulation guide group' which received and regularly reviewed an 'articulation guide sheet' developed by the author "based on the study of phonetics, native language, and music pedagogy" (p. 238). Students in this group scored significantly lower in the final evaluation of their ability to "articulate[d] clearly with accurate execution across various tempos" (p. 219) than students in the other test conditions, including a "practice group" and an "audio model group."

B. The Role of the Articulators in Brass Playing

While there seems to be a long-standing consensus among brass players and teachers that the movements of the articulators during brass playing closely resemble one of the most basic syllable structures of speech (cf. Dalla Casa, 1584; Loubriel, 2011), namely the consonant-vowel (or CV) pairing, disagreements abound on the exact nature of these movements (cf. Deye, 1947). Thus it is not surprising that x-ray imaging, or radiography as it was called in its early days, was soon applied to observing the articulators during brass playing. These studies showed lots of individual variation and when the results contradicted the widely-held belief of using different vowel tongue shapes throughout the register, the majority of the brass community did not seem to take notice (cf. previous section; Irvine, 2003). The following paragraph outlines those findings relevant to our current research.

The earliest study to look at brass playing was Hall's Ph.D. dissertation (1954). Even though the technology available at the time only allowed him to use still frames (instead of moving images as in the later studies), Hall tried to control for variation between different instruments by having all participants play on the same 'control trumpet.' He also produced spectrograms of the tones played while the individual images were taken, which unfortunately are unrecoverable today due to the scanned quality of the dissertation (along with the quality of the included x-ray images). Furthermore, images taken during the production of the extreme vowels /a/, /u/ and /i/ in three different pitch ranges allowed him to compare these tongue positions to the ones used during playing. The most "common formation" found among his participants "was that of "a" (ah)" but he added that "other players used the "u" (oo) formation or intermediate formations between these extreme vowels" (p. 246-247); performers tended to use "the same basic formation in every register," meaning that modifications while changing registers "were not large" (p. 247).

Subsequent studies by Meidt (1967), Hiigel (1967), Amstutz (1970), Frohrip (1972) and DeYoung (1975) mostly confirmed Hall's findings, in addition to observing a wider range of playing conditions including changes in dynamics and tongue placing for different types of articulation. Some of these studies included various brass instruments, while DeYoung (1975) observed trombone players exclusively. Perhaps as a result of the considerable inter-individual variation found in all the mentioned studies, Meidt (1967) reported a difference in results compared to Hall's (1954) findings with respect to register changes; some of his participants displayed large changes in tongue position with "the variations in formation […] usually approaching, if not actually reaching, the extreme "ah" and "ee" vowel formations" (p. 66).

Trying to investigate more closely the hypothesis that brass players use specific 'syllables' during playing, Hiigel (1967) asked his participants to 'think' prescribed syllables printed underneath the music while performing selected notes; he found no evidence "that thinking a syllable during performance will tend to simulate the tongue position resulting from the enunciation of that syllable" (p. 108). Similarly, significant differences were found "between the tongue placement for performance of the various pitches and styles and placement for the enunciation of the syllables" recorded separately, even for those performers who claimed to use those specific syllables during playing. The overall tendency was for the "tongue arch" to be placed higher with the tongue tip "farther forward" as compared to recitation (p. 107).

More recently, MRI and UTI have been applied to studying the articulators during brass playing. Kaburagi, Yamada, Fukui, and Minamiya (2011) investigated the effect of vocal tract

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resonances on the sound produced by a single professional trumpet player using MRI. Their results show that although vocal tract alterations accompanying changes in pitch occur all along the vocal tract (from the glottis to the lips), the position of the tongue plays a big part in changing vocal tract impedance. The single participant of this study was a speaker of Japanese who used a tongue position similar to /o/ for low and mid-range notes and positioned the tongue close to the tongue shape for the vowel /u/ (/ɯ/) for a high note.

MRI was also used in Germany by Schumacher et al. (2013) who investigated motor functions in the trumpet playing of 12 professional musicians. They found two general tendencies that held true across all of their subjects: “1. With increasing tone pitch in octave jumps and in playing natural tones, there was an increase in total free space of both the oral and pharyngeal cavity. The increase of both to achieve the higher pitch was greater in the pharynx than in the oral cavity.” And “2. The increase in areas of oral cavity and pharynx are present also when switching from lower to higher loudness and when performing crescendo to decrescendo... However, no general different in change of oral and pharyngeal cavity can be observed (p. 1177). In the same year, the Freiburger Institut für Musikermedizin, where this research was conducted, also released an instructional DVD which shows the movements of the articulators during wind instrument playing (Spahn, Richter, Pöppe, & Echternach, 2013).

Finally, a new method of real-time MRI with a temporal resolution of up to 100 frames per second was pioneered very recently by American kinesiologist and French Horn player Peter Iltis in cooperation with researchers at the Max-Planck-Institut in Göttingen (Iltis et al., 2015). Unfortunately, no real brass instruments can be used inside MRI scanners so that the researchers in Japan and Freiburg used plastic replicas, while Iltis et al. used a custom-built, MRI-compatible horn consisting of a non-ferromagnetic bell with graduated plastic tubing covering the distance from just outside the scanner to the player’s mouth; this fact limits the comparability of MRI-studies with the findings from other studies.

The earliest application of UTI to brass playing we could find is documented in Sram and Svec (2000) who took a more descriptive approach when compared with other studies and found the following divergent results regarding the function of the tongue: A series of studies showed that the vibrating tip of the tongue is a significant factor for sound production on brass instruments, which was especially pronounced for the low notes of the tuba. … In other cases, the tip of the tongue is positioned between the lips, especially at low frequencies, thereby helping to achieve the necessary tension. Another function of the tongue identified in their research is to enable regular lip vibration by continuously moistening them (p. 156).

Lastly, Zielke (2010) used UTI and video of the participants’ lower face and neck to observe the tongue and motor activity of the neck and face while playing wind instruments; this study was conducted within the field of music medicine so that differences among the different groups of wind instruments and possible aberrations within the individual players’ embouchures were of prime interest. Overall, Zielke found that ‘tongue amplitudes’ (meaning the displacement of the tongue during certain movements) were larger for players of brass instrument than flutists, for loud versus soft playing and for attacked notes versus slurred articulation.

C. Vocal Tract Influences on Brass Instrument Sound

The last decade has seen major advances in the research on brass instrument acoustics. While the evidence for brass playing is not as strong as for the saxophone (cf. Chen, Smith, & Wolfe, 2011) and didgeridoo (Wolfe, Tarnopolsky, Fletcher, Hollenberg, & Smith, 2003) where the use of vocal tract resonances is necessary to produce notes in the altissimo register and different timbres, respectively, the relevance of vocal tract impedance seems to increase for at least some brass players while they ascend to the higher partials of the instrument (Fréour, 2013; Wolfe et al., 2003). Matching the resonances to the vocal tract seems to be less of a requirement in the lower register, however, which led us to conclude in an earlier publication “that different tongue positions are possible in playing brass instruments (at least at the lower end of the register) and that they can lead to perceivable differences in timbre independent of the produced pitch” (Heyne & Derrick, 2014; p. 180).

II. AIMS

Our research aims to determine whether brass players’ L1s influence the way they play on their instruments by observing their tongue movements during playing and speaking using UTI. This approach requires taking into account the structure of the languages in question, and testing specific, carefully crafted hypotheses. Currently, we are looking at whether a relationship exists between the midsagittal tongue shapes used when producing vowels in speech and while sustaining notes on an instrument. We hypothesize that at least beginning players use a tongue shape that is closely modeled on one of the vowel tongue shapes in their L1 while more advanced players might ‘unlearn’ this pattern with increasing practice.

III. METHOD AND PARTICIPANTS

A. Ultrasound Imaging of the Tongue (UTI)

UTI is a noninvasive and relatively inexpensive method for imaging the tongue and has previously been used to record midsagittal tongue shapes during wind instrument playing (see above; Gardner, 2010). Due to the need of having to control for a multitude of factors that can influence brass instrument sound (cf. Benade, 1978; Bertsch, 1998; Campbell & Greated, 1987; Carral & Campbell, 2002; Carral, 2011; Hoekje, 2013; Smith, 1986; Steenstrup, 2007) we decided to limit this study to trombone players, which is the main instrument of the first author. This necessitated developing a new method of head stabilization that would be applicable to trombone players who have instrument tubing running along the left side of their neck. We modified a non-metal jaw brace, previously designed at the New Zealand Institute of Language, Brain and Behaviour, and reduced its width to minimize the danger of it being bumped by the trombone tubing; for most players it now only touches a thin strap running along the side of the face, depending on head

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and jaw size. This brace stabilizes the ultrasound probe against the jaw and thus ties probe motion to jaw motion. An assessment of the motion variance of the system (Derrick, Fiasson, & Best, 2014; Derrick, Fiasson, & Best, 2015) showed that 95% confidence intervals of probe motion and rotation were well within acceptable parameters described in a widely-cited paper which traced head and transceiver motion using an optical system (Whalen, Iskarous, & Tiede, 2005).

B. Participants and Instruments

This paper includes plots of midsagittal tongue contours captured during speech and trombone playing for six participants recorded at the University of Canterbury; we have finished the analysis for two additional participants but have excluded these from the current study due to deviant mouthpiece placement, in one case, and the lack of comparable data for a single participant whose L1 is German, in the other case. The remaining six participants have the following language and playing backgrounds: S1 NZE is a speaker of New Zealand English (NZE) who reported speaking no other languages and who is a professional trombonist working across different styles of music; he served as our pilot participant and the size of his dataset is smaller when compared to the other data. S5 NZE is a monolingual speaker of NZE whose proficiency level on the trombone is semi-professional after having played the instrument for eighteen years; he is also active as a singer in a barbershop quartet. S24 NZE is a 25-year-old female speaker of NZE who can speak elementary German and spent some time living in the UK and Germany before finishing High School; her playing level might be best described as intermediate and she has played the trombone for nine years. S4 Tongan is a speaker of Tongan who grew up in Tonga and only acquired English upon arrival in New Zealand (NZ) as an adult; his playing proficiency is that of an amateur and he started playing various brass instruments as a secondary school student in his home country. S7 Japanese is a speaker of Japanese who has lived in NZ for eleven years and only started learning English a few years before relocating to New Zealand in his forties; his playing level is that of a very good semi-professional player. Finally, S13 Mexican Spanish is a 40-year-old highly successful professional trombonist working in the Los Angeles Latin music scene on the American West Coast; he grew up in Northern Mexico and emigrated to the USA before completing High School; his Second Language (L2) skills are almost native-like which led us to collect speech data in both his native language Mexican Spanish and AE, although the sample size is smaller for the AE tongue contours.

Note that the reduced dataset for this study includes trombonists with four different L1s; these languages were selected due to similarities in their vowel systems and can be split up into two groups: Naturally, the NZE participants share the same vowel inventory (with small differences for S13's AE data). In contrast, the Tongan, Japanese and Spanish all speak languages that have five-vowel systems without any vowels occupying a central position.

The trombone used for recording all participants was a plastic 'pBone' trombone provided by Warwick Music in the UK for the purposes of our research. All players except the pilot participant used the same standard 6 1/2 AL mouthpiece by Arnold's and Son's, Wiesbaden, Germany.

C. Recording Procedure

All participants were asked to come to a sound attenuated room on campus and given sufficient time to warm up and familiarize themselves with the 'pBone' as well as complete a short questionnaire on their language and playing proficiencies. They were then asked to put on the probe holder with the ultrasound transducer and adjustments were made to ensure a comfortable fit; at this point we also applied ultrasound gel to improve the image and used the settings available on our ultrasound machine for further optimization.

The first part of each recording session consisted of reading word lists in each participant's native language; for S13 this included words in both Spanish and English. The word lists were presented in sections of approximately 2.5 minutes length and blocks of three to five words were shown on a computer screen, advancing automatically; for the pilot participant the words were printed in similar groupings and read off the page.

In the second part of the experiment, all participants played an almost identical set of eight musical passages that included sustained notes at varying dynamics, in different registers, and different kinds of articulation including double-tonguing (for which a more retracted, secondary place of articulation has to be used) and lip slurs without slide movement. Only two of these exercises required the use of the slide to alter the fundamental pitch of the instrument; these were slightly modified original etudes written for the trombone.

The ultrasound machine used for the recordings was a GE Healthcare Logiq e (version 11), with a 8C-RS wide-band microconvex array 4.0-10 MHz transducer. Ultrasound tongue images were captured on a 2013 Macbook Pro or a 2012 HP Elitebook, both running Windows 7 in the 64-bit binary, from the machine's VGA output using an Epiphan VGA2USB pro frame grabber; simultaneously a Sound Devices LLC USB Pre 2 microphone amplifier with a Sennheiser MKH 416 microphone was also connected to the laptop to record audio. Both signals were written to the hard drive using an ffmpeg binary accessed through the Windows Command Line; the video codec was x264 for recordings on the Macbook and mjpeg on the HP Elitebook, while audio was encoded as uncompressed 44.1 kHz mono on both machines. Frame rates varied between 58 and 60 Hz and were encoded in a progressive scan yuv420p pixel format at 1024x768 pixels.

D. Analysis

Before exporting individual midsagittal tongue contours from the ultrasound videos we had to correct for slight misalignment of the video and audio tracks originating from simultaneously recording two different USB inputs. For this reason we asked participants to produce five /ta/ or /da/-syllables at the beginning and end of each of recording block of 2.5 minutes average length (except for the pilot participant). This allows us to align the exact video frame when tongue first starts dropping down from its place of articulation with a sharp rise in the audio waveform (see Miller & Finch,

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2011) using ELAN (Wittenburg, Brugman, Russel, Klassmann, & Sloetjes, 2006).

We then performed an acoustic analysis of the speech and music data in Praat (Boersma & Weenink, 2014); for participants S24 NZE and S13's English words we used the HTK toolkit (Young et al., 2006) to perform automatic speech segmentation via its implementation in LaBB-CAT (Fromont & Hay, 2012). Individual video frames for contour export were selected at the midpoint of vowels and at one third of note duration for sustained notes; for the pilot participant this was done via the identification of tongue steady states in ELAN. Using the time stamps output by Praat, we then used the GetContours function (Tiede, 2014) in MATLAB (MATLAB Release 2013b) to extract individual tongue contours by clicking just below the visible contour. Average tongue contours were calculated by first transposing all data to polar coordinates using the transducer head as the vertex (Heyne & Derrick, 2015) and subsequently fitting an SSANOVA curve (Gu, 2014) using R (R Core Team, 2013). Finally, the average curves were re-imported to MATLAB and transposed back to the Cartesian plan before plotting speech and music data together.

IV. FINDINGS

Figures 1 and 2 on the following pages show the average midsagittal tongue contours for all participants discussed in this paper. The average curves are based on at least 21 individual tokens for each vowel and 33 tokens for the notes for participants S4, S5, S7, S24 and S13's Spanish data. For S1 the respective numbers are 5 and 36, except for the vowels /ʉː, e, ɒ, ɵː, oː/ with only two or three tokens each; for S13's AE data the minimum number for vowels is 10 except for /iː, ɔː, ʊ/ with 5, 2 and 7 tokens, respectively. The notes played on the pBone were conflated in the following way to make the graphs easier to read: 'high notes' include F4 and D4, 'middle notes' only Bb3 and 'low notes' F3 and Bb2, as per the US standard system for specifying pitch. Note that the NZE and AE plots look very crowded due to the large number of distinctive vowels in these language's sound systems. Similarly, plots can look quite different depending on ultrasound probe position and physical features such as tongue size, which vary widely among individual players.

Visual inspection of the four datasets included in Figure 1 indicates that the average position for playing sustained notes is very close to /o/ for the Tongan and Japanese players while it is located further to the front of the oral cavity and a bit lower for the two NZE participants included here. More specifically, the playing tongue shape seems to pattern in between the central /ɘ/ and /ə/ vowels for S1 and somewhat lower, in between /ə/ and /ɐ/, for S5. The fact that these participants all display a clear pattern was our reason for assembling their data in Figure 1.

For the data shown in Figure 2, however, no such patterns emerge. S24 places the back of her tongue close to the /oː/ vowel position while the front of tongue assumes a position equal to that used for uttering the /ʊ/ vowel; this position is clearly very different from what the other NZE participants (in Figure 1) are doing and bears more similarity to the pattern displayed by the Tongan and Japanese participants. For S13, it is even harder to establish a relationship between the vowel tongue positions used in speech and the tongue shapes assumed during playing; for AE data there exists some proximity to the /æ/, /ɪ/, and /ɘ/ vowels while /e/ and /u/ are the closest vowel tongue positions in his Spanish speech production.

An observation that applies to all semi-professional and professional participants (thus excluding S4 Tongan and S24 NZE) is that those players tend to raise the back of their tongues when playing higher notes while the pattern is the reverse for the amateur and intermediate players. The direction of changes in tongue positioning for the more proficient players thus agrees with the recommendations made by many brass teachers and method books advising the use of different 'vowels' to ascend to the high register but on average, these changes are of course much smaller than changing from, say, /ɑː/ to /iː/. Interestingly, the most successful player included in the dataset displays the biggest variations in this regard.

V. DISCUSSION

We believe that our findings presented above suggest that trombone players' First Languages constrain their availability of tongue shapes to be used in producing sustained notes. For some populations this might mean that they have different vowel tongue positions available from their L1 which are usable for brass playing, while for others there may be only one. We think that beginning brass players (who are seldom younger than age six) will resort to what they already know how to do: producing sounds in their native language.

Looking more specifically at the languages included in our study, tongue positions in the vicinity of the cardinal vowel /o/ form part of most of the world's languages so that they are also part of languages with smaller five-vowel systems such as Tongan and Japanese; central vowels like schwa (/ə/), however, are only available to our English-speaking participants. At this point, we do not have enough data to speculate why S24 NZE might be using a tongue position more similar to the one used by the Tongan and Japanese players, even though the more proficient NZE speakers seem to 'prefer' a more central position close to /ɘ/.

What we can suggest is that both vowel positions used by our participants included in Figure 1 may offer aero-dynamical advantages for brass playing. Early MRI research on speech production (Baer, Gore, Gracco, & Nye, 1991) has shown that for extreme vowels, meaning high front and low back vowels, the airway is heavily constricted in the oral and pharyngeal cavities, respectively, which would reduce airflow. Using a central vowel such as schwa (/ə/) certainly avoids such constrictions during playing, although Gick (2002) found for AE that, contrary to popular belief, the pharyngeal cavity is also somewhat more constricted for schwa than for the 'rest position.' Conversely, /o/ might simply be the best position to use for players who do not have a central vowel tongue position because it provides leverage for the tongue tip to perform consonant-like articulatory motions to begin (and end) notes and effects less of a constriction than the other two plausible options, /a/ and /u/ (/ɯ/ in Japanese).

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Measurements of changes happening in the pharyngeal cavity reported in several of the x-ray and MRI studies cited above point to the necessity of considering this cavity in addition to the oral cavity when trying to find the optimal tongue position for brass playing. Considerable inter-individual variation exists between our participants in the amount of change in the position of the back of the tongue when rising from low to medium and high notes. It is entirely possible that some players simply make the required changes in cavity size by raising their tongue while others constrict their pharyngeal cavity. In fact, S5 NZE who is also a proficient barbershop singer, reports that he can feel his pharyngeal cavity narrowing when playing high notes. These observations contradict the findings of Schumacher et al. (2015) for professional trumpet players who consistently increased the cavity size in both the oral and pharyngeal cavities for similar changes in pitch. Nonetheless, it is possible that this indicates a real difference between trombone and trumpet players caused either by differences in the necessary air flow and pressure, or by different cavity shapes required due to vocal tract tuning.

Moving down even further along the vocal tract we can find another articulator that plays a role in speech production and brass playing: the glottis. Findings regarding glottis opening during brass playing suggest that proficient players use glottal constriction as a means of controlling airflow (Mukai, 1989; Yoshikawa, 1998) and make changes for playing in different registers according to the blowing resistance of the instrument (Carter, 1966). Less proficient players might be varying their tongue height to the same effect which could explain their

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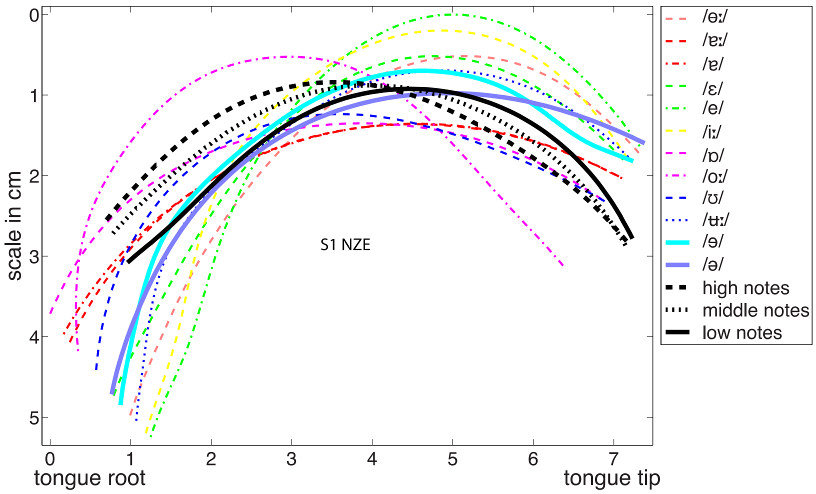

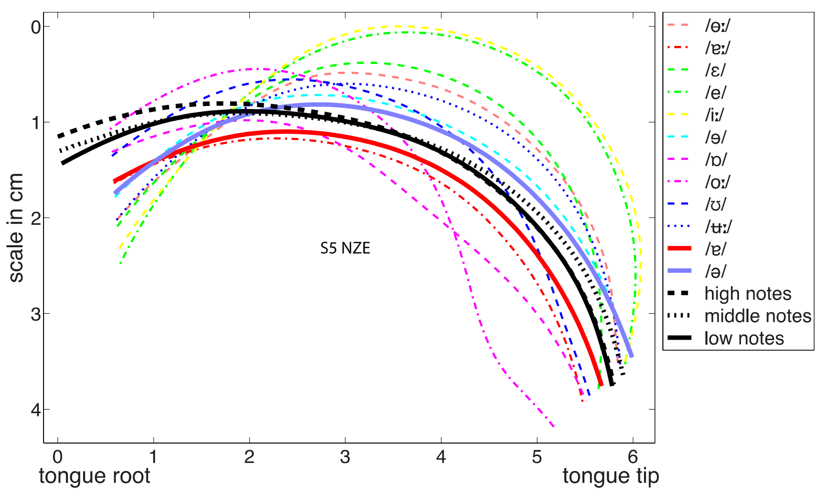

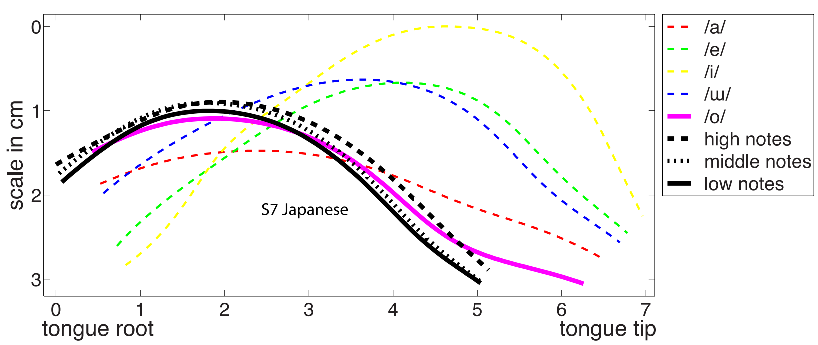

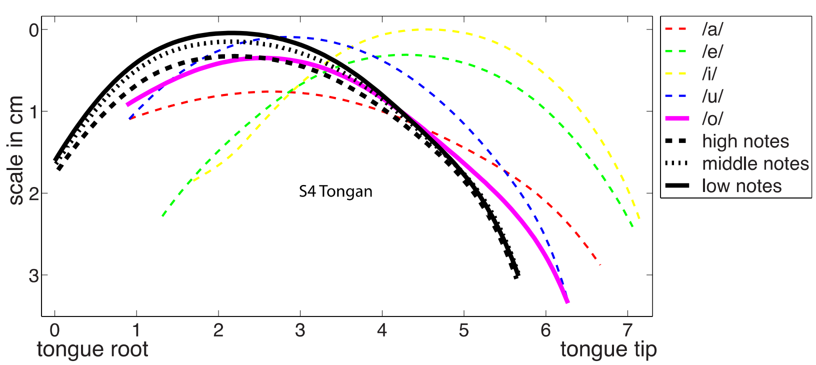

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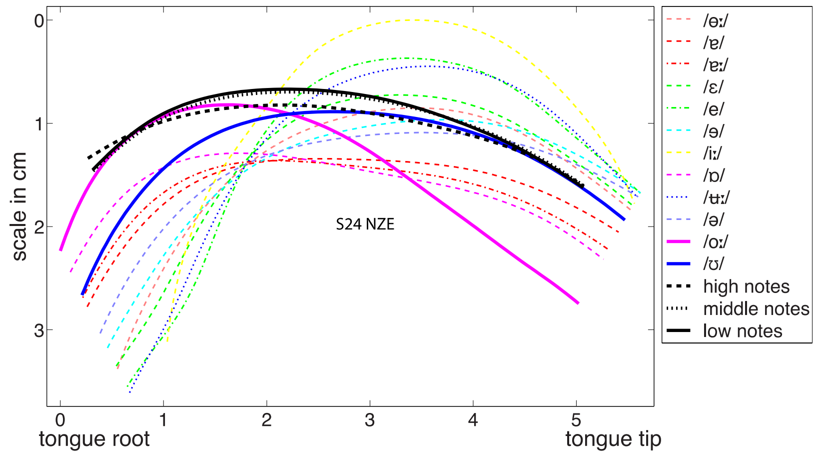
Figure 1. Average midsagittal tongue contours for four of our participants who follow the pattern outlined in the discussion section.



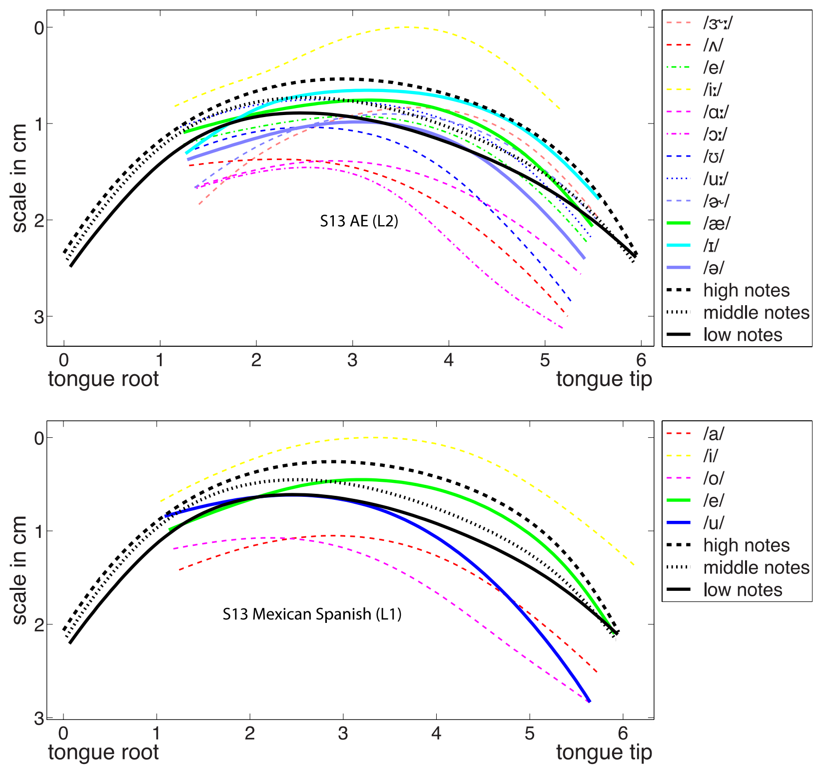


Figure 2. Average midsagittal tongue contours for two of our participants who do not seem to follow the pattern outlined in the discussion section.

pattern of lowering the tongue when ascending while blowing resistance increases.

Another interesting point to discuss are differences that seem to be related to players' proficiency levels on the trombone; in our earlier publication we hypothesized that "professional players of brass instruments [should] display less language influence than amateurs as these individuals spend countless hours practicing their instruments to improve their sound and articulation which should lead to the gradual 'unlearning' of tongue movement patterns acquired with their First Language" (Heyne & Derrick, 2014, p. 183).

This proposition seems to be supported by S13's behaviour in our new dataset; not only does his average tongue position for playing sustained notes fail to resemble any of his vowel tongue positions in either L1 or L2, the greater distance between his tongue shapes for playing in different registers may also show that he has learned to effect the necessary cavity changes almost exclusively within his oral cavity.

VI. CONCLUSION

Analysis of midsagittal tongue shapes recorded for six trombonists during speech production and sustained notes indicates that a relationship exists between a player's L1 and the average tongue position assumed during trombone playing. Specifically, players whose L1s have a standard five-vowel system seem to use a tongue position close to the cardinal vowel /o/ while players whose L1s offer central vowel tongue position have the option of using either of those. In the discussion we provided possible explanations for this behavior and discussed some differences between amateur and more proficient players.

In future work we plan to quantify our findings by analyzing more data which we have already recorded and investigating how the consonants of different languages affect the articulation on brass instruments.

ACKNOWLEDGMENTS

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Controlling the clarinet: Tongue and finger actions

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ABSTRACT

Background

Clarinettists have to control various parameters at the same time while they play their instrument. This for example includes the blowing pressure, the lip force, and the lip position (Almeida, 2013). To create a well sounding sequence of tones, it is important that the finger movements on the tone holes and the articulatory tongue actions on the reed are coordinated. Previous research on the saxophone showed that the finger movements of the players had dominance on the performed timing over the tongue strokes to the reed (Hofmann & Goebl, 2014).

Measurements on string instruments have shown that left-hand finger forces required to hold the string tight to sound board are ranging from 3 N on the violin (Kinoshita, 2009) up to 30–50 N on the guitar (Hori, 2013). However, the finger actions on the clarinet are merely to open and close the tone holes.

Aims

This study aims to investigate finger actions applied to the tone holes of the clarinet in relation to the tongue actions at the vibrating reed. Furthermore, we want to check if the observation made for saxophone playing (Hofmann & Goebl, 2014) also applies to clarinet playing.

Figure 1: Synthetic clarinet reed with a strain gauge sensor, to monitor tongue articulation during performance (left). Viennese Bb-clarinet with ring-shaped force sensor (blue) attached to the tone hole, key-work removed for the picture.

Method

Finger force profiles and tonguing techniques of N=23 clarinettists were observed under controlled performance conditions.

In order to carry out an expressive performance task, eight excerpts from Weber's first Clarinet Concerto were selected to fit a 2 x 2 x 2 design (register: low–high; tempo: slow–fast, dynamics: soft–loud). During the experiment, the experimenter introduced additional instructions that altered the clarinettists' expression levels (low–high).

Furthermore, the participants played a technical exercise task, in which different combinations of tongue actions (legato, portato and staccato articulation) and finger actions in three different tempi (slow, medium, fast) were required. This technical exercise task is a repetition of the production task from the previous study on the saxophone (Hofmann & Goebl, 2014).

All participants performed on the same sensor-equipped Viennese Bb-clarinet (Weilguni, 2013), which tracked the finger forces applied to the six main tone holes together with the reed oscillation signal (Fig. 1). From the force sensor measurements, the average finger forces (F_{mean}) and the peak finger forces (F_{max}) were calculated for each finger and each trial individually. Timing and articulation information were extracted from the reed signal using the same detection algorithm as in Hofmann & Goebl (2014).

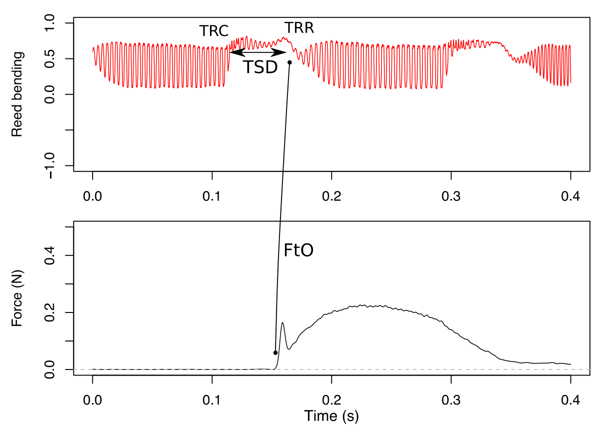

Figure 2: Reed signal (top plot) for portato note transitions and left-hand ring finger force to close the third tone hole (bottom plot) captured for player 3. The tongue stroke duration (TSD) is the time span between a note offset (tongue reed contact, TRC) and a note onset (tongue reed release, TRR) in the reed signal. The finger-to-note onset duration (FtO) is the time from the finger arriving on the force sensor to the TRR.

Results

The overall finger forces for the expressive performance task were low ($F_{mean} = 1.17$ N, $F_{max} = 3.05$ N) in comparison to finger forces reported for other instruments like the violin, or the guitar. The measurements showed that participants used significantly larger finger forces when performing with a high expression level ($p < 0.001$, $\eta^2 = 0.74$). Playing in the high register and with loud dynamics also increased the finger forces applied to the tone holes significantly ($F_{mean} = 1.3$ N, $p < 0.05$).

For the technical exercise task, the participants used less finger forces overall ($F_{mean} = 0.64$ N). In portato articulation, clarinettists use a tongue stroke to damp the reed between two tones. The average tongue stroke duration (TSD) was calculated from the reed signal. The TSD for all participants performing the technical exercise in portato articulation showed no influence on the performed tempo with a mean TSD of 28.5 ms (SD = 1.5 ms). In this time they have to change their fingerings.

We calculated the mean finger-to-note onset time duration (FtO) for portato playing with 18.5 ms (SD = 27.8), indicating that the finger-actions happened mostly while the tongue damps the reed (see Figure 2).

From the detected note onsets (TRR), the precision (regularity) of the performed onsets was calculated. We found that in a slow tempo, combined tongue-finger actions showed superior timing precision in comparison to only tongue or only finger actions. In contrast, finger timing was dominant in the medium condition and the fast tempo condition.

Discussion

The results of this study indicate that the finger technique plays an important role in clarinet performance. The participants used very light fingering technique, especially for the technical exercise task. This may allow them to remain stamina to perform and practice for hours. The timing observations made with the technical exercise task were in line with the observations made in the previous saxophone study. The timing of the fingers overruled the timing of tongue in medium und fast playing conditions (Hofmann & Goebl, 2014).

Such sensor-equipped musical instruments could be used in future to give real-time feedback for students in various learning and practising situations.

Keywords

Clarinet, Performance, Finger force, Articulation

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Self-other judgements of sonified movements: Investigating Truslit´s musical gestures

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ABSTRACT

Background

Truslit (1938) suggested a theory of gestalt and movement that highlights the gestural quality of musical interpretations. Since Repp's (1992) synopsis of this early theory, researchers have increasingly developed methods and paradigms to study listeners' responses to inherent musical gestures. Truslit presented movement graphs for a selection of musical pieces, assuming that these motion trajectories are valid on an intersubjective and supraindividual level. Yet empirical examinations are scant that tested whether this theory of a prototypicality of music-inherent motion is valid on a descriptive and comparative level.

In addition to self-other judgements of visual point-light movements (Sevdalis & Keller, 2010; Wöllner, 2012), the sonification of gestures appears to be a promising method. So far, movement sonification has mainly be applied in artistic performances (Renault et al., 2014) or sport and rehabilitation science (Effenberg et al., 2011). In this study we attempted to systematically investigate the motion qualities of Truslit's gestures with sonification of gestures and a self-other paradigm.

Aims

We investigated Truslit´s hypothesis of prototypical musical gestures by comparing free movements to Truslit´s original sound examples with movements following a visual presentation and detailed verbal instructions. The effects of watching point-light displays and listening to the sonification of movements was tested with a multimodal self-other judgements paradigm.

We expect differences in expression of the movements before and after instruction. Moreover, we assume that this variation is higher in musical experienced participants by contrast with non-musicians, according to the musicians' skilled capacity to perceive and process musical material and transfer it to appropriate movements.

We further assumed that self-identification of visually displayed movements is above chance. We expect higher scores of self-recognition for the unconstrained movements compared to post-instruction movements and a better performance in judging self and others movements by musicians in comparison with non-musicians.

Method

The experimental design consists of two parts. The first part is divided in three consecutive motion capture recording sessions, the second one contains a multimodal presentation stream of the recorded movements.

A total of 26 right-handed participants (age: M=28.04, SD=5.20; 30.8% female) took part in the recording session of the study. 13 of them currently study music or have already completed a music degree.

Excerpts of three selected Truslit pieces (24s) were presented during the first and the third recording session. In addition, another 7s- original Truslit piece (Broken Chord C major, staccato. bassoon) was played within the instruction part during the second session. While listening to the broken chord piece, an original Truslit drawing of a prototypical movement trajectory was presented on a screen.

Participants put a single reflecting marker around their index finger of the right hand that was captured by a 12-camera Optitrack®-system. Participants were instructed to follow or trace intuitively the melodies of the pieces they listened to with the index finger of the right hand using the three-dimensional space in front of them within the range of their right arm. During a test trial, they could try out their movements once to get used to the following recording procedure.

During the first block, each of the three musical pieces were played twice, whereby participants first listened and then moved their finger to the second presentation of the music. As part of the second block the participants first had to listen to a 7 second short pieces of a broken chord sequence before they should follow the melody as explained at the beginning. Second, participants had to listen to the same while looking at the appropriate Truslit drawing on a screen. The third part of this second session was a replication of the first one, but with the verbal instruction beforehand to follow the melody with the index finger right in the way they watched it while looking at the drawing that was presented on the screen. The third block was a replication of the first session without any additional instructions.

The material of the self-other judgements task consists of a multimodal audiovisual stream c.4 months after the recording sessions. The audiovisual stream contains 10 second clips of four different judgement conditions: 1. two-dimensional visual point-light displays of index finger movements, 2. sonification of vertical index finger movements, 3. combination of the first and second condition (audiovisual), 4. two-dimensional drawing map of index finger movements (comparable to those by Truslit).

Participants are paired in terms of age, general musical experience and body characteristics. Participants judge whether the visually depicted or auditory presented movements were performed by themselves or another person via a key press on a computer keyboard.

Results

In order to assess differences between the first experimental block (intuitive) and third block (after verbal and visual instructions), we analyzed the averaged global measures of their index finger movement lines in terms of movement velocity (session one: M=0.094m/s; session three: M=0.021m/s), acceleration (session one: M=-0.004m/s²; session three: M=-0.010m/s²) and cumulative distance (session one: M=2.894m; session three: M=2.7954m). A repeated-measures ANOVA indicates no significant differences between the values of the first and third session, participants were thus relatively consistent in their movement styles irrespective of the Truslit-based instructions. In a similarly vein, analysis of covariance indicated no effects of musical experience or preferences ratings for the music on movement characteristics.

Further spatial and temporal analysis of the recorded movement trajectories during the second recording, comparing Truslit´s drawings of prototypical movements, as well as results of the self-others judgements will be presented at the conference.

Conclusions

While there were large inter-individual differences in the movements trajectories, analyses revealed a high consistency in the repeated-measures condition, so that individuals performed comparable movements across trials. We discuss how people perceive the gestural quality inherent in different musical interpretations. In particular, we attempt to highlight a common perceptual basis that is grounded in human movements and lies beyond individual percepts of music.

Keywords

Truslit, Sonification, Motion capture, Self-others judgements, Musical movements, Movement prototypicality, Multimodal perception

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In quest of the autotelic personality among professional orchestral musicians

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ABSTRACT

Background

Flow is a state of consciousness characterized by complete immersion in an activity for its own sake, leading to altered time perception, loss of self-consciousness, and the feeling of happiness (Csikszentmihalyi, 1990). The concept of an "autotelic personality", i.e., a disposition to actively search for challenges and flow, was proposed but never empirically tested in depth. The study of flow in the context of work and sports has shed some light on the conditions leading to flow (e.g., personality traits such as locus of control) as well as on the positive outcomes of flow (e.g., higher degrees of well-being and resilience). However, little is known about autotelic personalities among musicians. Marin and Bhattacharya (2013) found a positive relationship between trait emotional intelligence and flow among pianists. Fritz and Avsec (2007) reported a positive correlation between flow and emotional well-being.

The evidence regarding the relationship between flow and high achievement remains inconclusive. Some studies reported a positive association between flow and high achievement in music performance (Baker & MacDonald, 2013; O'Neill, 1999), whereas others did not (Marin & Bhattacharya, 2013; Wrigley & Emmerson, 2013).

Aims

We investigated whether flow among professional musicians would be related to personality traits that have been identified as significant predictors and outcomes of flow in other domains than music. We also examined the relationship between flow and high achievement.

Method

158 professional musicians (43 females, age range 22-64 years) from ten Austrian symphony orchestras participated in the study. Questionnaires measuring dispositional flow for physical activities (Jackson, Eklund, & Martin, 2010), resilience (Leppert, Koch, Brähler, & Strauß, 2008), emotional self-efficacy (Schmitz & Salisch, 2002), locus of control (Kovaleva et al., 2012), the Big Five personality traits (Rammstedt et al., 2012), stress reactivity (Schulz, Jansen, & Schlotz, 2005), and implicit motives (Schmalt, Sokolowski, & Langens, 2000) were administered. Information on the musical background and measures of professional success were collected.

Results

A linear regression analysis revealed significant positive associations between flow states during orchestral performance and age, internal locus of control, emotional self-efficacy and resilience, respectively. The idea that flow is related to high achievement was not supported by the current data.

Conclusions

Our results extend those of Marin & Bhattacharya (2013) by showing that personality traits related to flow in the context of work and sport, i.e. internal locus of control and resilience, are also of critical relevance to music performance and thus may be domain-general.

Keywords

Flow, autotelic personality, high achievement, professional musicians

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Long distance musical relationships: Experiences of networked music performance

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ABSTRACT

The research described in this paper examines the effect of networked music performance (NMP) technology on musical communication, and the strategies taken by musicians to overcome the inherent difficulties of working at a distance. In NMP there is a trade-off between sound quality and latency when using lossy compression. Effects of latency have been investigated quantitatively. Acceptable levels of delay from the point of view of musicians' synchronisation reflect the delays experienced by musicians in an acoustic space. The effect of these issues upon the subjective experience of the musician has rarely been the focus of research. By separating musicians geographically, communication is disrupted aurally and visually. This phenomenological study investigates how NMP affects the musicians' experience of performance. Student musicians were physically separated, but connected via an audio and video link, and were asked to perform unrehearsed 'jams', followed by semi-structured interviews. A thematic analysis of the interview data was made and four broad themes emerged: the music itself, the process, the musicians, and technical issues. Musical communication was considered the most important form of communication when performing. The musicians reported that the music they played developed in technicality and creativity as the sessions progressed. Musical communication plays a large role when performing remotely, and when this communication is disrupted creativity is affected, as musicians concentrate on the technical aspects of playing together.

I. BACKGROUND

Musicians have engaged with Networked Music Performance (NMP) in various forms since network capability between computers developed. Methods include sending digital files, live streaming of performances, and transmission of control data, with sound re-synthesised at the receiving end. A challenge for some musicians working with NMP is to create working practices that are similar to musicians working in the same acoustic space, while others assume that NMP will require musicians to work in new ways, and accept the network as an acoustic 'space' of its own.

Musicians working with live versions of NMP, where groups of musicians are working synchronously at a distance from one another, have particular problems with latency. The latency is dependent upon the distances between the musicians, the bandwidth of the network connections they are using, routing of signals, and any audio compression that they may be using. Good network design can help reduce latency, however delays due to the geographical distance between the musicians cannot be eliminated. Most musicians working at home or semi-professional contexts are likely to be using typical domestic broadband Internet connections which are not designed for real-time audio applications, so there is additional audio degradation caused by jitter and packet loss.

These issues surrounding NMP are of increasing importance. The effects of latency and reduced audio quality on performance and the experience of musicians are of interest as more musicians have the technology available to them to work online and at a distance. The effects of disrupted communication between musicians when separated, even without significant latency, are not well understood. Examining the experience of musicians in NMP situations has the potential to provide insight into how they adapt to challenging musical conditions.

A. Review of Earlier Research

Much of the research into NMP has focused on quantative studies, such as the effect on rhythm and synchronisation between musicians, and 'ideal' latencies for musicians to work with (Chafe, Cáceres, & Gurevich, 2010; Chafe & Gurevich, 2004b; Darabi, Svensson, & Farner, 2008; Schuett, 2002). Delays of less than 11.5 ms cause musicians to accelerate, while delays of more than 14 ms lead to deceleration (Chafe & Gurevich, 2004b). While these studies suggest ideal latencies to aim for in a NMP system, they only account for specific repeatedly clapped rhythms, and do not take into account factors such as melody, harmony or timbre. It has been suggested that the largest delay that performers can cope with before losing synchronisation is 25 ms (Carôt, Krämer, & Schuller, 2006; Chafe et al., 2010), reflecting the time delays that would be experienced when performing in a natural musical arrangement in an acoustic space (Chafe et al., 2010; Darabi et al., 2008).

Chew et al. (2004) investigated the role of tempo in classical music NMP. They found that for faster tempos, only shorter delays were acceptable (50 ms for 132 and 160 bpm), whereas for slower tempos musicians could adapt to longer delays (75 ms for 46 bpm). In this study musicians also found musical interpretation more difficult at faster tempos. This may not be the case in other styles of music, where perhaps musicians rely more on their internal metronomes rather than cues from other musicians. The effects of various latencies on musicians' musical expression as an ensemble, playing classical duets, were examined by Bartlette et al. (2006). The musicians rated their musicality and interaction, with lowest ratings given for performances where there was a latency of more than 100 ms. The fact that this figure is larger than suggested in previous studies may be due to the additional musical cues present in a piece of music, rather than a hand-clapping study, and also the holistic approach of studying musicality rather than strict timing. Olmos et al. (2009) investigated how delay affects emotional connection between classical singers, the choice of strategies they use to compensate for delay, the effect of orchestra placement on their performance, and how these factors might affect the role of the conductor. This qualitative study focused on the experience of the performers and their

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strategies for overcoming the difficulties of working remotely. Performers in remote locations were connected with both video and audio links. Results showed that rehearsal helped performers to overcome delay conditions, as they formed strategies to work with the delay. The role of the conductor was found to be important to avoid "recursive drag on tempo", where each performer is waiting to hear the other player's parts, which slows the whole performance (Chafe & Gurevich, 2004a). Emotional connection increased throughout the experiment, even as latency increased, probably due to familiarity with technology (Olmos et al., 2009).

Studies have also examined the communication methods that musicians use, both in rehearsal and performance. Communication is primarily aural and visual, and is used to coordinate actions and to communicate ideas about the expression of the music. Aural communication is considered by some to be more important than visual communication (Goodman, 2002); however, as stated, Olmos et al. (2009) demonstrate the important role a conductor can play in NMP. If visual communication plays a lesser role than aural communication there are implications for NMP: specifically that the addition of a video link causes further latency in the signal chain. Seddon and Biasutti's (2009) study examined the communication modes of a string quartet and a jazz sextet. In both cases three modes of communication were used: instruction, cooperation and collaboration, and all of these modes took place both verbally and non-verbally. Although the two ensembles worked in different ways according to their genre (for example the string quartet used a score), the modes of communication used were similar. This suggests that distinctions between genres are perhaps less clear when considering communication between musicians. Goebl and Palmer (2009) investigated the role of auditory feedback and visual communication in synchronisation in ensemble playing. They found that as auditory feedback decreased between two members of a piano duet, gestures, eye contact and body sway increased to compensate. This supports evidence from a previous study which highlighted the importance of visual communication, with communicative head bends and eye contact increasing over rehearsal time between two pianists performing duets (Williamon & Davidson, 2002).

Quantitative studies in NMP have concentrated on measureable factors of performance, such as synchronisation and tempo, for example Chafe and Gurevich's (2004a) work on ensemble synchronisation. These studies give insight into the effect of NMP in terms of technical musical issues, and have concentrated on the final performance, rather than the cognitive and emotional world of the performer. Phenomenology of musical performance examines the thoughts and perceptions of musicians during performance, and the subjective world of the performer, investigating the relationship of the performer with the performance (Holmes & Holmes, 2013).

In any form of musical performance, the perspective of the performers is vital in understanding the processes that are taking place, and this is relatively ignored in NMP research. The effect of technology on performance cannot be studied by only looking at the final performance: musicians may make specific adaptations to their playing or communication that are not apparent to the audience. This study aims to examine the experience of musicians engaging in networked musical performances from their perspective.

II. METHODS AND DATA

A. Participants

Six undergraduate music students who classify their music as predominantly folk or Scottish traditional music were recruited. Potential participants were informed that they would be audio and video recorded and therefore musicians who are not affected severely with musical performance anxiety came forward. The participants were accustomed to working with asynchronous NMP, and several of them have instrumental lessons via video conferencing; however they are new to working in a live setting over networks. Participants who are inexperienced in NMP are of interest as they reflect how people using NMP in education or therapeutic musical relationships may experience the technology.

B. Procedure

The study was split into six sessions, emphasising different aspects of NMP:

- Latency, with one session having 25ms delay between musicians, and another 100ms delay, reflecting the different maximum delays that have been found to be acceptable for musicians (Bartlette et al., 2006; Carôt et al., 2006; Chafe et al., 2010);
- Audio quality – two sessions with different levels of audio degradation, reflecting different bandwidths of lossy compression;
- Role of video – one session had a high quality audio signal with no delay, but no video for the musicians to use;
- Video conferencing, which combined all the above issues for musicians.

It is not possible to completely isolate individual factors but highlighting particular issues in each session allows participants to focus on individual aspects of NMP.

Participants were asked to spend approximately five minutes in an unrehearsed 'jam' session. This was interpreted differently by each pair: one pair played continuous improvisation throughout, one pair played pre-composed songs with improvised accompaniments, and one pair brought in motifs they were working on and spent the sessions composing together.

Paired interviews took place after each session. The participants in each pair shared an experience. By interviewing them together there can be a conversation between them, and participants can "co-construct" their version of the topic (Morgan, Ataie, Carder, & Hoffman, 2013). Sessions were videoed and used for focused observation, using themes emerging from interview data to reinforce or question participant responses. An online survey was used to collect demographic information.

A thematic analysis of the interview data was made, using the themes that emerged from the interviews. They described the genre they played in as broadly 'Folk', with a combination of Scottish Traditional and Bluegrass styles.

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III. FINDINGS

The findings explore the following broad themes that emerged from the interview data: the music, the process, the musicians and technical issues.

A. The Music

The music that was performed in the sessions was affected in various ways by the technology used. Rhythm and tempo were affected by the introduction of latency, and several musicians stated that they would specifically choose a style of music to suit the technical set-up, based on the rhythmic content. In one session a Gaelic song was performed with an improvised accompaniment on the piano. The pianist was not familiar with the song, and the rhythm of the words was not consistent throughout the song, making it difficult for the pianist to maintain a steady beat.

> *AM: "In Gaelic song you must make the song fit the story rather than the story fit the song… And if there's a bit where the words don't quite fit as comfortably as they should, the words were written before the music, and the music to the words so it does tend to be a bit more tricky. Maybe this isn't the best for Gaelic song, this set-up!"*

Although the singer was happy with the accompaniment, the pianist felt that he did not convey the subtleties of the rhythm as much as he would have liked.

The overall rhythm and pulse of a piece was also a factor in the success of each session. Musicians suggested that both music with an obvious beat and the opposite situation – music where synchronisation is not so important – suit the conditions of NMP:

> *OS: "Maybe something a bit more open would be good, where time can flow a bit more, a bit more rubato I suppose. That would maybe be easier."*

This is particularly relevant when audio latency is an issue.

The creativity of the music created was initially affected by the use of NMP, as the musicians concentrated more on the technical aspects of playing together remotely and less on the creative aspects; however as the sessions progressed this changed:

> *LM: "Yeah, I was playing wee licks and fills and things as well, which last time I was here I wasn't doing. I don't know if that's just because I've been playing more of this kind of music or if it's more something to do with the fact that I'm finding it a bit more easy. I think it's a bit to do with both."*

The amount of creativity was also dependant on other aspects of the music:

> *LM: "I know it's all been improvised so far but I've been calling up chords I already know. But especially in the faster part that you did, I felt that it was strong enough and solid enough that I could have a wee mess about with the chords and stuff like that. The rhythm was basic. It allowed me to maybe be a little bit more creative."*

At this point the musician was getting more comfortable with working with NMP, and the technical challenges in the music were reduced, allowing creativity to increase.

B. The Process

The process of collaborating musically was a major theme that emerged from the interview data, with three categories of communication being highlighted: musical, non-verbal and verbal.

Despite the challenges that the musicians faced with communication through an audio and video link, including reduced audio quality and latency, musical communication was considered the most important form of communication. Dynamics were used to signal the start and end of sections, and these were also combined with gestures in some cases. Changes in tempo were also signalled using musical communication:

> *JP: "I consciously thought we should slow down, and tried to make that plain in my piano playing."*

It was also used for exchange and development of musical ideas:

> *LM: "It was pretty cool, we were both playing off each other's ideas and it was a bit more groovy than it's been."*

Verbal communication was mostly used at the start and end of sessions to plan what was going to be played and evaluate the end result. One pair used their sessions to work on developing ideas they had brought to the session, so concentrated more on teaching and learning motifs, then developing these into a larger piece. These musicians used the most verbal communication, and the technical issues such as latency and audio quality had minimal impact on this communication.

Non-verbal communication, including gestures and eye-contact were used in many different ways. Several musicians reported watching their colleague's hands to see where on the instrument they were playing, and therefore gaining clues about musical developments. Although useful, seeing a musician on screen felt uncomfortable for some musicians:

> *BS: "I think you just naturally understand that from when you're in the room with someone that you can really grab their attention, but not when you're videoconferencing. You feel someone's body moving towards you, giving you attention."*

A surprising effect of working remotely was that the musicians did not stop playing even when they would have done if they were playing in a room together, for example when synchronisation between the players breaks down.

> *BS: "For some reason when you play in the same room together you are more compelled to stop. Or maybe it's because you know you are going to be there for long enough that there's time to stop and start halfway through something if it's not working."*

All three pairs reported carrying on when they would usually have stopped, and several reasons for this were suggested, including time pressure, and the feeling of being in a recording session.

Several musicians highlighted the importance of listening, and how working with NMP changed the way they listened.

> *JP: "I suppose not having the video means you concentrate 100% on what you are hearing. Maybe it's not an ideal way to rehearse but it does completely focus you on listening."*

> *AM: "I would say that we got used to using the video for certain rhythmic guidelines for each other, but also it's just a different way you adapt yourself, if you're not in the same place. I was definitely listening harder for different things, less musically and more rhythmically, just the feeling of what we were doing, rather than the notes."*

This change of focus and alternative way of listening to the music could be beneficial, especially in a rehearsal or composition situation.

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C. The Musicians

The musicians themselves, how they felt about their own performances and playing, and their relationship with the other player were highlighted in the interview data. The relationship between the musicians contributed to the success of the sessions, but also the way they communicated. When asked about musical communication, JP stated:

"It's a dynamics thing and also to do with the rhythm. Because I think we have been playing with each other enough to know what… I knew that AM would know that I would want to keep going."

Another musician used the example of non-verbal communication:

OS: "Body language… always helps in music, but because I think we're already quite comfortable playing a lot of stuff, we've played together for years, so a lot of body language is automatic, so I kind of know what she'd be doing anyway."

Without this knowledge of each other's playing the musical communication may not have been successful. Trust in one another's playing and musical ability was also highlighted as important to communication.

Musicians also drew on their own musical knowledge and knowledge of their instruments when improvising:

CM: "I think from knowing musically what works and what doesn't, we know we're probably going to go to this chord, we're probably going to go to that chord. And then after you've done it through once you know what's going to happen next."

As the sessions progressed, the musicians fell into patterns and found ways of successfully working together despite the technical issues. These strategies included adopting roles of soloist and accompanist, allocating musical leadership according to changes in the music, or discussing the structure of the music in advance.

The change in the way musicians listen was highlighted above, but the focus of the musicians' concentration also changed:

AM: "… playing in this context changes your focus a bit more to your own playing as opposed to your collective sound."

The confidence of the musicians had a large impact on what was played, technically and creatively. This varied from session to session, and musician to musician, and was affected by factors such as ability to hear and see one another clearly, or feelings about their own playing on that day, as well as external factors such as tiredness.

Isolation was an issue that was highlighted several times, with some musicians feeling that they were cut off from their colleagues, affecting the enjoyment and feeling of control over the music:

JP: "Yeah, especially in the nature of what we were playing there, you very much wanted to be in, on the ball, in the same place, together at the same time, so yeah, maybe we were a bit isolated."

One musician, however, felt the isolation was a positive aspect of the technical set-up:

BS: "You weren't put on show as much, because you did have that isolation from each other, which I enjoyed. It was quite good."

In this case the isolation increased the musician's confidence as they felt their performance was more private.

D. The Technical Issues

Due to the nature of the sessions, technical issues were a major theme in the interview data. Audio quality was not considered to be an issue for the musicians, even with the lowest quality setting. Headphones were not used during the sessions to avoid isolating the musicians from their instruments, so there were some issues with echo, which were resolved in later sessions.

There were some difficulties with timing during the session, including either loosing synchronisation with the other player, or slowing down. When the different parts became out of time with one another, the ability to resynchronise using either the audio or video link was key to the success of the music. Sometimes this was successful:

AM: "I noticed at least a couple of times where either I was a little bit behind, or vice versa and we both remedied it and managed to do so and get back on track."

In another case (when there was no video for the musicians to use) this was impossible:

CM: "We didn't have a strong beat there and it was very difficult to zone in to it. I think if we were able to just look at each other, get a nod, like 'OK, straight back in', [it would have been better]."

The role of the video in the sessions varied a great deal, with some musicians contradicting themselves on their use of video within the same session. For some of the musicians, being able to see their colleague was reassuring, but they did not use the video link to enhance their playing together:

CM: "I think it's just because [the video] is there, and when you are playing with someone you do want to see them, but I wasn't making any decisions because I could see him."

For others, the video link gave them confidence to take control of the music:

LM: "I felt a lot more confident to be able to initiate something musically because of the stronger video link and how loud the audio was and I felt a bit more confident to put musical ideas forward."

Others tried to use the video but decided not to, or just used it at specific moments in the music:

OS: "I did look at [the video] when I was playing, not deliberately, but when I did look at it I made the decision not to, because it was like, that's really weird."

AM: "I only really looked at the video when I was assuming he might communicate something or I might need to communicate something to him. Most of the time I had my eyes shut!"

In most cases the audio link was used more than the video link, and was considered more important.

In most of the sessions the musicians adapted well to the technical limitations that they were working with, but also recognised when something they were trying was not going to work:

AM: "I was trying to think what would be the best way to communicate the rhythm and where the beats fell so I was swaying, and then I was like, that's not really coming through on the video so I started clapping and was immediately, no, that's not going to work at all."

The musicians found all the sessions to be productive, and felt they had worked on material that they would revisit in the future.

E. Discussion

Due to the temporal effect of latency on music, rhythm and tempo are the most likely musical factors to be affected by

NMP. The link between rhythm and tempo, and style and genre will mean that some styles of music will be more suited to NMP than others. Throughout this study, the musicians have adapted to the various simulated network conditions they have been put under, including adopting what Carôt and Werner (2009) describe as the 'master slave' approach, where one musician keeps time and ignores the delayed signals coming from the other musician, who plays in time with signal as they hear it. The musicians also suggested using freer, less rhythmically driving music as a solution to latency issues, described by Carôt and Werner (2009) as the 'laid back' approach, which accepts the delay of the second musician as a feature of the music.

Initially, the musicians felt that their creativity was reduced as they concentrated on the technical aspects of playing together in an unfamiliar setting. As the sessions progressed and they became acustomed to the technology and adapted to playing in this way, they reported that they were more creative. This has implications for the use of this technology for composition and arrangement, even if the ability to perform accurately is reduced.

Musical, verbal and non-verbal communication methods were used during the sessions, with musical communication highlighted by the musicians as the most important. Verbal communication was used when planning musical content of the sessions, and also when teaching motifs and patterns. The musicians rarely spoke when they were playing, something they would usually do, especially in rehearsal, and occasionally in performance. During the interviews several musicians said they felt they were in a recording session, partly due to where the sessions were taking place, but also because microphones were set up for instruments and vocals. This could make any verbal communication feel very exposed. Non-verbal communication was used in most of the sessions, including the use of gestures, and watching the other player's hands on their instrument. Some musicians reported not using the video link, while also highlighting the importance of non-verbal communication in music. Several players highlighted the importance of "feeling" the music, which is also described by Glennie (1993), and feeling the other person playing; this will clearly be affected by the separation in NMP.

All three pairs of musicians reported that at times they kept playing when they would have stopped, had they been in a room together. Time pressure was suggested as a reason for this, as it took them longer to resynchronise when playing remotely. This is an area for further investigation, to see whether this would change with further practice.

The musicians in this study were peers, both musically and socially, and they drew on this knowledge of each other as players and as people throughout both performances. It is likely that they recognised specific patterns and motifs in each other's playing, and are relaxed playing together, which helped them to play and improvise fluently. Both when playing and in the interviews they demonstrated their respect and support for each other, even though one musician may be more experienced on their instrument than the other. This was also observed in student musicians by Davidson and Good and described as allowing "musical space" (2002, p. 198).

As the sessions progressed, the musicians developed strategies for successful working, which included planning the music in detail and deciding on leadership roles (which could change as the music progressed). Confidence also increased during the sessions, and with further practice this could increase further, potentially leading to further creativity. Although feelings of isolation may be expected to occur in this setting, one musician reported that she enjoyed the isolation and that she felt less 'on show' when in a room on her own.

The role of video is not clear in these sessions. Although some musicians found the on screen presence of their colleague comforting, others ignored the image completely, and others found it useful for non-verbal communication. This varied between musicians and sessions. In general, though, the musicians relied on the video link less than the audio, which has been noted in other studies (Cáceres & Hamilton, 2008). It is possible that the musicians were using the video as a 'safety net' more than as a functional tool for communication, especially as latency was a big problem on the video link.

Audio latency made synchronisation problematic in some situations, especially when attempting to resynchronise after an error. Various NMP setups get round this problem by using distributed metronomes (See, e.g. Mills 2010; Bouillot 2007; Gurevich 2006), although this is not practical for improvised music that changes tempo or time signature.

IV. CONCLUSIONS

This study has found that musicians quickly adapt to the technical challenges of NMP and show improved confidence and creativity with practice. They also developed strategies for successful working with their peers in the compromised musical situation of NMP. The rhythmic characteristics of the music played affect the way student musicians approach NMP; however music with both a strong beat, and freer rhythms can be played successfully. The relationships between the musicians can also help to overcome these challenges, by recognising and responding to idiosyncrasies within their playing. Musical communication is considered the most important form of communication between players, and verbal communication is used differently in NMP than during collocated playing. Non-verbal communication is affected by the musicians' use of the video, which varies greatly.

Musicians' adaptation to NMP requires further investigation, including examining improvements in creativity across various styles of music. Further investigation into the role of video in NMP also has potential to examine whether the disadvantage of bandwidth requirements outweighs the advantage of musicians being able to see one another.

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Ginsborg, J., Lamont, A., Phillips, M., Bramley, S. (Editors)

Describing music-mediated emotion with motion: PDA-measured acceleration data predict perception of GEMS-9 to different degrees

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ABSTRACT

Background

Music is often discussed to be perceived as emotional because it renders expressive movements into audible musical structures. Different theoretical accounts of embodied music cognition state that listeners internally mimic movements during music listening experiences. Thus, a valid approach to measure musical emotion could be to assess movement stimulated by music.

Aims

That is why this study tested if mobile-device generated acceleration data produced by free movement during music listening experience can be used to predict different degrees of the Geneva Emotion Music Scales (GEMS-9). These findings will contribute to understand, how acceleration data can be used to integrate embodied music cognition into Music Recommender Systems.

Method

The study has been conducted in both lab (n = 22, age in yrs.: M = 27, SD = 2.4) and field (n=11, age in yrs.: M = 34, SD = 11.5).

Participants were instructed to move a mobile device (smartphone or tablet) continuously while listening to music in order to describe their experience. After each embodied description they rated the perceived emotional qualities of the musical excerpts according to the GEMS-9 on a 100-point, unipolar intensity scale initialized to '0'.

For this study 10 musical excerpts of ~ 40s duration were selected in advance by the field participants covering various genres and GEMS states. During the experiment, participants were also asked how suitable they considered both embodied and GEMS descriptions for each excerpt.

In order to fit a linear model to predict ratings for each of the GEMS-9 states, spectral and temporal features were extracted from the motion data recorded by the device's acceleration sensors. These features have been related to the following categories: 'tempo', 'size', 'smoothness' and 'regularity' of the movement.

Results

The variance of the perceived GEMS-states could be explained by the fitted models as follows: (1) power (r^2 = .37), sadness (r^2 = .17), tenderness (r^2 = .16), joy (r^2 = .15), tension (r^2 = .11), peacefulness (r^2 = .08), nostalgia (r^2 = .07), wonder (r^2 = .066) and transcendence (r^2 = .01).

The most 'peaceful', 'nostalgic' and 'tender' musical excerpts have been the ones for which participants preferred the GEMS over the embodied description. For 'transcendence' there has not been enough variance in the perceptional degree between musical excerpts.

Conclusions

One reason for the better performance of 'power' over the other states might be the individual capabilities and preferences to express complex emotions like 'nostalgia' or 'tenderness' by gestures. The rather rhythmic features of the method might also have contributed to the observation that 'power' can be more easily captured while 'transcendence' e.g. would require additional directional features representing the contour of the movement. Hence, observations suggest that there might still be a lot of hidden potential in additional movement features capturing direction and position, and also describe the gestalt of the movement (gestural data).

Keywords

Embodiment, Emotion, GEMS, Music Recommender Systems

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Rainbow color mapping between pitch classes and colors in colored hearing: Synesthetes and non-synesthetes

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ABSTRACT

Background

Colored hearing is a type of synesthesia in which sounds trigger color sensations. Specific sensations experienced by colored-hearing synesthetes are believed to be idiosyncratic and lack universality, as the audiovisual correspondences between sounds and colors are apparently randomly determined for each individual. However, it remains to be clarified with evidence to what extent the notion of idiosyncrasy is true in colored hearing. The issue of universality vs. idiosyncrasy is one of the central questions in synesthesia research, as it is relevant to the etiology and the neural mechanism of this neurological condition.

Aims

There is a well-known tendency that high and low pitches are associated with bright and dark/dim colors, respectively. This audiovisual association between *pitch height* and lightness/brightness is seen not only in synesthetes (Marks, 1975), but also in the normal population (Hubbard, 1996; Marks, 1974) and even in the chimpanzee (Ludwig et al., 2011). Pitches in music, however, are perceptually organized not simply linearly along the pitch height dimension, but rather in a helical structure reflecting octave equivalence of pitches belonging to the same *pitch class* (C, D, E, etc.) (Shepard, 1982). In contrast to the reported universality of the correspondence between pitch height and color, there is a general agreement that the audiovisual mappings between pitch classes and colors differ more widely from individual to individual. Nevertheless, systematic studies that have explicitly addressed this issue are scarce. This work investigated the nature of synesthetic color perception/imagery associated with pitch classes.

Method

Thirty-two self-reported colored-hearing synesthetes freely chose, on a computer, colors that corresponded to the seven pitch classes of the diatonic scale. Some, but not all, of them possessed absolute pitch. Sixteen subjects without synesthesia also undertook the same task. The pitch classes were specified orally using the solfège syllables: do, re, mi, fa, sol, la, and si. (In Japan where the work was conducted, pitch classes are commonly specified by these syllables rather than C, D, E, etc.) The test was administered twice for each subject, separated by at least two months, and the results were averaged for these two tests.

Results

There were individual differences among our synesthetic subjects in their choice of colors, as expected. However, across-subject averaging of the obtained RGB values uncovered an orderly rainbow color mapping between the solfège syllables and hues, beginning with do(C)-red and ending with si(B)-violet. Moreover, a virtually identical color mapping was revealed in the non-synesthetic subjects also.

In a separate behavior experiment, in which a solfège syllable was presented monochromatically in black-and-white on a computer screen and the subjects reported their subjectively associated colors, synesthetic subjects were significantly faster in reporting the colors than non-synesthetes, $p < 0.05$ (*t*-test), consistent with stronger pitch class-color associations in the former

Conclusions

This work uncovers a previously undocumented systematic mappings between pitch classes and colors in colored hearing synesthetes and non-synesthetes. The finding suggests that there is a universal, subliminal crossmodal correspondence (or so-called "weak synesthesia") between pitch classes and hues, and that this association is strengthened above some threshold of awareness in synesthesia. Combined with the well-known association between pitch height and lightness/brightness, our results lead to a helical model of musical pitch synesthesia, in which pitch height correlates with lightness/brightness and pitch class corresponds to the hue circle.

However, because our study used subjects in Japan only, mulitcultural validations are necessary to substantiate our conclusions. We are seeking collaborators to this end; if interested, please contact us at itoh@bri.niigata-u.ac.jp.

Keywords

chromesthesia, pitch chroma, solfa syllables

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Tracking the tempo of involuntary musical imagery: A naturalistic study

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ABSTRACT

Involuntary musical imagery (INMI, or "earworms"), the spontaneous and repetitive occurrence of music in one's head, is a common everyday experience. Previous studies of INMI have relied almost exclusively on self-report evidence regarding its features and phenomenology. The present study aimed to extend existing literature by objectively capturing a specific musical feature of the INMI experience—tempo—during the course of everyday life. This allowed for the investigation of two specific research questions regarding 1) the veridicality of INMI tempo and 2) the relationship between INMI tempo and concurrent affective state. Over the course of 4 days, participants tapped to the beat of their INMI while wearing a wrist-worn accelerometer that recorded their tapping movements and documented details about their INMI. Across all INMI episodes comprising songs that exist in canonical versions, the mean absolute deviation of the participant's tapped tempo from the original, recorded tempo was 10.8%. Songs heard aloud within the past day were not experienced at a more veridical tempo than songs heard over one week ago. A significant positive relationship between arousal level and the tempo of a concurrent INMI tune was also found. These results indicate that even in an experience as unpredictable as INMI, long-term representations for the tempo of familiar music are remarkably stable. The results also suggest a relationship between a specific musical feature of INMI (tempo) and concurrent level of arousal, providing some first evidence that INMI may play a role in daily mood regulation similar to actual music listening.

I. INTRODUCTION

Involuntary musical imagery (INMI, or "earworms"), the spontaneous and repetitive occurrence of music in one's head, is a common mental experience. In a large-scale internet survey, approximately 90% of respondents reported experiencing INMI at least once per week (Liikkanen, 2012a). A study of over 80,000 entries on Twitter found reports of "earworms" in 173 different geographic regions across the globe (Liikkanen, Jakubowski, & Toivanen, in press). The ubiquity of this phenomenon makes INMI an ideal means by which to study the memory mechanisms and possible functions underlying spontaneous, everyday cognitions.

Previous studies of INMI have focused on describing its phenomenology (Brown, 2006; Williamson & Jilka, 2013), situational factors that influence its occurrence (Hyman et al., 2013; Liikkanen, 2012b; Williamson et al., 2012), affective evaluations of the experience (Beaman & Williams, 2010; Halpern & Bartlett, 2011; Williamson, Liikkanen, Jakubowski, & Stewart, 2014), and individual differences that contribute to its occurrence (Beaman & Williams, 2013; Beaty et al., 2013; Floridou, Williamson, & Müllensiefen, 2012; Müllensiefen et al., 2014; Wammes & Barušs, 2009). The majority of data on INMI experiences has been collected via questionnaires or diaries (e.g., Beaman & Williams, 2010; Halpern & Bartlett, 2011; Liikkanen, 2012a), although a few laboratory-based studies have been conducted with the aim of inducing or suppressing INMI during different cognitive tasks (Floridou, Williamson, & Stewart, 2014; Hyman et al., 2013; Liikkanen, 2012b). One limitation of previous research is that most of the existing evidence on the mental experience of INMI is based on subjective reports from participants. As such, the present study aimed to add a new dimension to INMI research by obtaining the first objective measurements of one musical feature of the experience: INMI tempo.

Laboratory-based research on *voluntary* musical imagery--imagined music for which retrieval is intentional and deliberate-- has indicated that tapping along to the beat of the music in one's head is a viable means for measuring the tempo of imagined music (Clynes & Walker, 1982; Halpern, 1992; Jakubowski, Farrugia, & Stewart, 2014). As INMI is an ephemeral experience that is less conducive to being captured in a laboratory setting than voluntary imagery (Floridou, Williamson, & Stewart, 2014; Liikkanen, 2012b), these tapping methods were adapted in the present study for use in everyday contexts. The adaptation of these methods served to increase both the total number of INMI episodes that could be captured and the ecological validity of the experiment; to our knowledge, this study represents the first investigation of the tempo of INMI in the "stream of everyday life" (Konecni, 1982). The collection of data on INMI tempo allowed the present study to explore two previously uninvestigated research questions regarding 1) the precision of tempo representations within INMI and 2) the relationship between the tempo of INMI and concurrent affective state.

Precise measures of the pitch, tempo, and timbre of participants' mental representations within voluntary musical imagery have been obtained in laboratory-based studies. These measures suggest that voluntary musical imagery is a relatively veridical mental recreation of a perceptual musical experience (Crowder, 1989; Halpern, 1988, 1989; Hubbard, 2010; Janata & Paroo, 2006). However, the extent to which this may also be the case for INMI is not well understood. Participants in interviews and case studies have reported that INMI can be a quite vivid replication of a familiar song (Brown, 2006; Williamson & Jilka, 2013), but researchers have not objectively probed the precision with which the imagery replicates the original music. As such, the present study aimed to obtain more objective measures of the mental fidelity of INMI, with a specific focus on the veridicality of INMI tempo. High veridicality of tempo within INMI would provide strong

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evidence for parallels between INMI and both voluntary musical imagery and the perceptual experience of music listening, suggesting the implication of similar cognitive mechanisms in perceiving, imagining, and spontaneously imagining music.

If the experience of INMI is indeed similar in nature to a perceptual experience of music, it is plausible that INMI may also serve comparable functions to music listening. One key function of music listening in the Western world is mood regulation (Juslin & Laukka, 2004; Saarikallio & Erkkilä, 2007; Sloboda, O'Neill, & Ivaldi, 2001). The extent to which INMI might also have a role in mood regulation is hinted at by Williamson et al. (2012), whose participants reported emotional state as a potential trigger for their INMI experiences, as well as Bailes (2012), whose participants reported more frequent INMI in moderately to very alert states. However, no studies to date have investigated whether certain facets of the music within INMI (e.g., pitch height, tempo, timbre, articulation) directly relate to certain facets of one's affective state, in an analogous manner to the way in which such features relate to emotional responses during perceived music (Gagnon & Peretz, 2003; Webster & Weir, 2005).

The present study specifically investigated the relationship between INMI tempo and concurrent affective state. Hypotheses regarding this relationship were drawn from previous literature on music listening. In several studies of perceived music, tempo has been positively related to subjective and physiological arousal (Edworthy & Waring, 2006; Husain, Thompson, & Schellenberg, 2002; Jakubowski, Halpern, Grierson, & Stewart, 2014; North & Hargreaves, 2000). Some previous research has also suggested a positive relationship between tempo and emotional valence, although this relationship is less clear and not always present (Dalla Bella, Peretz, Rousseau, & Gosselin, 2001; Husain et al., 2002; Webster & Weir, 2005). As such, a positive relationship was hypothesized between INMI tempo and concurrent arousal, while the possibility of a relationship between INMI tempo and emotional valence was also investigated.

To summarize, data on the tempo of INMI was collected in the present study in order to address two research questions. The first research question aimed to investigate the temporal veridicality of INMI (i.e., are tunes represented within INMI at their original recorded tempo?). The second research question investigated the relationship between INMI tempo and concurrent affective state.

II. METHOD

A. Design

A naturalistic study was conducted over the course of 4 days. The tempi of each participant's INMI episodes were recorded, along with information regarding the song title and artist, time of day, concurrent mood, and situation surrounding each INMI episode.

B. Participants

A total of 17 participants completed the study (7 males), ages 20-34 years (M = 24.6, SD=4.2). All participants reported that they experienced INMI several times a day and were screened in advance in order to exclude any participants who exhibited difficulties in tapping to the beat of imagined music.

C. Materials

1) *Measuring INMI Tempo.* A GeneActiv wrist-worn accelerometer was employed to measure INMI tempo (http://www.geneactiv.org/). This device resembles a wristwatch and is a non-invasive tool for measuring movement data during the course of everyday activities (Rowlands, Schuna, Stiles, & Tudor-Locke, 2014; Zhang, Rowlands, Murray, & Hurst, 2012). In the present study, participants tapped to the beat of their INMI episodes with the forearm on which the accelerometer was worn. All movement data was recorded at a sampling rate of 100 Hz.

The viability of the GeneActiv for use in the research was assessed in a pilot study, in which a wide range of tapped tempi was recorded simultaneously on a laptop touchpad and the GeneActiv accelerometer. Tap onset time series for both data collection methods were processed. All tempi calculated with the accelerometer data were within 1 beat per minute (bpm) of the tempi measured using the touchpad.

2) *Self-Report Diary Measures.* A paper diary was provided in which participants recorded information about each INMI episode after tapping to the beat of the imagined music. The diary included fields in which to enter the time and date of the INMI episode, the time the diary was completed, the title, performer, and section (e.g., chorus) of the INMI tune, and the last time the tune was heard aloud. The diary also included seven bipolar mood pairs used in previous musical imagery research by Bailes (2006, 2007, 2012) that were adapted from a study of music in everyday life by Sloboda et al. (2001). These seven mood pairs group onto three factors: Positivity, Arousal, and Present Mindedness. Participants were asked to rate their mood on each of the seven scales in terms of the way they felt just before the INMI episode began.

D. Procedure

Each participant met with the experimenter for 15 minutes to receive the study instructions and materials. The term *earworm* was used in all instructions to participants, as it was a more familiar term than *INMI*. The experimenter provided a definition of an *earworm* ("an earworm is a short section of music that comes into your mind without effort and then repeats by itself") and told participants that they would be asked to wear the GeneActiv accelerometer over the next 4 days in order to keep track of their earworms. Participants were instructed that when they experienced an earworm they should 1) tap to the beat of the imagined music, as closely as possible to what they heard in their heads, for at least 20 taps, 2) press the button on the accelerometer to mark the end of the tapping period, and 3) fill in the paper diary as soon as possible following the

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tapping period. Examples of familiar melodies ("Jingle Bells" and "Row, Row, Row Your Boat") were provided with the beat structure marked to ensure that participants understood what was meant by the beat of the music.

The experimenter demonstrated the tapping method to the participants and showed them how to press the button on the accelerometer to mark the end of each tapping period. No button press was required at the start of the tapping period so that participants could begin tapping as soon as they noticed a tune in their head, without impeding upon the spontaneous nature of the event. The experimenter also explained each question in the paper diary.

Participants wore the accelerometer and carried the paper diary with them for a period of 4 days (96 hours) in order to record their earworms as they occurred. They returned the materials to the experimenter at their earliest convenience after these 96 hours had elapsed.

E. Analysis

1) Diary Data Analysis. Hand-written diary data for each of the 275 total reported INMI episodes was inputted into Microsoft Excel for analysis in Excel and R.

2) Tapping Data Analysis. To isolate individual tapping sequences, each participant's movement data was viewed within the Data Analysis feature of the GeneActiv software. Each tapping sequence was located using the time and date reported in the diary, with the button press as a marker of the sequence endpoint. No corresponding tapping sequence was found for 10 INMI episodes reported in the diaries (3.6% of the reported episodes).

Each tapping sequence was then extracted and analyzed using a tap detection algorithm in MATLAB. Sequences comprising fewer than 20 total taps were excluded on the basis of being too short to extract reliable tempo estimates (10.9% of the data). For each of the remaining sequences, the time series of inter-tap intervals (ITI) was calculated as the difference between all successive tap onsets. Artifacts and outliers were removed from each ITI series (similarly to the ITI analysis procedure used in Benoit et al., 2014). Finally, all remaining tapping sequences were visually inspected. A further 2.5% of the data was excluded in this stage on the basis of comprising a noisy signal without clear tapping peaks. Following all data cleaning and exclusion steps, 228 INMI episodes had usable tempo data (82.9% of the total reported INMI episodes).

III. RESULTS

A. Descriptive Statistics

The total number of INMI episodes reported by each participant during the 4-day period ranged from 7 to 32 episodes (M = 16.2, SD = 6.1). On average, participants reported approximately 4 INMI episodes per day (M = 3.6, SD = 2.1). A total of 182 different tunes were reported as INMI, from a diverse array of genres including pop, classical, rock, rap, jazz, musical theatre, Christmas, and children's music. Forty-two tunes were reported more than once, with the vast majority of these repetitions being reported by the same participant. The only tune that was reported as INMI by more than one participant was "Barbie Girl" by Aqua.

To investigate the frequency of INMI during different times of the day, the dataset was partitioned into 3-hour bins. Less frequent INMI were reported in the early morning and late night hours. However, between the hours of 9:00 and 21:00, when all participants were most likely awake and engaged in the study, the number of reported INMI episodes was highly stable across each 3-hour bin (see Figure 1).

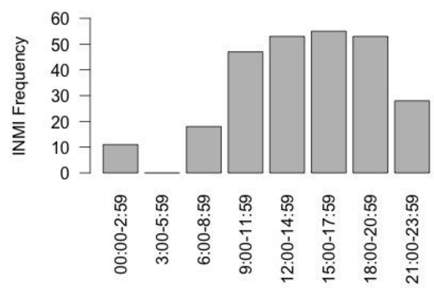

Figure 1. Number of INMI episodes reported at different times of day.

Participants also reported on how long it had been since they had heard the tune experienced as INMI played aloud, e.g., on the radio, as a live performance, etc. For 16.2% of episodes, the tune experienced as INMI had been heard less than 1 hour ago, and for 23.4% of episodes the tune had been heard less than 3 hours ago. However, for 40.0% of episodes, participants reported that they had not heard a recording or performance of the tune experienced as INMI in over one week.

For the 228 INMI episodes with usable tempo data, the tapped tempi ranged from 42.0 to 196.5 bpm (M = 100.9, SD = 29.9; see Figure 2). The mean coefficient of variation (CV; a normalized measure of tapping variability, calculated as the standard deviation of the ITI series divided by the mean ITI) across all 228 episodes was 0.06 (range = 0.02-0.13).

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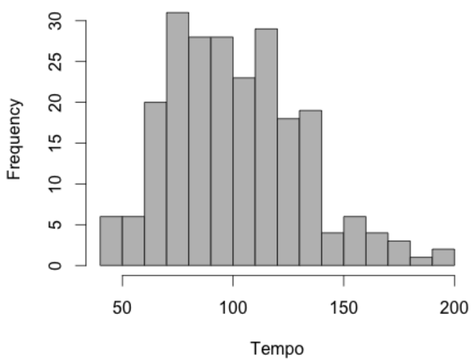

Figure 2. Tempo distribution of the 228 INMI episodes with usable tempo data.

B. Research Question 1: Temporal Veridicality of INMI

Of the 228 INMI episodes with usable tempo data, 132 comprised INMI for a song that exists in a canonical (standard recorded) version. In order to investigate the temporal veridicality of INMI, the tempo of each of these 132 INMI episodes was compared to the tempo of the original recorded version of the song. The absolute deviation from the original recorded tempo was calculated for each INMI episode, as a percentage (0% = participant tapped at the exact original tempo of a song). The mean absolute deviation from the original tempo for all 132 episodes was 18.5% (*SD* = 28.8%; median = 9.5%; see Figure 3).

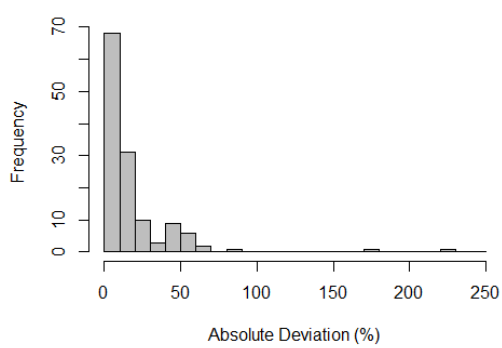

Figure 3. Distribution of absolute deviations from the original recorded tempo for all 132 canonical INMI tunes.

As there are some clear outliers present in this distribution, an exclusion criterion utilized in previous research on the tempo of voluntary musical imagery was applied (Halpern, 1988; Jakubowski, Farrugia, & Stewart, 2014). INMI episodes for which the ratio of the tapped tempo to the original recorded tempo was less than 0.6 or greater than 1.9 were excluded on the basis that these ratios suggest the participant was tapping at a different metrical level than expected (halving or doubling the beat). This resulted in the exclusion of 17 episodes, leaving 115 episodes for further analysis.

For these 115 INMI episodes, the mean absolute deviation from the original tempo was 10.8% (*SD* = 10.8%; median = 7.9%). Overall, 59.1% of tunes were imagined within 10% of the original recorded tempo and 77.4% of tunes were imagined within 15% of the original tempo. The overall mean absolute deviation of 10.8% was significantly different from perfect performance of 0% deviation, $t(114) = 10.7$, $p < .001$, but is comparable to previous, laboratory-based results on the temporal veridicality of voluntary musical imagery. Jakubowski, Farrugia, and Stewart (2014) asked participants to deliberately imagine and tap to the beat of familiar pop songs and reported a mean absolute deviation from the original recorded tempo of 17.3%.

It is plausible that recent hearing of a melody might influence the above results, i.e., that the quite veridical reproduction of tempo within INMI might be explained solely by recent exposure. A Wilcoxon rank-sum test was employed (due to non-normal data distributions) to compare the absolute deviation from the original recorded tempo for INMI tunes heard within the past week (N = 64) to the absolute deviation for tunes heard over one week ago (N = 51). The result of the test was non-significant, $W = 1399$, $p = .19$. A more stringent criterion was also applied to compare only tunes heard within the past day (N = 32) to tunes heard over one week ago (N = 51); this result was also non-significant, $W = 754$, $p = .57$. These results indicate that INMI tunes heard aloud more recently are not experienced at a more veridical tempo than those heard over one week ago.

C. Research Question 2: INMI Tempo and Affective State

The next goal of the study was to examine the relationship between the tempo of INMI and concurrent affective state, specifically in relation to emotional arousal and valence. Correlations were calculated between the tempo of all 228 INMI episodes with usable tempo data and the two dimensions of the mood scale relevant to the present research questions: Arousal and Positivity (see Table 1). Significant correlations were found between INMI tempo and both Arousal and Positivity.

Table 1. Correlations between INMI tempo, Arousal, and Positivity

	INMI Tempo	Arousal	Positivity
INMI Tempo	1.00		
Arousal	.14*	1.00	
Positivity	.15*	.07	1.00

Note: * signifies a significant correlation at the level of $p < .05$.

A linear mixed effect models was then fitted with Arousal and Positivity as predictors of INMI tempo. A mixed effects model was employed in order to take account of the multiple observations recorded from each participant by including

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"Participant" as a random effect in the model. In this model, Arousal emerged as a significant positive predictor of INMI tempo and no significant relationship was found between Positivity and INMI tempo (see Table 2). It should be noted that this non-significant relationship between Positivity and INMI tempo emerged despite an initial significant correlation between these two variables when examining all INMI episodes together (disregarding that there were multiple observations taken from each participant). This indicates that the initial significant correlation is actually driven by specific individuals. Thus, when individual variations are taken into account by allowing a random effect in the model for "Participant," the initial significant relationship disappears.

The previously non-significant effect of Positivity was then removed and the model was re-fitted with only Arousal as a predictor of INMI tempo. Arousal was again a significant predictor and the reduced model provided a better fit to the data, based on the Bayesian Information Criterion (BIC), than the full model with both mood variables included as predictors (BIC of full model = 2164.0, BIC of Arousal-only model = 2160.6).

Table 2. Results of linear mixed effects model with Arousal and Positivity as predictors of INMI tempo.

	Coefficient	S.E.	*t*-value	*p*-value
Intercept	81.24	12.99	6.26	.00
Arousal	1.87	0.67	2.78	.01*
Positivity	0.08	1.11	0.08	.94

Note: * signifies a significant predictor at the level of $p < .05$.

IV. DISCUSSION

The results of the present study indicate that the objective measurement of specific musical features of INMI, in this case tempo, can add a new dimension to INMI research and provide avenues for exploring previously under-investigated aspects of this phenomenon. Despite the reduced degree of experimental control exerted over the naturalistic setting in which the study took place as compared to a laboratory, participants were able to successfully complete the study and provided a large amount of usable data, with over 80% of the collected tapping sequences meeting the criteria for inclusion in the data analysis.

Overall, tempo was represented in a relatively veridical form within INMI. The mean deviation from the original recorded tempo of the tunes experienced as INMI, after excluding episodes that strongly suggested halving or doubling of tempo, was 10.8%. In previous research using a similar laboratory-based task of tapping to deliberately imagined music, the mean deviation from the original tempo across all trials was 17.3% (Jakubowski, Farrugia, & Stewart, 2014). These findings suggest that tempo representations within INMI are at least as veridical as, or perhaps even more veridical than, tempo representations within voluntary musical imagery generated within a controlled laboratory setting. In the literature on involuntary *autobiographical* memories, it has been found that these types of memories are often more specific or vivid than their voluntarily recalled counterparts (Berntsen, 1998; Schlagman & Kvavilashvili, 2008). Future research should be conducted to directly compare the temporal veridicality of involuntarily and voluntarily recalled musical imagery within the same participants using the same songs for each type of imagery. Such research could provide clearer insights into whether memory recall might also be more precise for involuntary *semantic* (musical) memories than voluntary semantic memories.

Although approximately one quarter of INMI episodes reported in the present study comprised tunes that had been heard aloud within the past 3 hours--which is consistent with previous findings that recent exposure is the most common trigger of INMI (Williamson et al., 2012)--another 40% of INMI tunes had not been heard aloud in over one week. However, the precision of tempo recall within INMI was not affected by recency of exposure to a tune; INMI for tunes heard more than one week ago was not experienced at a less veridical tempo than INMI for tunes heard within the past week or even the past day. This suggests that the high veridicality of tempo within INMI cannot be explained solely on the basis of INMI tunes being mentally looped within short-term memory after just having heard them aloud, but that precise long-term memories for the tempo of music are also necessarily implicated.

The present study also revealed a significant relationship between the tempo of INMI and concurrent arousal. A musical tempo-arousal relationship has been previously reported in several studies of music listening in a variety of contexts (e.g., Edworthy & Waring, 2006; Husain et al., 2002; Jakubowski, Halpern, Grierson, & Stewart, 2014; North & Hargreaves, 2000). The present study is, to our knowledge, the first to objectively demonstrate this tempo-arousal relationship using music that is both imagined and spontaneously recalled. This finding provides some first evidence that INMI might serve mood regulatory functions similar to those implicated by perceived music.

No relationship was found between INMI tempo and emotional valence. This analysis was more exploratory in nature, as a relationship between musical tempo and valence has been found in some studies of perceived music, but was absent in others (Dalla Bella et al., 2001; Husain et al., 2002; Webster & Weir, 2005). Future work should investigate additional musical features of INMI that might serve as stronger correlates to emotional valence, such as musical mode. Such studies could also explore a wider range of different musical features of INMI (e.g., pitch height, timbre, articulation, lyrical content) in order to uncover how these specific features might also relate to one's current affective state. Additionally, previous literature has revealed that involuntary autobiographical memories tend to be more emotional in nature than voluntary autobiographical memories (Berntsen & Hall, 2004). As it is currently unknown whether any similar pattern exists between involuntarily and voluntarily recalled semantic memories, a study to compare emotional responses to INMI versus voluntary music imagery could help to clarify this question.

In conclusion, the present study introduced a novel method for measuring the tempo of INMI during the course of everyday life. The findings have provided new insights indicating that INMI can be a highly veridical experience in terms of tempo, even when a song experienced as INMI has not recently been heard aloud. The results also revealed a significant relationship between subjective arousal and INMI tempo, suggesting a first link between spontaneously imagined music and mood that parallels findings in the perceived music domain. These findings suggest strong parallels between the memory mechanisms implicated and functions served by INMI, voluntary musical imagery, and music listening.

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Professional classical musicians' awareness of and interactions with their audience: A survey study

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ABSTRACT

A recent decline in audiences for classical music has been documented. Research suggests that limited inclusion and participation in a performance may be a reason for lack of attendance by younger adults. However, there is little knowledge about how classical musicians view their audience, and how willing they are to interact formally or informally with their audience in the ways that research has indicated as motivating for contemporary audiences.

The present paper provides an overview of an opportunity sample of young British classical musicians' perception of their own audience and their willingness to interact with their audiences formally and informally.

52 professional London-based classical orchestral players and singers ($_{(age)}$ = 28), all contracted to contribute to a performance of Haydn's Creation, responded to an online questionnaire, e.g. asking about the contributions an audience made to their recent positive concert experiences, as well as their general attitudes towards recruiting and interacting with audiences. Use of promotional and communication channels (including social media) was also explored.

Participants generally saw audience recruitment as primarily the job of the concert promoter and tended to prioritise word of mouth in any personal recruitment undertaken. Two contrasting concepts are manifest in this sample. Some musicians prefer a distant relationship, while others are focused on a positive experience for audiences. But both these groups are unlikely to aim to plan pro-actively to reach out to their audiences. A minority of participants agreed that it is important to know something about the audience before a performance. Those musicians are more likely to engage with audiences in both formal and informal ways. On the basis of this survey, we may conclude that only a small number of musicians are fully conscious of their active role in securing and relating to an audience.

I. INTRODUCTION

Over the last decades aging and declining audiences for cultural activities such as classical concerts has been documented for Europe, North America and Australia (Wolf, 2006). The report "Cultural access and participation" documented changes in the cultural behaviour of EU citizens between 2007 and 2013 (Eurobarometer 399 2013). This study shows that attending live classical music is the least popular cultural activity for citizens in most European countries. Similar data has also been collected for the USA,showing a decline across recent years, particularly marked among young adults (18-34 years of age, see Table 1).

Various initiatives of orchestras and cultural institutions as well as research activities (Schlemmer & James 2011, Dobson, 2010, Roose, 2008, Brown, 2004) have worked with audience members to understand reasons for this decline and adjust concert environments to accommodate expectations and changing preferences among audiences. There is a growing perception that the social aspect of concert attendance (who interacts with an audience member and how) is as important as the musical. For instance, data collected for the national survey of U.S. adults (Brown et al.,2002) suggest that many people who enjoyed attending a live music performance did not take the initiative to buy their own tickets, but were brought along by a friend. The importance of social factors is also apparent in a study carried out by Dobson (2010). Here young adults, who were attending arts events on a regular basis but not classical music, agreed to visit three different types of classical live concerts, and their reactions recorded in depth. One type was the more informal event Night Shift, a concert series by the London-based Orchestra of the Age of Enlightenment. In this series audience members are not only allowed to drink, move, applaud or talk during the performance, but also musicians talk directly to the audience about the music and their musical intentions being interview live by a compere. Dobson's participants pointed out how much this made them feel part of the performance, something which did not happen in the more traditional concerts they attended. Other innovative methods of audience inclusion, such as participation in post-concert discussions with performers, have been investigated by Dobson & Sloboda (2014). Although not yet common in classical venues, they appear to be highly valued by those who have experienced them.

Innovations in performer-audience engagement require the willingness of musicians to change traditional habits of relating to audiences. There is at present very little available data on the perceptions and beliefs of classical musicians themselves about their audiences, and how they interact with them. The present paper represents a first attempt to gather some data about musicians' level and nature of engagement with their audiences.

Table 1. Percent of U.S. Adults Who Attended a Classical Music Performance, by Age: 2008 and 2012 (published in: SPPA (2013) p.12)

	2008	2012
All Adults	**9.3%**	**8.8%**
Age		
18-24	6.9%	6.7&
25-34	7.0%	7.3%
35-44	8.9%	6.4%**
45-54	10.2%	8.2%**
55-64	11.6%	11.0%
65-74	12.2%	13.9%
75 and over	9.7%	10.9%

** change is statistically significant at the 95 confidence level

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The data for the present paper were collected as part of a larger research project investigating a new classical music initiative Vocal Futures (www.vocalfutures.org) founded by Suzi Digby OBE whose aim is to encourage classical concert attendance among young people in the 16-22 age range. The central feature of the Vocal Futures project is the mounting of staged performances of major oratorios in central London, employing established professional performers alongside advanced students from London conservatoires. Some of musicians who took part in the production also contributed to induction events, in which young participants heard extracts of the piece before and learned something about how the musicians involved were approaching the performance. Vocal Futures management was particularly interested to understand how the singers and players they engaged generally related to their audiences. And so, as part of their contract with Vocal Futures, all musicians were asked to take part in research activities. This was in line with Vocal Futures' stated aim to help educators to understand how aspiring professionals can excite and recruit new audiences and help performers, promoters and providers in thinking about how best to establish long term commitment of younger audiences for classical music (http://www.vocalfutures.org/page/research).

II. AIM

The aim of the present paper is to provide an overview of an opportunity sample of young British classical musicians' perception of their own audience and their willingness to interact with their audiences formally and informally.

As this was an exploratory study, the following broad areas of investigation were chosen:

(a) How aware are musicians of the contribution that an audience may make to the success of a live classical concert? See sections A-C of Results.
(b) What behaviours do musicians engage in to promote or project their own concerts to existing or potential audiences? See section D of Results.
(c) What interactions with audience members do musicians engage in before, during, or after a concert? See section E of Results.
(d) What feelings and attitudes do musicians have towards relating to their audiences? See section F-G of Results.
(e) How do attitudes towards audiences (area d) relate to the promotional behaviours (area b) that musicians engage in? See section H of Results.

III. METHOD

56 (82%) professional London-based classical orchestral players and singers, who were contracted to perform in a performance of Haydn's Creation which took place in central London in late 2013, responded to an online questionnaire. 52 responses were used in the analysis (four musicians did not reveal their age or were under the age of 16). There were 29 female and 22 male participants with one not revealing gender. The sample comprises 15 singers and 36 instrumentalists, with one musician not revealing his or her background. The average age was 28 (=27.8, median=23), ages ranged between 19 and 64 years of age. For some parts of the analysis musicians were categorised into age groups. Three age groups were formed: group 1 (representing the target age group of Vocal Futures) = 16-23, group 2 (representing young professionals) = 24-30, and group 3 (representing established professionals) = 31-65.

The questionnaire asked about the contributions made by the audience to a recent positive concert experiences as well as the nature, quality or circumstances of the performance, different ways of personally inviting and audience (e.g. website, social networks, word of mouth) and interactions with audience members through such things as formal introductions or informal contacts before or after concerts. The last part of the questionnaire contained statements expressing different attitudes towards audiences ('I always welcome audience members to come up and speak to me after a concert' or 'I generally try to 'blot out' the audience when I am performing').

IV. RESULTS

A. A recent successful concert

Musicians indicated the type of performance of a recent successful performance. These types included: Student orchestra, student chamber music, professional orchestra, professional chamber music and solo performance (table 2). Music students reported more orchestral performances than chamber music, while professional musicians reported more chamber music than orchestra. The difference is unlikely to be caused by a general preference for chamber or orchestra performances. Students are less likely to get the opportunity to perform with their chamber groups than well established professionals. Also, students are very likely to play in an orchestra in their college, while not all professional musicians who took part in the Vocal Futures' Creation hold an orchestra position.

Table 2. Performance type of a recently successful performance

	number	%
Student orchestra	17	32.7
Student chamber music	6	11.5
Professional orchestra	7	13.5
Professional chamber music	12	23.2
solo	9	17.3
missing	1	1.9
Total	52	100

Table 3. Audience members' age group according to musician's own perception in absolute numbers and (%)

	Yes	No	Don't know
Children/Teenager	15 (28.8)	14 (26.9)	12 (23.1)
Student age (16-22)	45 (86.5)	2 (3.8)	2 (3.8)
Young adults (23-40)	47 (90.4)	0	3 (5.8)
Adults (41-60)	51 (98.1)	0	0
Mature adults (+61)	46 (88.5)	1 (1.9)	3 (5.8)

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Musicians were asked which of the following age groups were in the audience during this memorable performance: children/teenager, students, young adults, adults and mature adults (table 3). Most audiences included adults, from young students to mature adults. As a large number of concerts described here were in a music college environment, the high number of student age audience members is not surprising. In their own perception, teenagers or children took part in just under 30% of these concerts.

B. Audience contributions to a successful concert

When asked whether the musicians noticed anything about the audience that may have contributed to the success of the performance, 65.4% of respondents said yes (Table 4)

Table 4. Musician's response to the question: "Was there anything about the audience, their reaction, or your knowledge of them which contributed to the concert's success?"

	number	%
yes	34	65.4
no	16	30.8
missing	4	7.1

Out of these, 32% of the comments described something special about the response of the audience in general (Table 5). That included 'Very enthusiastic applause', 'They were complimentary afterwards, saying they enjoyed it etc.', 'I think that a full hall makes it feel more like an exciting occasion for audience and players alike.', ' very welcoming, focused and enthusiastic', or 'complete silence in parts where there was tension, huge cheer at the end!'. Similar to these type of audience response is a category which we have labelled as 'intimacy', which either described a physical interaction between performers and audiences ('A lot of direct interaction they gave ideas and we did it there and then') or a closeness between performers and audience members ('Lots of friends and relatives of performers, very sympathetic to performers'). Three musicians described the particular response to the soloists. The comments labelled as 'investment' reflect on expectations due to audiences' financial support ('It was the opening of a new building around which there had been a fair amount of press hype and it was predominantly donors to the school […]'), or hoping for a successful collaboration in the future ('People in the audience who could be good contacts in the future were complimentary and receptive to our performance). Another 3 musicians mentioned the special atmosphere due to a specific soloist ('A lot of them would have been specifically fans of Andreas Scholl and would have come to see him perform').

Table 5. Categories created out of musicians' responses to the question "What was special about the audience?"

	number	%
Positive audience response	18	34.6
investment	7	13.5
intimacy	6	11.5
Performer/person related	3	5.8
missing	17	32.7

C. Nature of the performance that contributed to a successful concert

When asked whether musicians thought that there was something special about the nature, quality or circumstances of the performance, that made it special, 75% agreed that that was the case (Table 6).

Table 6. Musicians' response to the question: "Was there anything about the nature/quality or circumstances of the performance that contributed to its success?"

	number	%
yes	39	75
no	11	21.2
missing	2	3.8

Out of the "yes" responses, 30% of the comments described the quality of the performance due to preparation ('Very well rehearsed'), excellent fellow musicians ('talented conductor and players') which led to a high standard performance ('Everyone gave it 110%'). The high figure of 'special occasion' in table 7 is due to the fact that many of the musicians are students at the Guildhall School of Music and Drama and the concert opening the brand new College building and concert hall was the memorable event that many described. Interpersonal atmosphere described occasions where the traditional division between musicians and audiences were less distinct: "This was the return of a regular audience, and the traditional divide between audience and performers seemed blurred. A level of intimacy was achieved, despite the relatively large audience."

Table 7. Categories created out of musicians' responses to the question "What was special about the performance?"

	number	%
Quality	16	30.8
Special occasion	11	21.2
Venue	5	9.6
Interpersonal atmosphere	5	9.6
missing	14	26.9

D. Attracting an audience

One important aspect of the present study was to get an understanding of musicians use of a range of advertising methods to promote their own concerts. Results, summarized in table 8, indicate, that apart from social media (e.g. Facebook), musicians who took part in Haydn's creation don't use a wide range of channels to advertise their own concerts. More traditional methods such as 'word of mouth' and 'leaving it to the concert promoter' is for more than 50% of the musician the way that an audience will learn about a concert, while personal website, micro blogging (e.g. twitter), email newsletters, distributing flyers, adverts in newspapers and magazines are not or rarely used by the musicians to advertise a concert.

When looking at musicians' age groups, One-way ANOVA results suggest that there are significant differences for the use of personal websites, social media, and the use of word of

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mouth between different age groups (table 9). There is also a tendency to use the distribution of flyers as well as poster in concert venue areas differently. Tukey Post-hoc tests reveal that young professional musicians seem to be the more likely to use personal websites to promote concerts, while music students were significantly less likely to do so. Established musicians were significantly less likely to use social media to promote concerts compared to both younger groups, while younger musicians were more likely to trust word of mouth for concert promotion. While the distribution of flyers as well as posters does not suggest a significant difference between groups, results indicate that student musicians may be still more likely to use flyers as well as posters, even though all figures suggest that the use of flyers and posters is rarely used by individual musician's altogether.

Table 8. Frequency in % of musicians' use of different advertisement channels to promote their own concerts. (1=never, 2=rarely, 3=sometimes, 4=mostly, 5=always) Numbers in bold indicate where the majority of responses lied for each column

	never	rarely	sometimes	mostly	always	
Word of mouth	1.9%	0%	13.5%	28.8%	**53.8%**	4.4
Concert promoter	3.8%	5.4%	25.0%	**41.3%**	21.2%	3.7
Social media	17.3%	11.5%	25.0%	**30.8%**	15.4%	3.1
Nothing special	19.6%	17.9%	**30.4%**	12.5%	0%	2.5
Poster	**32.7%**	13.5%	**30.8%**	17.3%	5.8%	2.5
Micro blogging	**55.8%**	11.5%	11.5%	9.6%	9.6%	2.0
Personal website	**57.7%**	11.5%	7.7%	11.5%	9.6%	2.0
Email newsletter	**57.7%**	11.5%	21.2%	5.8%	1.9%	1.8
Distributing flyers	**48.1%**	19.2%	25.9%	3.9%	0%	1.9
Newspaper advert	**50%**	13.5%	23.1%	9.6%	1.9%	2

Those musicians who chose a solo performance as their recent successful concert indicated that they made significantly more use of their personal website than those who chose a student orchestra performance or a professional orchestra performance (One-way ANOVA DV: use of personal website, IV: type of performance (solo, professional orchestra, student orchestra, professional chamber concert, student chamber concert), df=51, F=4.37, p=.004, $_{(solo)}$=3.3, $_{(StudOrch)}$=1.27, $_{(ProOrch)}$=1.57), post-hoc Tukey sig between student orchestra and solo performance p=.002, between professional orchestra and solo performance p=.061).

All other methods of advertising don't seem to be used differently for musicians reporting different types successful performances. The results suggest that musicians might be more likely to promote a solo performance on a personal website. The general low rate in using a personal website to promote concerts (=1.96) indicates that more than half of our musicians don't have or use their personal websites for concert promotion on a regular basis.

Table 9. Use of personal website, social media, 'word of mouth', distributing flyers as well as posters to advertise live concert performances for three different age groups . (1=never, 2=rarely, 3=sometimes, 4=mostly, 5=always)

	Age group	$\bar{X}$	SD	Sig.	Tukey Sig.
Word of mouth	16-23	4.53	.64	**.026**	
	24-30	4.4	.74		
	31-61	3.67	1.3		.021
Concert promoter	16-23	3.6	.8.4	.131	
	24-30	3.5	1.3		
	31-61	4.3	.71		
Social media	16-23	3.7	1.0	**.000**	.000
	24-30	3.0	1.2		
	31-61	1.8	1.4		.034
Nothing special	16-23	2.4	.85	.285	
	24-30	2.4	1.4		
	31-61	3.0	.53		
Poster	16-23	2.9	1.2	.051	
	24-30	2.3	1.4		
	31-61	1.2	1.2		.056
Micro blogging	16-23	2.1	1.4	.366	
	24-30	2.3	1.5		
	31-61	1.4	1.3		
Personal website	16-23	1.5	1.1	**.014**	.011
	24-30	2.8	1.65		
	31-61	2.2	1.5		
Email newsletter	16-23	2.0	1.1	.355	
	24-30	1.6	1.2		
	31-61	1.7	1.0		
Distributing flyers	16-23	2.2	1.1	.053	.084
	24-30	1.6	.73		
	31-61	1.5	.88		
Newspaper advert	16-23	2.2	1.3	.444	
	24-30	1.8	1.01		
	31-61	1.78	1.2		

E. Interactions with the audience

Musicians were asked how likely they are to interact with their audience before, during or after concerts. Table 10 illustrates the frequency musicians' interacted with their audiences in different ways. Results indicate that musicians don't often speak at an introduction or an organised event and only sometimes if at all step forward on the podium to speak to the audience, seek information from the audience afterwards or give feedback to the audience e.g. through social media. However, musicians are more likely to have informal contact with audience members before, during the interval or after the performance.

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Musicians older than 31 were significantly more likely to speak at an introduction than musicians between 16-23, for any other type of audience interaction no significant difference between age groups where obvious (df=51, F=4.57, p=.015, $_{(16-23)}$= 1.8, $_{(24-30)}$=2.37, $_{(31-99)}$=2.89), post-hoc Tukey sig. between music students and established professionals p=.017).

There was no difference between singers and instrumentalists, genders or type of performance the musicians reported upon in this survey, when it comes to audience interaction before, while or after a concert.

Table 10. Frequencies of activities engaging with the audience as a musician (1=never, 2=rarely, 3=sometimes, 4=mostly, 5=always) Numbers in bold indicate where the majority of responses lied for each column.

	Never in %	**rarely in %**	**sometimes in %**	**mostly in %**	**always in %**	
You speaking at an event prior to the performance	**34.6**	21.2	**33.6**	5.8	1.9	2.2
You speaking to the audience from the platform	11.4	15.4	**53.8**	11.5	7.7	2.9
You speaking at an event after the performance	**50.0**	23.1	19.2	3.8	-	1.7
Informal contact with audience members	-	1.9	32.7	**46.2**	19.2	3.8
You seeking information from audience after the event (e.g. comments)	21.2	26.9	**32.7**	9.6	7.7	2.5
You giving feedback to your audience after the event (e.g. twitter, personal contact)	**32.7**	21.2	**34.6**	5.8	3.8	2.3

F. General concept of audiences

The last section of our questionnaire included general statements illustrating musicians' concepts of their relationship with audiences. Table 11 illustrates musician's agreement or disagreement for statements describing general attitude towards audiences. Results indicate, that musicians overall like to get involved with their audience, welcome audience members to come up and speak to them after a concert, don't feel the need to quickly get home after a concert, don't agree that attracting an audience is necessarily someone else's job, agree that their main wish for a concert is that the audience has a good experience, agree to a certain extent that it is also the musician's responsibility to ensure that people come to their concerts, do not generally 'blot out' the audience, agree strongly that it is important that the audience finds their performance convincing and really value a loyal audience at their concerts. The musicians were less likely to try to establish some contact with the audience before a concert or want to know something about the audience beforehand. They were more likely to agree that the opinions of their fellow performance matters the most to them and also enjoy to unwind with fellow musicians after a concert.

Table 11. Musicians' agreement/disagreements with statements about their general concepts of audiences in %, and for all participants (1=strongly disagree, 2=disagree, 3=somewhat disagree, 4=somewhat agree, 5=agree, 6=strongly agree)

	Strongly disagree	**disagree**	**Somewhat disagree**	**Somewhat agree**	**agree**	**Strongly agree**	
I'd rather not get too involved with the audience	15	**27**	6	4	-	-	1.9
I always welcome audience members to come up and speak to me after a concert	1	-	1	7	17	**26**	5.2
After a concert I like to get home as quickly as I can	**5**	8	**21**	14	3	-	3
Attracting an audience is someone else's job (e.g. promoter)	3	8	**23**	17	-	-	3
The opinions that matter most to me are those of my fellow performers	3	10	15	**17**	4	2	3.3
My main wish for a concert is that the audience has a good experience	-	-	2	10	**23**	17	5
I have a responsibility for ensuring that people come to my concerts	-	1	7	**24**	15	5	4.3
I generally try to "blot out" the audience when I am performing	12	13	**16**	10	1	-	2.5
I need an appreciative audience in order to enjoy a perform.	3	8	12	**17**	8	3	3.5
It is important to know something about the audience before a performance	**9**	**13**	**13**	**13**	3	1	2.8
After a concert I like to unwind with fellow musicians	-	-	**4**	18	**22**	8	4.6
It is important that the audience finds my performance convincing	-	-	1	8	10	**33**	5.4

I really value a loyal audience at my concerts	**-**	1	2	8	**22**	19	5.1
I try to establish some contact with my audience before a concert	2	9	**23**	14	2	23.2	

G. Musicians' attitudes towards audiences

Not all musicians answered in the same way and therefore there is a range of attitudes towards audiences in this sample. In order to discover underlying patterns of response the suitability for a factor analysis was tested for these 14 items. The Kaiser-Meyer-Olkin (KNO) measure of sampling adequacy value of .602, (recommended value is .6 or above) as well as statistical significance of Bartlett's Te t of Sphericity supported the factorability of the matrix. Therefore the 14 items were subjected a principal component factor analysis. Inspection of the correlation matrix revealed the presence of six components, with eigenvalue exceeding 1, explaining 23.5%, 14.3%, 11.6%, 8.9%, 8%, and 7.2% of the variance respectively. The screeplot indicated a clear break after the third component, and it was decided to retain three components for further investigation. The three-component solution of the analysis with varimax-rotation explained 50.4% of the variance, with component 1 contributing 24.5%, component 2 14.1% and component 3 11.6%.

The strong loadings for component 1 – which we here name "performing unrelated to recruiting audience" – reflect attitudes where recruiting an audience is someone else's responsibility and music making is seen as a 'job'. Component 2 – "'blot out' audience" – describes a turning away from audiences. Component 3 – "responsive to audience" – describes an audience embracing attitude but in a passive way: it welcomes when audience members speak to the musician after a concert, and the good experience for the audience is in the centre of a performance. It also shows a 'job satisfaction' attitude, where the satisfaction of the audience plays an important role, but also the social aspect of sharing time with fellow musicians beyond the concert platform is seen as important.

Table 12. Principal Component Analysis, rotation method: Varimaz with Kaiser Normalization

	Component		
	Performing unrelated to recruiting audience	**'blot out' audience**	**Responsive to audience**
I have a responsibility for ensuring that people come to my concerts:	**-.826**		
Attracting an audience is someone else's job	**.821**		
After a concert I like to get home as quickly as I can:	**.820**		
I generally try to "blot out" the audience when I am performing:		**.738**	
It is important to me to know something about the audience before a performance:		-.729	
I'd rather not get too involved with the audience:	.360	**.675**	-.320
I try to establish some contact with my audience before a concert:	-.371	-.496	
The opinions that matter most to me are those of my fellow performers:	.355	.371	
After a concert I like to unwind with fellow musicians:		.328	**.616**
I always welcome audience members to come up and speak to me after a concert:	-.307		**.611**
My main wish for a concert is that the audience has a good experience:			**.548**
It is important to me that the audience finds my performance convincing:		-.387	**.508**
I need an appreciative audience in order to enjoy a performance:		-.319	.488
I really value a loyal audience at my concerts:	-.316	-.362	.487

H. Who engages how with the audience?

The final step of the analysis looks at the relationships between these different factors and their reported promotional engagement of musicians with their audience.

Table 13. Person Product-moment correlation between the main item of components 1&2 and the different types of promotional engagement

		Performing unrelated to recruiting audience
You speaking at an introduction	**r** **p** **n**	.123 .395 50
You speaking from platform	**r** **p** **n**	-.150 .293 51

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Speaking after the performance	**r** **p** **n**	.064 .661 49	
Informal contact with audience	**r** **p** **n**	.018 .899 51	
You seeking information after event	**r** **p** **n**	.026 .860 50	
You giving feedback after performance	**r** **p** **n**	.046 .751 50	
You giving feedback to your audience after the event	**r** **p** **n**	.084 .558 51	-.110 .442 51

Using Pearson product-moment correlation coefficient results suggest that musicians, who score high in the component 'Performing unrelated to recruiting audience' don't score significantly lower or higher in any type of promotional engagement, i.e. even though they don't engage in the process of recruiting audiences, they are not less likely to engage with audiences before, during or after a performance than others. Needless to say they are also not more likely to engage with audiences in any other way than other musicians (table 13). Musicians who score high in ''blot out' audience' indicated that they are significantly less likely to speak at an introduction prior to a performance as well as speaking at an organised event after a performance.

Looking at the group scoring high in the component 'audience embracing, passive' it is worth breaking the component down into its individual variables. While musicians scoring high on 'after a concert I like to unwind with fellow musicians' don't score higher or lower on the audience engagement activities compared to all other musicians, those who score highly on 'I always welcome audience members to come up and speak to me after a concert' are significantly less likely to speak at an organised event after a performance and also show a tendency to be less likely to speak at an introduction prior to a performance, which underlines a passive attitude towards audiences for this group.

Table 14. Person Product-moment correlation between two items of component three and the different types of promotional engagement

		After a concert …	**I always welcome audience …**
You speaking at an event prior to the performance	**r** **p** **n**	-.107 .454 51	-.270 **.055** 51
You speaking to the audience from the platform	**r** **p** **n**	-.048 .738 52	-.146 .303 52
You speaking at an event after the performance	**r** **p** **n**	-.069 .636 50	-.403 **.004** 50
Informal contact with audience members	**r** **p** **n**	.181 .198 52	.216 .125 52
You seeking information from audience after the event	**r** **p** **n**	-.136 .341 51	-.079 .582 51

The final step of the analysis looks at the relationships between these different factors and their reported promotional engagement of musicians with their audience.

Musicians scoring highly in 'I really value a loyal audience at my concerts' have the tendency to score higher for 'informal contact with audience members' as well as 'you stepping forward and speaking to audience from the platform', but these correlations are not significant.

So far it looks that none of the different types of musicians would engage actively with the audience. Looking through the remaining variables not featuring in the 3-component-factor analysis, one variable gives an idea which musicians will actively engage with audiences: Musicians, who scored high on 'it is important to me to know something about the audience before a performance' reported to be significantly more likely to 'step forward and speak to the audience from the platform', 'speak at an organised event after the performance', would 'seek information from the audience after an event', as well as 'give feedback to audiences after the event' via twitter, facebook or personal contact. But only a minority of musicians in our sample find it important to know something about the audience before a performance (table 11).

Table 15. Person Product-moment correlation between the item 'It is important to me to know something about the audience before a performance' and the different types of promotional engagement

		'it is important to me to know something about the audience before a performance'
You speaking at an event prior to the performance	**r** **p** **n**	.237 .094 51
You speaking to the audience from the platform	**r** **p** **n**	.364 **.008** 52
You speaking at an event after the performance	**r** **p** **n**	.377 **.007** 50
Informal contact with audience members	**r** **p** **n**	-.113 .423 52
You seeking information from audience after the event	**r** **p** **n**	.452 **.001** 51
You giving feedback to your audience after the event	**r** **p** **n**	.463 **.001** 51

V. DISCUSSION

As a first attempt to gather some systematic data in an understudied area this study clearly leaves several issues under-determined. The opportunity sample of musicians

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cannot necessarily be considered representative of even London's classical musician population, particularly as they were primarily those on the books of a small number of professional "fi ers". The production values of Vocal Futures was such as to ensure that musicians were from the "top end" of the younger and emerging talent in London's professional scene. This may have produced a research sample over-represented by those "in high demand", and therefore less likely to have developed their own audience-focused strategies.

The study is entirely a self-report study, with all the standard biases that this can introduce (including mis-remembering or mis-estimation, and possible influence of social acceptability considerations in the choice of answers). Gathering documentary and behavioural data on actual audience engagement would clearly bring considerably greater validity and reliability, as would in-depth qualitative interviews with a range of musicians in the key categories identified.

The items in the attitudes scale were developed informally based on the authors' general awareness of relevant issues. Although most of these items elicited responses across the full range of options, qualitative investigations could likely refine and enrich the range of attitudes probed.

Despite all these problems, the high response rate on all the questions, and the lack of problematic or hard-to-classify responses suggests that the exercise had validity for the participants and was tapping areas of experience and value with which they could easily connect.

VI. CONCLUSION

Musicians taking part in this study were able to clearly identify and articulate what made a recent performance successful. While preparation is key to a successful performance, positive audience responses are also important. Given the recognized importance of audience response it is interesting that most musicians don't actively recruit or engage with their audiences but rely on word of mouth and promoters.

While the majority of musicians are happy to mingle with audience members informally, formal contacts with audiences, such as speaking at organised events before, during or after a performance are not common. These engagements with audiences seem to be affected by musicians' general attitudes towards audiences, such that those who are more likely to 'blot out' audiences are less likely to engage formally with audiences. Musicians who adopt the 'passive' stance of welcoming audience members to come up to them after a performance also reported that they would be less likely to engage formally with audience members. Those musicians who think it important to know something about their audiences beforehand are more likely to engage actively in organised events as well in informal settings.

It is probably most accurate to characterize the musicians we studied as "open to" the audience and audience engagement, rather than strategically and energetically pro-active in reaching out to audience members. This means that there could still be a quite large gap in audience focus and awareness between promoters and concert managers on the one hand, and the performing musicians they engage on the other. Proposing strategies for narrowing that gap (should such narrowing be appropriate and desired) is beyond the scope of this research. But we hope that the data we have provided gives some clues about the nature and extent of the gap that still exists.

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When words and music meet in the brain: Reviewing effects of music and second language education on executive functions

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ABSTRACT

EF refer to a general broad cognitive concept that includes working memory, inhibitory control and attention shifting, and seems to predict academic achievement. Previous studies have shown that both language and music training have similar effects on executive functions (EF). The present study aims at further investigating these effects in children aged between 9 and 12 years, that either participated in musical training since age 5 or attended second language immersion school programs since the age of 5. 31 monolingual musicians were compared to 31 monolingual children without musical training (control 1). In addition, 44 non-musically trained children being in immersion education were compared to 48 monolingual non-musicians (control 2). Socio-economic status, verbal and non-verbal intelligence were taken into account. All children underwent the Simon task, a neuropsychological test that measures inhibitory control by measuring reaction times (RT's) and error rates on congruent and incongruent trials. To assess verbal and non-verbal intelligence, the Raven's Coloured Progressive Matrices and the Peabody Picture Vocabulary Test, respectively, were used. The musically trained children showed significantly faster RT's on the incongruent trials only, compared to the monolingual non-musicians, suggesting an inhibitory control advantage. In contrast, the immersion learners showed faster RT's on both congruent and incongruent trials compared to monolingual children, suggesting another aspect of EF might be enhanced. To the best of our knowledge, this may be the first study comparing the cognitive effects of music versus second language education methods. Both training types, musical training and language immersion, seem to enhance EF. However, the precise aspect of EF might be different between both training types, which will be discussed.

Keywords: Executive Functions- Early Childhood Education- Immersion Education- Music Education- Bilingualism

I. INTRODUCTION

Previous studies indicated how particular experiences may affect some aspects of cognition, such as the executive functions (EF) (Diamond & Lee, 2011). EF is a general name for several cognitive processes, such as working memory, inhibitory control and cognitive flexibility (Miyake et al., 2000). Although EF seem to have a fixed development (Diamond, 2002), it has been shown that several experiences might enhance EF as well (Diamond & Lee, 2011). Examples of such experiences are aerobics (Hillman, Erickson, & Kramer, 2008), mindfulness and martial arts (Lakes & Hoyt, 2004). Despite recent questioning (Paap, Johnson, & Sawi, 2015), another experience that might be associated with enhanced EF is bilingualism (Bialystok, 2001; Costa, Hernández, Costa-Faidella, & Sebastián-Gallés, 2009). The reason why bilingualism is associated with improved EF is still unclear. Current hypotheses are that, given the fact that two languages remain active in the bilingual mind (Brysbaert, 1998), bilinguals need to select the appropriate language in a given context and inhibit the non-desired language while communicating in the selected language This constant need to switch between languages and to inhibit the non-desired language might improve EF. (Bialystok, 2001; Costa et al., 2009; Hilchey & Klein, 2011). Beside studying EF advantages in 'full' bilinguals (bilinguals learning their second language at home or in the family), recent studies started to look at EF in children enrolled in immersion education settings as well. In immersion education a foreign language is used to teach other academic subjects, such as mathematics. For instance, in the French- speaking part of Belgium, French-speaking children will have some parts of the curriculum in Dutch in immersion schools. Studies suggested that EF advantages might emerge in immersion learners, but that sufficient second language exposure is needed in order to make advantages on EF appear (Bialystok & Barac 2012; Carlson & Meltzoff, 2008; Nicolay & Poncelet, 2013).

Another activity that has been thought to be associated with enhanced EF is music training. Despite inconsistent findings, some studies point towards an EF advantage in musically trained children (Degé, Kubicek, & Schwarzer, 2011; Moreno et al., 2011; Schellenberg, 2011; Zuk, Benjamin, Kenyon, & Gaab, 2014). The reason why music training could affect EF might be that several components of EF are required when playing a musical instrument, such as selective attention, switching between different time signatures and rhythms, working memory when memorizing musical parts, etc.

Given the fact that both bilingualism and music seem to affect EF, one may ask whether they have similar effects on EF and what could explain such similarities or disparities. Hence, some studies have directly compared performance of bilinguals and musicians on EF tasks. For instance, Bialystok and Depape (2009) compared adult bilinguals, musicians and monolingual non-musicians on their performance on the Simon arrows task and on the auditory Stroop task. Musicians and bilinguals outperformed the monolingual non-musicians on the Simon arrow task by showing overall faster RT's on both congruent and incongruent trials. However, musicians outperformed the

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bilinguals and monolingual non-musicians on the auditory Stroop task. Interestingly, in a recent study by Moradzadeh, Blumenthal, and Wiseheart (2014), monolingual musicians, bilingual musicians, bilingual non-musicians and monolingual non-musicians were examined on their performance on tasks assessing task switching and dual-task performance. Only the musicians showed advantages on switching and dual-task performance. Moreover, the performance of the bilingual musicians did not differ from the monolingual musicians, making additional effects of both training types unlikely. It thus seems that both activities, namely music training and bilingualism, could be associated with enhanced performance on EF tasks, but that findings might depend on the task being used and on the assessed EF component.

The comparison of language and music, two seemingly different activities, might be justified by some previous studies, suggesting a possible overlap between both domains (Patel et al., 1998; Patel, 2003; Patel & Iversen, 2007). For instance, EEG-studies found common ERP-components between language and music, such as the P600, which emerged as a response to syntactic violations in both language and music (Patel et al., 1998), suggesting similarities between the syntactic processing of language and music. Another study, using MEG, showed that the 'Early Right Anterior Negativity' (ERAN), another ERP-component associated with the syntactic processing of music, emerged in the Broca area, a brain area associated with language production (Maes, Koelsch, Gunter, & Friederici, 2001).

The aim of this brief article is to present a comparison between two early childhood education types and their associations with EF: early childhood second language education (also known as immersion education) and early childhood music education. Since previous studies have shown that advantages on EF tasks might be found in bilinguals and musicians, we wondered whether we would find similar advantages in early childhood education methods in the domains of language and music. This comparison will be illustrated by two separate studies assessing EF in children being enrolled in early childhood second language and early childhood music education, respectively, for an average duration of 5 years.

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II. STUDIES

A. Study 1

In this study (Joret, Germeys, Kerckhofs, & Van de Craen, 2015, *submitted*), 44 French-speaking Belgian children involved in Dutch immersion education (with an average immersion training of 5 years) were compared to 48 monolingual children following the traditional education. The mean age was 123.1 months for the immersion group and 124.5 months for the traditional education group. The immersion children learned their second language, Dutch, in the immersion program only. None of the children were involved in an early childhood music education method. All children underwent the Simon task (Simon & Rudell, 1967), a neuropsychological measure assessing EF by measuring reaction times (RT's) and error rates on congruent and incongruent trials. There were no significant differences between groups on age, gender, verbal intelligence (measured by the Echelle de Vocabulaire en Images Peabody, EVIP; Dunn,Thériault-Whalen, & Dunn, 1993) or non-verbal intelligence (measured by the Raven's Coloured Progressive Matrices; Raven, Court, & Raven, 1998). Both groups were matched on socio-economic status (SES-level of education of the parents) as well. This suggests that the groups are comparable and that any of the following differences could not be attributed to these confounders.

Analysis of the RT-data indicated that the immersion learners showed significantly faster RT's on both congruent and incongruent trials compared to the control group. This result suggests a possible advantage on EF in the immersion group.

B. Study 2

In this study (Joret, Germeys, & Gidron, 2015, *submitted*) 32 Belgian, monolingual Dutch-speaking children with an average music training of 5 years, were compared to a control group of 31 Belgian, monolingual Dutch speaking children, who did not receive any formal music training, except of the music classes required by the school curriculum. Mean age was 125.3 months for both the music and the control group. In addition, none of the children followed immersion education or similar activities, such as scouting or sports, in a foreign language. All participants underwent the Simon task (the same version as in Study 1). There were no significant differences between both groups on age, gender, SES (parental education), verbal intelligence (measured by the Peabody Picture Vocabulary Test III, Dunn & Dunn, 2005) or non-verbal intelligence (measured by the Raven's Coloured Progressive Matrices, Raven et al., 1998). Analysis of the RT's showed a reduced interference effect in the music group (the difference on RT's between incongruent and congruent trials), suggesting an advantage on EF (inhibitory control skills) in children with music education.

III. DISCUSSION

This manuscript aimed to provide an empirical comparison of results of studies testing an EF advantage in two separate studies (immersion versus controls and music learners versus controls). The first study showed that children in immersion education programs showed significantly faster RT's on both congruent and incongruent trials in the Simon task. These results are similar as in previous studies on 'full' bilingualism, in which 'full' bilinguals show a similar overall RT advantage (Bialystok, 2001; Bialystok, Martin, & Viswanathan, 2005). Our study suggests that immersion learners, being in the immersion programs for an average duration of 5 years, might also show these overall faster RT's. When trying to explain these overall faster RT's observed in 'full' bilinguals, uncertainty is omnipresent and different explanations for this overall RT-advantage in bilinguals have been suggested. While some researchers interpret it as evidence for enhanced inhibitory control (Bialystok, 2001), others have questioned such interpretation since no inhibitory control is needed in the congruent trials. Instead, it has been suggested that the explanation is to be sought in other mechanisms such as an enhanced monitoring system (Costa et al., 2009; Hilchey & Klein, 2011). According to the enhanced monitoring hypothesis, bilinguals might have advantages on tasks in which different types of trials (congruent and incongruent trials) need to be managed. The monitoring system is able to detect the type of trial and to adjust the level of cognitive control in order to solve the trial (Hilchey & Klein, 2011). Performing overall faster RT's on both types of trials (congruent and incongruent) in a conflict task suggests a better ability to manage these different trials and could hence be explained by a more developed monitoring system (Costa et al., 2009). The reason why bilinguals might have a better monitoring system could be explained because of their constant need to monitor the appropriate language in a given context (Costa et al., 2009; Hilchey & Klein, 2011). However, it is impossible to make conclusions about monitoring from our first study. It can also not be excluded that other factors, such as motivation or even personality, explain these overall faster RT's in our study.

The results of the second study indicate that the musically trained children showed a reduced interference effect, suggesting an inhibitory advantage for the musicians. Musicians seemed to be less affected by the conflict in the incongruent trials and hence reacted significantly faster on the incongruent trials only. Our findings confirm previous studies assessing EF in musically trained children that also found advantages on inhibitory control (Degé et al., 2011). However, this contradicts other studies finding no advantage on EF in musically trained children on inhibitory control using the Sun-Moon Stroop task (Schellenberg, 2011) or another study using a version of the Stroop task (Zuk et al., 2014). Possible explanations for these discrepant findings could be methodological aspects that might be different between studies, such as the sample size or the amount of musical training of the partcipants. Hence, the sample size in Zuk et al (2014) is relatively small and the children assessed in Schellenberg (2011) had less musical training than in our study, which makes it possible that EF advantages were not yet present. It is also possible that not all studies were careful in recruiting children with similar backgrounds concerning confounders (such as SES, or linguistic status of the participants), while in the two previous studies presented above, such cautious steps were taken. Other explanations could be linked to differences between the EF tests used to measure inhibitory control.

When considering the performance of the two education types on the Simon task in the two studies, it seems that children involved in both early childhood education methods show a different, but enhanced performance on the Simon task, an index of EF. Evidence for a different performance between both 'full' bilinguals and musicians can be found in some previous studies. For instance, in Bialystok and Depape (2009), the performance of 'full' bilinguals and musicians was similar on the Simon arrow task, but different on the auditory Stroop task. Here the musician advantage might be explained by the nature of the auditory Stroop task, which uses sounds and which might facilitate the tasks for musicians. In Moradzadeh et al. (2014) however, only the music group showed enhanced performance on dual-task performance and task-switching, while bilinguals did not have an advantage. In addition, a recent study using fMRI and making a direct within-subjects comparison of the processing of language and music questioned the overlap between language and music and suggested differences between the processing of both domains are present as well (Rogalsky, Rong, Saberi, & Hickok, 2011).

One element that needs particular attention when comparing two education systems is the issue of pre-selection. For instance, children enrolled in immersion settings often come from families with a higher SES (Bruton, 2011), which has been shown to affect EF (Mezzacappa, 2004). Previous studies have also shown that 'high-functioning' children are more prone to enroll and to stay in music classes (Schellenberg, 2011). Moreover, even certain personality traits, such as 'openness-to-experience' and 'conscientiousness' seem to predict who will take and persist in musical training (Corrigal, Schellenberg, & Misura, 2013). Such family, cognitive and personality factors may play a role in any tacit pre-selection to participate in either immersion education or music education and could hence affect outcomes. Another important element might be the interaction between parents and the child. Being enrolled in an immersion program or in an early childhood music education program requires a lot of parental involvement in order to succeed. Previous studies have shown that this relation between the child and the parent seems to affect EF as well (Bernier, Carlson, & Whipple, 2010). All these elements should be taken into account in future studies assessing possible associations between EF and immersion and music education.

IV. CONCLUSIONS

In conclusion, we could state that children involved in early second language immersion education and early childhood music education seem to outperform controls on the Simon task in both studies. However, the pattern of the findings in both studies seems to be different, making it possible that both activities are associated with different specific effects on EF. This needs to be assessed more deeply in future studies however, in which both education types will be directly compared to each other, while taking important confounders into account (such as personality, child-parent interaction, etc.). Such a study would enable us to understand the common and specific effects of early immersion and music education on EF.

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Manipulation of mechanisms underlying emotional reactions to music

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ABSTRACT

Background

A common approach to study emotional reactions to music is to attempt to obtain direct links between musical surface features such as tempo and a listener's response. However, such an analysis ultimately fails to explain *why* emotions are aroused in the listener. If only some musical events succeed in arousing an emotion, and if different listeners might respond differently to the same piece of music, what are the precise conditions that will cause a specific emotion to occur? We submit that real progress in the study of music and emotion can only be achieved if we understand the underlying process that mediates between surface features and aroused emotions. The most comprehensive attempt to describe a set of mechanisms thus far is the BRECVEMA framework (Juslin & Västfjäll, 2008; Juslin, 2013), which currently features eight mechanisms: (1) *Brain stem reflex*, (2) *Rhythmic entrainment*, (3) *Evaluative conditioning*, (4) *Contagion*, (5) *Visual imagery*, (6) *Episodic memory*, (7) *Musical expectancy*, and (8) *Aesthetic judgment*. Each mechanism is responsive in its own unique way to specific configurations of information in the *music*, the *listener*, and the *situation*, referred to jointly as 'the musical event'. In a recent study (Juslin, Harmat, & Eerola, 2014), we tried to manipulate a short piece of music so as to activate specific mechanisms, using computer synthesis. The results showed that target mechanisms were activated and aroused emotions as predicted by the BRECVEMA framework. However, the synthesized stimuli were rather simple, compared to most 'real' music, in order to achieve experimental control. It is thus important to show that similar effects can be obtained with 'real' pieces of music by 'real' composers.

Aims

The aim of this experiment was to test four of the causal mechanisms hypothesized to underlie emotional reactions to music, using more ecologically valid excerpts of music. To activate the mechanisms, we selected pieces of music that included an 'extreme' acoustic event (Brain stem reflex), a voice-like emotional expression (Contagion), an unexpected musical sequence (Musical expectancy), or a melody linked with significant life events for most people (Episodic memory). We used converging evidence from multiple measures to draw more valid conclusions about aroused emotions than would be possible from a single index. Hence, in addition to self-reports of emotions, we obtained 'post-hoc' self-reports with regard to mechanisms (*MecScale*) and psychophysiological measures (skin conductance level and facial electromyography). We also used a control condition (a 'neutral' piece of music) to help rule out alternative explanations.

Method

Sixty participants (29 males, 31 females, age 19-58 years) took part in the study as a whole. They were randomly distributed across four experiments with the only provision that there must be an equal number of participants in each experiment. Sixteen pieces of music - four in each experiment - were selected for inclusion in the study on the basis that they featured information deemed relevant for the activation of each target mechanism. All experiments used a within-subjects design featuring target mechanism as independent variable (5 levels: Brain stem reflex, Contagion, Episodic memory, Musical expectancy, and Neutral condition), and self-reported feelings (15 scales), mechanism impressions (*MecScale*), facial expressions (zygomaticus and corrugator muscles), and autonomic activity (skin conductance level) as dependent variables. Analyses of facial and autonomic measures also included an additional 'baseline' condition. The only difference between the four experiments was that different music excerpts were used to represent the target mechanisms.

Results

The results from our four experiments can be summarized as follows: First, it was found that the target mechanisms aroused emotions in listeners largely in accordance with our theoretical predictions: The listeners' self-reports revealed that the Brain stem reflex conditions aroused the most *surprise*; the Contagion conditions aroused the most *sadness*; the Episodic memory conditions aroused the most *nostalgia* and *happiness*; and the Musical expectancy conditions aroused the most *anxiety*. Second, these results were supported by the psychophysiology data: measures of skin conductance level and zygomaticus and corrugator activity were significantly influenced by the target mechanism condition in the majority of cases. These results showed that listeners were *experiencing* emotions, rather than merely perceiving emotions in the music, and the patterns were consistent with the emotion ratings. Third, the results regarding emotion ratings and psychophysiology were extended by the data for *MecScale*, the self-report items focusing on subjective impressions of mechanisms. A multiple discriminant analysis indicated that these items could predict the target-mechanism condition with a high level of accuracy.

Conclusions

The present findings may be compared with those of our previous study, which used computer-manipulated versions of a piece (Juslin et al., 2014). This study corroborates the findings

in that study, by showing that reasonably predictable response patterns can be obtained also with existing pieces of music. The inclusion of four different pieces to represent each mechanism - all pieces taken from the actual repertoire of classical music - serves to enhance the generalizability of the results. In general, the findings are sufficiently encouraging to suggest that the multiple-mechanism approach is a promising avenue toward understanding the mystery of emotional reactions to music.

Keywords

music, emotion, listening, mechanism, psychophysiology

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Idiographic modeling of aesthetic judgments of music

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ABSTRACT

Background

Emotional responses to music have been thoroughly examined by music psychologists (Juslin, 2015). In contrast, aesthetic responses have received rather little attention and have often been defined as *any* response a person could have to a work of art. Here we define an 'aesthetic response' as a response that involves a judgment of the music's value as art, based on one or more criteria. There have been numerous attempts in the history of aesthetics to find a single criterion that may distinguish 'aesthetic responses' from other responses (e.g., beauty, originality, skill, expressivity). However, to explain listeners' responses to music, a psychological theory must take *their* criteria as a point of departure, rather than those advocated by art theorists. The results from a recent survey, featuring both musicians and non-musicians, indicated that there is no single criterion that might account for listeners' aesthetic judgments. Several criteria are involved and these may differ from one listener to another (Juslin & Isaksson, 2014). In the present experiment, we adopt a psychological model of aesthetic judgment in music experience outlined by Juslin (2013). According to this model, the listener first adopts an 'aesthetic attitude'. Information about the musical event is then channeled through the perception, cognition, and emotion of the listener. However, whether these inputs will influence the resulting aesthetic judgment depends on the listener's individual criteria and their relative weighting. If the judgment process indicates that the music is 'good', this will result in liking (preference). If the outcome is that the music is extraordinarily good (or bad), an emotion (e.g., *awe*) will be aroused, in addition to preference. Hence, the present model presumes that aesthetic judgment, preference, and emotion are partly independent.

Aims

The aim of this study was to address a set of questions that have a bearing on the model of aesthetic judgment mentioned earlier. Are listeners' aesthetic judgments systematic? Which aesthetic criteria do listeners rely on in their judgments? How many criteria do they use? Are there individual differences with regard to how the criteria are weighted? Which of the criteria are most influential? How do preference, aesthetic judgment, and emotion intensity relate to each other? To address these questions, we aimed to model aesthetic judgments of music based on subjective criteria, featuring a representative sample of musical pieces and using the tools of Judgment Analysis (Cooksey, 1996). Judgment analysts use multiple regression to model how an individual combines various *cues* (pieces of information) to arrive at a judgment. The focus on *individual* judges in Judgment Analysis is crucial for its use in the present context, because a typical feature of aesthetic judgments is large inter-individual variability. Hence, we adopted an idiographic approach in which listeners' judgments are first modeled at the individual level before they are aggregated and summarized.

Method

To obtain a representative sample of pieces of music, we used a *stratified random sampling procedure*, where the strata corresponded to a modified version of the STOMP factors for music preference (Rentfrow & Gosling, 2003). We randomly selected 72 pieces from 12 genres using a large music database. The pieces were divided across two groups of participants (22 males and 22 females, 19-66 years old). Each participant group listened to 40 pieces of music (32 unique to their group, and eight common to both groups), and rated each piece on eight rating scales: seven that referred to various aesthetic criteria (i.e., beauty, originality, expressivity, skill, emotion, message, and typicality) and one that indexed the overall aesthetic value of the piece. In addition, listeners rated their liking (preference) for each piece as well as the intensity of their emotional reaction, if any. We conducted idiographic (individual) and nomothetic (averaged) regression analyses on the listeners' judgments. In both types of model, the goal was to predict listeners' overall aesthetic judgments (dependent variable) based on their ratings of aesthetic criteria (independent variables). We also computed the correlations between their ratings of preference, aesthetic judgment, and emotion intensity, respectively, to explore how much variance the three scales shared.

Results

The results showed, first of all, that linear regression models provided a good fit to listeners' aesthetic judgments of music, which indicates that the judgment process is systematic and mainly additive. Second, all of the included criteria received a significant beta weight for at least some of the listeners. Third, most listeners appeared to use only a small number of criteria in their judgments. Fourth, there were large individual differences between the listeners regarding what criteria they used, and how these were weighted. Fifth, despite individual differences in the criteria weighting, some criteria appeared to be more important overall, across different listeners. Finally, the results confirmed that preference, aesthetic judgment, and emotion intensity are partly independent.

Conclusions

Music psychologists have, on the whole, been poorly able to explain why and how we find music aesthetically valuable. To

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our knowledge, this is the first experiment to attempt to model aesthetic judgments of music based on subjective criteria, and it features one of the most representative samples of music used in experimental studies of aesthetics. The results suggest that there really *is* accounting for taste - at least in the sense that aesthetic judgments are systematic, and that individual differences can be explained by different weighting schemes for subjective criteria of aesthetic value. Thus, we conclude that aesthetic judgments are systematic *and* personal - listeners have particular ways of attending to, interpreting, and experiencing music aesthetically. These individual ways of engaging with aesthetic value may be fruitfully modeled using an idiographic approach.

Keywords

music, aesthetics, judgment, preference, theory, modeling

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Proceedings of the Ninth Triennial Conference of the European Society for the Cognitive Sciences of Music, 17-22 August 2015, Manchester, UK
Ginsborg, J., Lamont, A., Phillips, M., Bramley, S. (Editors)

Effectiveness of special musical training (workshops) organized for children at the age between 4-7 by Lodz Philharmonic

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ABSTRACT

The results of the surveyed audience of concerts for children "Explorers of Music" conducted jointly by the Philharmonic in Lodz and the Department of Music Education Grazyna and Kiejstut Bacewicz Music Academy in Lodz will be presented and discussed in this paper. Those workshops are organized on Saturday morning by the Philharmonic of Lodz. They are designed for children in preschool and early school age (from 4 to 7 years). "Explorers of Music" is a unique art project run by German composer and educator Carl Orff. The basis of the method is the general-educational foundation.

The results of the survey show high satisfaction with concerts of both children and adults. Parents believe that the atmosphere at the concerts was pleasant, children amounted to a lot of pleasure from the concert, felt well on it, and most importantly, the concert was adapted to their intellectual and emotional needs. The workshop was a great shared experience for the whole family. A positive signal is also a willingness to re-admission to the concert given by 4/5 of the test audience. The positive effects of concerts on their children have been observed by nearly 90% of parents.

I. THEORETICAL BACKGROUND

A. Introduction

Music is an essential part of everyone's life. "Active education through art directed educational process, stimulates the imagination, gives the ability to explore their own creative paths and allows the development of personality" [Cieślk-Klauza, 2006, p. 136]. Education of children of preschool age is extremely important for their overall development. Children learn about the world around us primarily through sensory impressions, visual, auditory and tactile experiences. During the follow-musical phenomena children make observations requiring from their attention, which has a huge impact on the development of memory and thinking.

Musical education is the process of organizing a variety of musical experiences aimed at developing their musical perception, and action. The purpose of music education is not only to develop musical abilities or musicality in children, but most of all, the contact with the music effectively influences the development of the child's personality traits, and mainly impacts on their emotion and motivation.

The study focused on children in preschool. This age is followed by a large development processes, shapes the personality of the child and their experience. The subject of the author's research is the impact of music on the development of preschool children and the role of music education in their development. The aim of the conducted research is to find an answer the question of how music education affects the development of children. In order to show the effects of music classes on children's development, this project has been conducted on a group of children taking part in music workshops "Explorers of Music", organized by the Arthur Rubinstein Lodz Philharmonic of in the artistic season 2013/2014.

B. Previous research

The surveyed audience of symphonic concerts has not a long tradition. In the 80s among a few projects of that kind was a study of Dollase et al. on the jazz and rock concerts listeners [Dollase; Rüsenberg; Stollenwerk 1978], later also symphonic concerts audience [Dollase et al. 1986]. In the 90s Neuhoff conducted research on symphonic concerts and opera audience [Neuhoff 2001]. In Germany in 2006 results of telephone surveys of symphony concerts and opera audience commissioned by Radio-television stations ARD (ARD-E-Musikstudie) [Eckhardt, Pawlitza, Windgasse 2006] were published.

The survey of audience satisfaction of concerts for children, unfortunately, cannot have such a long tradition. One of the few completed projects was the study of public concerts for children conducted in 2005 by the Institute for Research in Music Ability (IBFM) in Paderborn and the Higher School of Music in Detmold (Hochschule fur Musik Detmold, Germany). "Concertino Piccolino" concerts for young audiences took the form of a subscription in the number of six concerts in the artistic season. Another study was a project carried out by the IBFM and Lodz Philharmonic in 2008. It concerned the public of children's concerts: "Meeting with a tone" organized by the Lodz Philharmonic Orchestra, and was conducted by Stella Kaczmarek [2009].

C. About "Musical Explorers"

The Lodz Philharmonic is a place not only for adults. Thanks to the artistic workshops "Explorers of Music" held in concert halls, children can experience an unforgettable and fascinating adventure, even more interesting than a sandbox, cinema or zoo. The youngest have the opportunity to become real explorers of music, getting to know the richness of sounds, to play and enjoy the game, to dance and sing.

"Explorers of Music" is a unique art project run by German composer and educator Carl Orff. The basis of the method is the general-educational foundation. Creating, playing and listening to music is a part of this whole concept with an emphasis on creative activity of the child. The forms of music education by Orff include: playing and making vocal and instrumental music, physical implementation, playing instruments and singing combined with the movement.

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During one-hour-workshops the natural tendency of children to join the movement, gesture, dance, and therefore the rhythmic speech is engaged. During the workshops music instruments that Carl Orff created especially for children (the so-called Orff instruments) are used. Children can play them, regardless on their level of musical talent. Various types of drums, cymbals, triangles, castanets, tambourines, pieces of wood, maracas, flutes, bells, etc. of various sizes belongs to Orff instruments.

"Explorers of Music" is a project implemented in cooperation with the Polish Society of Carl Orff, whose aim is to promote music education of children, adolescents and adults through general aesthetic education of Carl Orff. Workshops are held under the supervision of experienced and skilled in working with children teachers from Polish Society of Carl Orff. During the workshops, children learn skills that they can together jointly present on stage during the concert. Parents at that time can relax in the cafe or watch the actions of their children. It is also possible to purchase a ticket only for the concert.

II. METHODOLOGY

A. The aim of the study

The main aim of the conducted survey on a group of parents was not only to identify the opinions and assessments of recipients on the workshops, but also to serve evaluation, improve the quality and change the approach to the musical and educational activities organized by the Lodz Philharmonic.

The aim of the survey conducted in the Philharmonic in Lodz during the workshops "Explorers of Music" on 29 May 2014 in artistic season 2013/2014 was as follows:

- to examine the degree of satisfaction of parents and children with workshops,
- to get the knowledge of the functions of performing activities,
- find out about parents' expectations with respect to future activities of the "Explorers of Music",
- to learn about children's development thanks to workshops,
- to assess all activities involved in the workshops,
- to make a qualitative assessment of the workshops.

B. Research group

The study involved 100 respondents - parents or guardians of children who took part in music workshops led by Carl Orff Organization and Lodz Philharmonic.

Most parents (60%) who participated in the survey are people between 30 and 39. Every fourth respondent (25%) was between 40 and 49 years old, and every eleventh (9%) between 20 to 29. 6% of respondents was over 49 years. As for the age groups 50-59, 60-69 and 70 and more, it can be assumed that they were mostly grandparents of children taking part in the workshops.

Nearly three-quarters of respondents (72%) are women. Men account for the remaining 28% of the total respondents.

C. Research tool

The survey of parents/guardians of children participating in the workshops took place with the help of a specially constructed questionnaire consisting of 48 questions. The questions have been divided into three parts. Part I referred to the overall assessment of satisfaction with the activities and atmosphere of workshops. Parents assessed the songs, tutors and the level of active participation of children in the classroom. Part II contains a lot of questions/statements relating to expectations, assessments, functions and effects caused by the child's participation in the music groups. Part III contains an open questionnaire, where each parent was able to express what is desired in relation to future activities of the "Explorers of Music". All questions were addressed to parents. The answers were constructed on a four-point Likert scale (usually: definitely not - definitely yes).

The questionnaires were handed out before the beginning of workshops and during breaks by authors and operating staff. A total of 100 questionnaires were received.

III. RESULTS

A. Demographic data

Almost the third of parents (32%) play a music instrument. The most frequently mentioned instrument was guitar, accordion, violin, piano and drums. The vast majority of the parents (almost two-thirds, 73%) have higher education. The rest achieved incomplete higher education (11%), secondary education (11%), technical/vocational (2%) and other (3%).

In conclusion, two thirds of the tested group were children aged between 4-6 years, which is a typical preschool age in Poland. Children younger and older accounted for 1/3 of the total sample. There was 5% of children younger than 3-4 years, and older than 6 years were 31% of the total sample.

B. Preferences

The first aspect that will be discussed is the degree (level) of satisfaction with the music activities during the workshops, both in the evaluation of children as well as their parents.

90% of parents responded positively to the question: "Does your child likes to take part in “Explorers music”? Other - negative and neutral answers - accounted only for 10%. More than half of the respondents (58%) say that their children definitely like to participate in the classes. On the other hand, every third respondent (32%) believe that their child rather likes it. Only 33% of parents have quite a different opinion: they think children definitely do not like to take part in those workshops.

The vast majority of parents (81%) liked this form of music activity very much. Only 17% said they liked it on average, and 2% that liked it a little. There were no negative responses.

C. Effectiveness

91% of the respondents considers the workshops to be a wonderful shared experience, both for parents and their children (definitely yes 40%, rather yes 51%). Slightly fewer

(89%) of respondents agree, that the atmosphere in the classroom is very nice (definitely yes 56%, rather yes 33%). On the other hand, 4 out of 5 respondents (80%) said that all activities for them personally were very interesting (definitely yes - 43%, rather yes - 37% of respondents).

As many as 89% of respondents regards the activities as properly designed and adjusted to the level or emotional and musical needs of their children. Also, the vast majority (98%) of parents declared that they definitely liked the workshops.

The authors conducting the study, wanted to find out what the reminiscences and the effects of participation in such activities for a child are. 84% of respondents declare that their child talks about the workshop after their completion. Also, 84% believe that their child sings song learnt in the workshop. As many as 2 out of 3 respondents (66%) say that their child plays similar stories as the ones heard in workshops. On the other hand, 39% say that their child paints pictures that are related to the class. Thus, it can certainly be stated, that the workshops remain in the memory of children in different forms.

Analyzing the expectations of parents in relation to the children`s activities it should be noted that most (79%) of the parents/guardians wish that children should have a lot of fun. In turn, 2 out of 3 parents would like a child to learn something about music (65%). The workshop should be a common experience for the whole family (64%). Half of the respondents (50%) expects that the child will learn something about classical music during the "Explorers of Music".

The last aspect of the test was to evaluate the parents` observation of emotional, social and physical changes in children's conditions due to the attendance on workshops. Almost half of the respondents (49%) believes that engaging their child in the different music activities affected his/her self-esteem. However, 63% said, that their child has become more open to contacts with other children, more social and sociable - the moment they started participating in those classes. The vast majority of respondents (87%) believe that the child likes to take part in the team work groups that actually is an integral part of the workshops and concerts.

D. Atmosphere

Let's now examine the well-being and the process of learning children during the music workshops. As many as 92% of the respondents believes that their children definitely or rather had a lot of fun. In turn 90% of respondents strongly or rather believes their child could learn a lot about music. The situation looks a bit worse in terms of wellbeing of the children during the classroom. None of the respondents was of the opinion that the child feel good, while 44% believe their child felt rather well and, according to the half (50%) rather did not feel well. Few people (6%) even believe that their child definitely did not feel well in the classroom. Probably the child's age determined the fact.

E. Group comparison - analysis of *t*-test

In order to obtain more detailed information, our entire study group was divided into two age groups: younger – below 5 and older – more than 5 years of age.

Analyses carried out using *t*-test showed that there is a statistically significant difference in the level of activities in the classes ($t(98) = -2.820$, $p < .01$) and teamwork skills between groups ($t(98) = -2.406$, $p < .05$). The research results indicate greater social skills, better ability to work in a group, to comply with the rules of games and guidance instructor among older children.

Definitely more parents of older children consider them to be musically talented ($t(97) = -2.054$, $p < .05$) (group 3-6 years: $M = 3.06$, $SD = .752$; group 6-9 years: $M = 3.34$, $SD = .600$). The group of parents of older children expressed a greater desire to participate again in workshops (results of borderline significance: $t(97) = -1.915$, $p = .056$). Parents of children aged 6-9 years old frequently had a positive impression that their child felt well ($t(97) = -2.087$, $p < .05$). This may be due to the fact that the groups of younger children are not always so self-contained, socialized and ready to interact with strangers (other children, leaders or persons engaged). The younger children often cry, run, play with toys, or fall asleep during workshop or concert.

The degree of satisfaction with the activity of the parents of older children ($M = 3.35$, $SD = .782$) was also higher than those of younger children ($M = 3.60$, $SD = .538$). The workshops in the older age groups appealed to parents more than with the youngest group ($t(98) = -2.578$, $p < .05$). But the possibility of child's participation in many different activities (singing, movement to music, learning songs) was assessed higher ($t(97) = 2.085$, $p < .05$) within the group of parents of younger children.

F. Correlations

Parents/guardians who want/expect their child to have a lot of fun activities, at the same time expect the child to feel well in the workshop ($r. = .690$, $p = .000$), and to learn many new things about classical music ($r. = .642$, $p = .000$).

Certain relationships are also evident. It turns out that parents, for whom classes are a great emotional experience, particularly appreciate the friendly atmosphere in the classroom ($r. =. 723$, $p < .000$), and they rate the workshops more often as engaging, interesting and entertaining ($r. = 733$, $p < .000$).

Similar situation appears with the effects of child's participation in the workshops. And so:

- parents who believe that participation in the activities has a positive impact on a child's self-esteem are also of the opinion that the child from the moment of active participation in workshops, "Explorers of Music" is more open to contacts with other children ($r. = .762$, $p = .000$, $N = 100$);

- parents who believe that a child - from active participation in "Explorers of Music" - is more open to contacts with other children, at the same time believe that workshops help the children to develop better skills in establishing contacts (r = .745, p = .000, N = 100);
- parents, who believe that the workshops help the child develop better skills in establishing contacts, also believe that the child in the class is more disciplined than usual (r = .715, p = .000, N = 100).

G. Discussion

The result of the study showed clearly the trend, that most often the workshops with their children attend women (mother, babysitter with age 30-50) with higher education degree. Demographic data from other studies (Gembris, 2005; Kaczmarek, 2008) also confirm this trend.

In the survey, the vast majority (73%) of parents have higher education. It can be concluded that the highly educated and economically better-off parents draw more attention to the development of the music skills and interests of children, including the development of their personality. They are more often aware of the fact that participation in extra-curricular activities affects success in life and career of their children in the long run.

Comparing the test results of the workshop "Explorers of music" from earlier studies conducted by Kaczmarek [2009], it is clear that this type of workshops and concerts organized by the Philharmonic in Lodz are in highly demand.

In both cases, the parents are largely satisfied with the workshops and concerts, and assess them positively. The fact that the parents can watching certain effects on their children after visiting philharmonic concerts certainly positively affects their rating. What is more, they would eagerly come back for the next concerts or workshops.

IV. CONCLUSION

In conclusion we can say that the workshops organized by Lodz Philharmonic are very effective. Their effectiveness was confirmed in many aspects by the parents.

In summary, we can conclude that the results indicate a high degree of satisfaction among parents with "Explorers of Music". It turns out that these activities meet most of the expectations of parents and bring to children many advantages (even non-musical).

To sum up, expectations of parents/guardians for the philharmonic workshops and concerts for children are as follows: first and foremost, they expect a common experience for all members of the family and enjoyment for children from the concert. Parents' expectation are connected with the educational and pedagogical issues, the development of general musicality and socialization in music.

We conclude that the activities for the youngest group may have less appeal to parents, but they are very well adapted to children`s needs and capabilities (both motor, cognitive, and emotional). The parents of children from older group believe that their child feels well in class and more willing to come to the next workshop of this type.

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Ginsborg, J., Lamont, A., Phillips, M., Bramley, S. (Editors)

Practice strategies used by musically highly gifted adolescents from Germany and Poland during instrumental practice

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ABSTRACT

The amount of research on instrumental practice and the demand for this topic has increased greatly in the last decade. More than half of all studies concern professional musicians, and there are relatively few investigations carried out on children or adolescents. The aim of this paper is to present a recent study on musically gifted adolescents in Germany and Poland. The examined groups included young students who attended music schools in Germany and Poland. Two questionnaires were used in which young musicians were asked to reflect on their practice behavior, practice strategies, and strategies of mental rehearsal. The analysis suggests that musically gifted adolescents from Germany have greater knowledge regarding the use of appropriate planning and evaluation strategies. We have only found significant differences in the use of mental strategies between two groups in one scale.

I. INTRODUCTION

The practice is the most important activity in the life of every musician. As a matter of fact, the time musicians spend on practicing is crucial in the development of expertise (Ericsson, Tresch-Romer & Krampe, 1993). Studies on musicians` practice strategies and rehearsal techniques started in the 80s due to the possibilities offered by audio or video recordings. Some studies used recordings of practice (training) behavior in combination with some kind of verbal reports (Nielsen, 1997, 2001, Miklaszewski, 1989, Chaffin et al., 2002, Chaffin & Imreh, 2001); other examinations relied on interviews or questionnaire studies (Hallam, 1995, 1997, McPherson & McCormick, 1999, Williamon & Valentine, 2002, Ginsborg, 2002). Most of the studies were carried out on students or professional musicians (McPherson, 2005, O`Neill, 1997, Hallam, 1995, Harnischmacher, 1993). There are relatively few research carried out on children or musically highly gifted adolescents (Kaczmarek, 2012).

A. Aim of the study

The present study investigates the differences in practice behavior and the use of practice strategies between musically gifted adolescents from Germany and Poland. The aim of this study is to examine the quality and structure of practice strategies in both groups of young instrumentalists - especially focusing on the planning, organization and evaluation strategies, as well as mental rehearsal strategies.

B. Research questions

Our research questions were the following:

1. Are there any differences in the quality of practice (e.g. in the duration of practice)?
2. Are there any differences in the quantity of practice?
3. Are there any differences in the use of practice strategies?
4. Are there any differences in the use of mental practice?

Those research questions were investigated with quantitative methods.

II. METHODS

A. Instruments

To examine the differences in practice behavior between two groups we have used two questionnaires. One was developed in the Institute for Giftedness at the University of Paderborn (*Fragebogen zur Praxis des Übens, 2008*). It consisted of items related to the use of practice strategies, practice time, practice behaviour, practice motivation, and the special aspects of practicing (like troubles with playing, relaxation and sport activity). This questionnaire was designed by a project group, which included experts from Paderborn and Detmold.

The second one was the *Functions of Imagery in Music Questionnaire* from Gregg, Clark & Hall, (*FIMQ, 2008*). The FIMQ questionnaire was created to explore how musicians use the functions and power of imagery, if they use any mental strategies and how they use mental skills during practice. The FIMQ is a self-report with 28 items, which assess cognitive and motivational functions of imagery. The FIMQ based on 5 different dimensions: cognitive specific (CS), cognitive general (CG), motivational specific (MS), motivational general-arousal (MG-A) and motivational general-mastery (MG-M).

B. Participants

Our participants were young students from music schools and a special music study program in Germany (like IFF, DHZ and PCC) (*n*=120). The examined control group consisted of students from the music school in Lodz (*n*=180). Our "German group" makes up for 40% and the control group "Polish group" for 60% of the whole sample (N=300).

C. Methods

For data analyzing we have used the method factor analysis to find the hidden dimensions or constructs. Furthermore, practice behavior and mental practice in the music imagery questionnaire were compared with the *t*-test for both groups. Additionally a Multivariate Varian analysis was run so as to find any differences between two national groups.

The mental rehearsal measured by FIMQ was examined with the reliability analysis. The questionnaire is based on 5 given subscales (cognitive specific, cognitive general, motivational specific, motivational general-mastery and motivational general -arousal). All data was analysed with the statistical software program SPSS.

III. RESULTS

Each questionnaire was completed by 300 candidates. The average age in total sample was 15.28 (*SD* = 1.78). The average age of German group was 15.33 (*SD* = 1.97), and the Polish group was 15.24 years old (*SD* = 1.64). Differences in age between the groups were not statistically significant. Within the 300 candidates, 122 (40.8%) boys and 177 (59.2%) girls participated in the study.

Most of the students played string instruments (38%, 113) keyboard instruments (23%, 69), and woodwind instruments (16.7%). The rest of the interviewees was composed of brass instruments (both 6.7%). The differences in the played instruments between the two groups were significant (χ^2 (8.1)=46.320, p=.000). In the German group there were more singers and composers; and in the Polish group more guitarists, drummers and eurhythmics.

The time experience of playing the main instrument was meaningful as it amounted to 7.5 years (*SD*=2.94) for both groups. Difference in the length of time playing the main instrument between the two groups was not significant. The length of daily practice is also different in our groups. The German group spend daily 0.5 minutes more on practicing (*M*=2.30, *SD*=1.26) than their colleagues from Poland (*M*=2.04, *SD*=.85); ($t(298) = 2.157, p. \leq .05$).

The group of young students from Poland spent a higher average number of years playing the second instrument ($t(119)$ = -2.440 two-tailed $p < .001$, d = 2.76) than the German group. For the German students the average time was 4.7 years of playing (*SD*=3.4), and for the music school students 5.7 years (*SD*=2.5). The discrepancy between groups in the length of the instrumental playing accounts for almost 1 year. The most popular main instrument in Poland is piano, but in Germany music students played various instruments. All the participants had regular individual music instrumental lessons for a minimum of one hour per week.

A. Practice motivation

Since the researchers had many questions about the use of practice strategies in the questionnaire, they used the PCA analysis with varimax rotation to reduce items to a smaller number of factors. A principal component of the factor analysis was conducted on the correlations of the 19 variables considering the motivation during the practice. The first factor analysis on practice strategies found 4 components, which explain 54,271% of the variance. Detailed information about the summary of the factors is given in Table 1 (see next page).

The first factor "Joy" (33.18% of variance) included the items related to having good feeling during the practice. In the second factor "Motivation" (9.05% of the variance), the following statements were often mentioned: when I try harder I will be better. The factor “Low self-esteem” (6.18% of the variance) arranged the items concerning the lack of faith in its own practice. The next factor “parental support” (5.83% of the variance) focused on having someone, who will help you with practicing at home. Only in the first (“Joy”, $t(292)$ = 6,265, p=.000, d = 1.09) and the last factor “parental support” ($t(292)$ = 3,356, $p < .001$, d = 1.02), significant differences between the groups have been found.

Table 1. Factor analysis according motivation to practice.

	Factor	Eigenvalue	% of variance	Cumulative %
1	Joy	5.786	33.150	33.15
2	Motivation	1.581	9.059	42,20
3	Low self-esteem	1.080	6.188	48,39
4	Parental support	1.025	5.873	**54,27**

B. Practice goal and warm up

The sitting goals for every practice session is the most important thing in the practice process. Among many setting goals by practicing music, which could be e.g.: learning a new piece, practicing trouble spots or thinking about the sound or interpretations. In our study we could find significant differences in goal, which is learning the piece by heart ($\chi^2(1)$ =19.214, p=.000). The polish music students use this goal more frequently than the German students.

The right warm up is the first thing, which you could do. In our study we also have asked about the time and the kind of warm-up. The German students spent more time by warming up ($t(223)$=1.975, $p \leq .05$). The content of warm-up is for German students different and they use technic pieces (χ^2 =24.511, p=.000) and etude (χ^2=18.470, p=.000) more frequently.

C. Practice behavior

The questions concerning practice behavior were combined with the following items of the questionnaire like: playing by ear, playing from memory, improvising, sight-reading and making a recording. The categories came from the study of McPherson (2005). *T*-test comparison found significant differences in three given practice behaviors (see Table 2). The polish students tend to use informal kind of practicing, like making a recording, playing by ear or improvising more frequently. The participants of both groups felt confident in using other two types of informal kinds of practice (playing a`vista, playing from memory), which indicates the control strategies while practicing.

Table 2. Group differences in practice behavior.

	Germany		Poland				
Scale	***M***	***SD***	***M***	***SD***	***t***	***Df***	***p***
Making a recording	1.95	.842	2.23	.887	-2.727	297	.007
Sight-reading	2.71	.867	2.84	.892	-1.276	297	n.s.
Play by ear	2.36	.890	2.61	.899	-2.360	297	.019
Imptovi-sation	1.88	.855	2.34	1.015	-4.048	297	.000
Playing from memory	2.49	.872	2.49	.918	.066	297	n.s.

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D. Use of practice strategies

The use of effective practice strategies may make the practice easier, quicker and effective. The next aim of the study was to examine the differences in use of practice strategies between both groups.

The meaning analysis of the comparison between Polish and German groups showed, that:

- The Polish group more frequently learn the piece by heart and gradually increase the tempo (pace) of the music piece.
- The German students use more often mental strategies, write fingering, listen their play very carefully, change the tempo of the piece, and separately practice the trouble spots.
- The German musically gifted students know better how to handle with errors; what to do when you make a mistake.

E. Use of mental strategies

The first estimations and analysis showed that the difference between two groups in the *Functions of Imagery in Music Questionnaire* is significant for all five given scales. In the study researchers found significant differences using the *t*-test for unrelated scores between the German and Polish music students; this concerns three motivational and two cognitive scales of the music imagery questionnaire. The results of this comparison in the FIMQ questionnaire between the two groups are shown in Table 3.

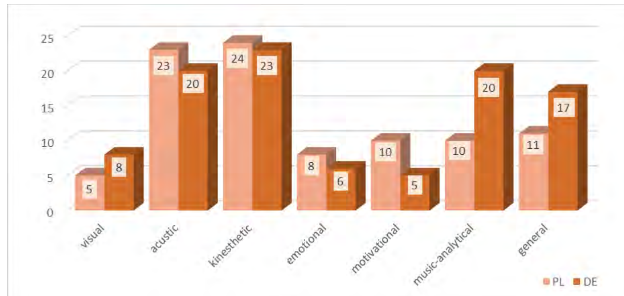
Table 3. Group differences in the FIMQ questionnaire in the 5 given subscales.

	Germany		Poland				
Scale	***M***	***SD***	***M***	***SD***	***t***	***Df***	***p***
CS	22.44	5.69	21.28	6.87	1.503	286	n.s.
CG	23.01	6.39	21.40	7.11	1.968	286	.050
MS	22.49	8.17	24.33	9.05	-1.766	286	n.s.
MG_M	25.35	8.43	25.48	8.37	-.164	286	n.s.
MG_A	24.34	8.22	27.77	7.90	-3.563	295	.000

In the study researchers found significant differences using the t-test for unrelated scores between the German and Polish music students only in the cognitive general scale and in the motivational general-arousal scale of the music imagery questionnaire. The cognitive general scale is responsible for mental running through an entire piece or program. The motivational-general arousal scale controls the level of excitement and anxiety during a performance or establishes appropriate mood for a piece.

We wanted to know which content refers to mental rehearsal. The participants had possibility to describe the content of mental rehearsal. On the figure 2 you can see the five categories, which most frequently came in the open questions. In most cases it was a kinesthetic and auditory (acoustic) representation of music. The second big group is made up of general, music-analytical imagination of music played. The last group consists of the visual, motivational and emotional imagery of music.

Figure 1.Content of mental rehearsal in the 5 given categories.



The participants from both groups use mental rehearsal to imagine the same (or similar) content. There were significant differences in both groups only in one type of representation (musical-analytical). Both groups made equal use of mental strategies and face similar elements (or types of representation) of a piece, then fingering, finger exercises or the sound. Most often they imagine movements, finger movements or handles connected to the idea of sound, or they link kinesthetic and acoustic representations together. With one exception, German students use mental practice to analyze notes, to imagine general elements of a piece or to find out a strategy to learn a piece (for example by heart).

IV. DISCUSSION

The results concerning the use of mental practice are disappointing. We could find many differences in the use of mental rehearsal strategies, in all the scales in the FIMQ questionnaire.

In the study of Gregg et al. (2008) with classical musicians, who participated in the study, it was discovered that musicians from the Faculty of Music at the University of Western Ontario reported employing imagery to overcome distractions and avoid errors, to maintain mental toughness, demonstrate confidence, and overcome mental and physical fatigue. Researchers of this study have found significant differences in the use of mental strategies between both groups only in two scales. It demonstrates that none of the groups were better in mental rehearsal.

The analysis suggests that highly gifted adolescent musicians do not use the correct practice strategies while practicing. The Polish group made more use of the informal way of practice.

In our study only information from the self-perceived perspective was collected without proving the actual musical level of competencies of participants. At this point of the study we cannot say anything about the link or correlation between the use of practice strategies and the improvement of the musical abilities.

The limitation of the study is the missing consideration of the role of the teachers and parents in the process of practicing or learning how to play an instrument. Possibly better results of experts also depend on the quality of music education they had. In our study it was important to check the current knowledge and use of practice strategies during the practicing at home, independently of the teacher´s (tutorials, lessons) quality.

V. CONCLUSION

The results of this study show the importance of teaching students the right planning and practice strategies. The analysis suggests that highly gifted adolescents from both countries know about the use of the appropriate planning and evaluation strategies. Students from Germany are not better in mental rehearsal than Polish music students. Music teachers should consider, how they could teach the pupils the right practice strategies during the music lesson.

Music and instrumental teachers teaching adolescents should certainly consider these results. It is important for music educators to know what could be improved in the content of music lessons.

In the future, researchers will expect studies to include a detailed analysis of the use of practice strategies by musically gifted adolescents. A future study might explore the use of practice and mental strategy by observation and in more diverse samples of young musically gifted musicians.

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Psychological profiles of polish instrumentalists and conductors

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ABSTRACT

Background

Both conductors` and orchestra musicians` occupation is seen as hardest among the other activities in the context of music and classical music education.

Most information about these two groups of musicians can be found in the increasingly emerging biographies, encyclopedias and monographs. There are very few studies on the psychological profiles of conductors or professional orchestral musicians. The most popular literature to this topic was made by A.E. Kemp (1996, 2009; Kemp & Mills, 2002). The solo, string and wind instrumentalist were surveyed by Davidson (2002, 2003, 2007, 2012), King (2006) and Sawyer (2008). Latest the jazz musicians investigated Macdonald & Wilson (2005); and rock musicians Gillespie & Myors (2000).

A major of the studies of orchestra musicians, their job satisfaction and stress susceptibility was made by Paternoga (2005, 2006), Olbertz (2003, 2004, 2006), Breda & Kulesa (1999) or Levine & Levine (1996). The interaction processes between conductors and orchestra musicians was investigated by Atik (1994) and Boerner (2002; 2009; Boerner & Krause 2001; Krause & Boerner 2006). More about conductors we can learn from Wöllner (2007) or Hattinger (2013).

Aims

The main objective of the project is to create psychological profiles of orchestral musicians and conductors. Description of their personality traits, psychological abilities, emotional dispositions, and organizational skills is one of the aim of the project. Another research goal is to gather knowledge of their self-esteem, assessments about themselves, professional situation and working environment.

The aim of the study is to compare a group of conductors with a group of orchestral and choral musicians for evaluation of work, burnout, level of self-esteem and the level of narcissism. With the aim of the study following research questions are connected:

1. Are there any differences in gender, material status or seniority?
2. Is there a difference in the assessment of the factors of labor between conductors, orchestral and choral musicians?
3. Do musicians in the compared groups differ in the sense of burnout at work?
4. Whether and how the groups differ levels o in level of self-esteem?
5. Does the professional musicians differ in terms of the level of narcissism?
6. What are the relationships between the level of narcissism, the level of self-esteem, burnout and job satisfaction in each group?

Method

The research was conducted in the period from January to March 2015 year. One hundred and fifty sheets were distributed to orchestral, choral musicians and symphony and choir conductors in the city of Lodz. Batteries test sheets have been transferred to the musicians during rehearsals for concerts at musical institutions like; Loch Philharmonic or Musical Theatre. Sheets for conductors have been handed over in person.

The pilot study was conducted by means of four questionnaires and psychological tests, like SES, NBI, MBJ and AOP. Additionally a special questionnaire was developed due to get the information about the occupation, motivation and demographic data.

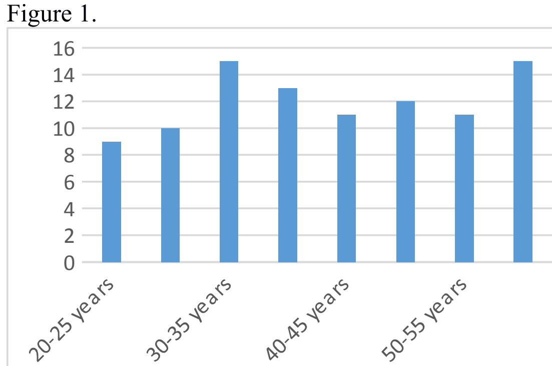
Research group. The sample of conductor (N = 41) and other musicians (instrumentalists, orchestra musicians, choir members, N = 55) was collected from the Lodz musical institutions. From over a 150 subjects, a total of 96 professional musicians were surveyed. In this group there were 41 women (43.6%) and 55 men (56.4%). The study involved thirty orchestral musicians, twenty-five singers and forty-one conductors (Table 1).

Table 1.

Occupation	Nr.	%
symphony and opera conductor	18	18,8
choral conductor	23	24,0
orchestral musician	30	31,3
choral singer	25	26,0
altogether	96	100,0

In the study group there were nine people aged from 20 to 55 years and more. The biggest group built the people in their 30`es (28) and their 40`es (23). One fourth made up the age group with professional musicians in their 50`es (26). The musicians with the age less than 30 was nineteen. The data presented in Figure 1.

Figure 1.



Results

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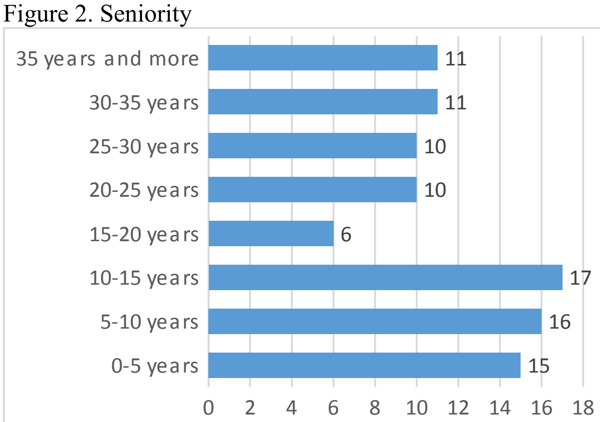
Figure 2 show the data distribution of the studied musicians because of the seniority of the work. Seniority subjects was spread in the ranges from 0 to 35 years. The greatest number make up the group of musicians with experience of 5-15 years (33). Fifteen professional musicians worked in their professional for less than 5 years. Eleven people have seniority in the range of 30-35 years or more. We have found 20 professional musicians with the job experience between 20-30 years. Fewer people working in the profession for 15 - 20 years (6).

Figure 2. Seniority



To find the answer for the question No. 1, chi-square tests for variables group and sex, group and marital and group and seniority was performed. The results obtained indicate that: there is a relationship between gender and belonging to a group; $\chi 2$ (2, N = 94) = 8.25; p <0.05. The profession of the conductors and orchestral musicians is dominated by men, while among singers dominated women. There was no evidence of other relationships between the kind of exercised profession and marital status or seniority.

To find the answers to research questions No. 2-5 one-way analysis of variance was made. Before starting the one-way analysis of variance the assumption of homogeneity of variance and normal distribution was verified. Because of the lack of non-compliance in some cases the assumption of homogeneity of variance, the authors have decided to use a nonparametric test by Welch. The independent variable was in this case the group of respondents: orchestra musicians, conductors and singers. The dependent variables were eighteen different dimensions of four tests, which musicians were tested (see: Table 2).

Table 2. Test name and test description

Test Name	Test dimensions
SES	Rosenberg self-esteem scale, one dimension that measures the level of general self-esteem
NPI	Questionnaire investigating beliefs about oneself and narcissism by Raskin & Hall **Leader** - a dimension that measures the level of leadership qualities **Admiration** - a dimension that measures need to be admired **Vain** - a dimension that measures the level of vanity **Self-sufficient** - a dimension that measures the level and the need to be self-sufficient. **Narcissism all**- a dimension that measures overall indicator of narcissism, the sum of the four aforementioned. sub-dimensions
MBI	Burnout questionnaire by Maslach, Jackson & Leiter **CY** - a dimension that measures the level of cynicism in relation to the work **EX** - a dimension that measures the level of exhaustion of work **PE** - a dimension that measures a sense of efficiency at work
AOP	Job description sheet by Neuberger & Allerbeck **Colleagues** - a dimension that measures satisfaction with contacts with colleagues **The Rector** - a dimension that measures satisfaction with the relationship with your supervisor **Jobs** - dimension measuring job satisfaction **Terms and Conditions** - dimension measuring satisfaction with the physical conditions in the workplace **The organization** - a dimension that measures satisfaction with the organization of work **Development** - a dimension that measures the ability and satisfaction with professional development **Wages** - a dimension that measures satisfaction with salary **Time Work** - a dimension that measures satisfaction with the division of labor at the time **Guaranteed a place** - a dimension that measures a sense of security and stability in work

As a result of the analysis reveals that the groups differ in terms of:

- dimension leader in the test NPI (F (2, 46) = 8.23; p <0.05);
- dimension of evaluation work colleagues in the test AOP (F (2, 59) = 23.25; p <0.001);
- dimension of the evaluation of the test AOP (F (2, 59) = 16.11; p <0.001);
- dimension of the assessment of organization and management in the test AOP (F (2, 55) = 12.88; p <0.001);
- dimension assessment of remuneration (reward, salary) in the test AOP (F (2, 56) = 56.27; p <0.001);
- dimension of time working in the test AOP (F (2, 58) = 17.55; p <0.001);

To see which groups differed among themselves, a post hoc comparisons by Scheffe have been performed. As a result of this analysis we have found that:

Dimension leader (NPI):

- a group of orchestral musicians (M = 32.14) and conductors (M = 37.51) differed significantly with respect to a result in the dimension leader in the test NPI; p <0.05;
- a group of singers (M = 31.48) and conductors (M = 37.51) differed significantly with respect to result in the dimension leader in the test NPI; p <0.05;

Dimension colleagues (AOP):

- a group of orchestral musicians (M = 24.32) and conductors (M = 21.63) differed significantly with respect to a result in the dimension colleagues in the test AOP; p <0.001;

- a group of orchestral musicians (M = 24.32) and singers (M = 19.64) differed significantly with respect to a result in the dimension colleagues in the test AOP; p <0.05;
- a group of singers (M = 19.64) and conductors *(M =* 21.63) differed significantly with respect to result in the dimension colleagues in the test AOP; p <0.05;

Dimension work (AOP):

- a group of orchestral musicians (M = 38.68) and conductors (M = 34.05) differed significantly with respect to a result in the dimension of work in the test AOP; p <0.05;
- a group of orchestral musicians (M = 38.68) and singers (M = 31.56) differed significantly with respect to a result in the dimension of work in the test AOP; p <0.001;

Dimension organization (AOP):

- a group of orchestral musicians (M = 26.68) and conductors (M = 34.05) differed significantly with respect to a result in the dimension of the organization in the test AOP; p <0.001;
- a group of orchestral musicians (M = 26.68) and singers (M = 32.32) differed significantly with respect to a result in the dimension of the organization in the test AOP; p <0.001;

Dimension wage (AOP):

- a group of orchestral musicians (M = 15.29) and conductors (M = 19.15) differed significantly in size as a result of the wage in the test AOP; p <0.05;
- a group of orchestral musicians (M = 15.29) and singers (M = 18.12) differed significantly in size as a result of the wage in the test AOP; p <0.05;

Dimension time working (AOP):

- a group of orchestral musicians (M = 3.11) and conductors (M = 2.32) differed significantly with respect to result in the dimension of time working in the test AOP; p <0.05;
- a group of orchestral musicians (M = 3.11) and singers (M = 1.92) differed significantly with respect to result in the dimension of time working in the test AOP; p <0.05;

To find the answer to the question 6 the Pearson correlation coefficients were calculated. The results showed that:

- In the group of orchestral musicians there is a linkage between the SES and the dimension Self-Sufficient in the NPI test (r = 0.43; p <0.05). This result indicates the higher sense of self-sufficiency and self-esteem in this group of professional musician.

- In the group of vocalists there is a relationship between SES and dimension Vain in test NPI (r = 0.42; p <0.05); SES and NPI self (r = 0.57; p <0.05); and SES and Narcissism all (r = 0.48; p <0.05). This means that the higher the level of self-esteem by vocalists, the more vanity, but also the overall level of self-sufficiency and narcissism.

- In the group of conductors there is a relationship between SES and dimension Vain in the test NPI *(r* = 0.4; p <0.05), which means that a higher level of -esteem cause the greater level of the vanity.

- The negative correlation between SES index and the MBI Cynicism (r = (-0.45); p <0.05) in the group of conductors attests to the fact that higher level of self-esteem cause the lower level of cynicism in relation to their work.

- The relationships between the NPI admiration and MBI Exhaustion (r = 0.34; p <0.05) means that the greater the need to be admired, the greater the work fatigue and exhaustion.

- The relationships between NPI admiration and MBI Cynicism (r = 0.35; p <0.05) in the group of conductors means that and the greater the need to be admired, the higher the level of cynicism in relation to their work.

- The negative correlation between the dimension of the NPI self-sufficient and MBI EX (r = -0.5) and MBI CY (r = -0.32; p <0.05) shows that the higher the feeling of being self-sufficient, the lower feeling of exhaustion and cynicism or impersonal approach to the work.

- A positive correlation between the dimension of the NPI self-sufficient and MBI PE (r = 0.35; p <0.05) indicates that the greater sense of self-sufficiency cause the greater sense of professional efficacy.

- The relationship between the dimension of the NPI together and MBI PE (r = 0.35; p <0.05) in the group of conductors was significant and attests to the fact that the higher the level of narcissism the more sense of efficiency in the work.

Conclusions

Membership of a particular group of musicians is undoubtedly related to gender. Definitely more men practicing job as a conductor. Men in the course of evolution possessed more sense of leadership than women, and the conductor profession requires such features. It also appears that in the group of orchestral musicians is more men than women. Perhaps this is associated with higher levels of persistence, which is necessary to achieve perfection in playing on the instrument. The study confirmed the widespread view that the conductors have more leadership qualities than orchestral musicians and singers.

Best relations with colleagues at work seems to have orchestral musicians. This may be due to less competition, which is bigger between conductors or singers. Conductors higher assessed their colleagues from vocalists. His work, entrusted the task and its contents the conductors assessed the highest of the three surveyed groups of musicians. However, work organization and management at the work place was assessed by the conductors' worst.

With regard to the working conditions conductors are however more satisfied with: content and organization of workplace, salary, working hours and leadership.

Orchestra musicians evaluate their earnings much lower as opposed to conductors, who have describe their salary as satisfactory. Conductors and singers, however, are much less satisfied with the distribution of working time, as opposed to orchestral musicians. Probably due to the fact that the orchestra musicians are less burdened with additional responsibilities and timescales of their work.

It has been proven that all the surveyed musicians had the higher level of self-sufficiency. In the group of singers, we have found the higher self-esteem, including greater vanity, but also the overall level of self-sufficiency and narcissism. Singers - as individual artists - presenting themselves on stage usually show a certain level of narcissism and vanity. It is in fact inscribed in the profession they practice. A kind of exhibitionism they show on stage requires on the on hand confidence, but also on the other frequent exposure on public make them be monitored and evaluated by others.

The higher is the level of self-esteem of the conductors, the higher the level of vanity and the lower level of cynicism in relation to their work. A higher level of self-esteem often results in a better mood at work and more satisfaction at work. The greater the need by the conductors to be admired, the more work fatigue and a higher level of cynicism in relation to their work. This is probably related to soliciting for attention. Such a person may also objectively approach to his work, since its main purpose is not to conduct a beautiful concert, excellent preparation of the choir and the orchestra, but being in the foreground.

Conductors are experiencing less sense of exhaustion and burnout, when they are more empowered and self-reliant. Also they feel a higher sense of being effective in their profession. The higher the level of narcissism cause greater sense of efficiency in their work. It is probably associated with high self-esteem, which prevents critical look at their weaknesses, critical analysis and possible correction of mistakes.

High scores in self-esteem is, however, for the profession of music better option than too low scores. This profession is associated with the issuance of the continuous social exposure, evaluation and criticism. Struggling for people with low self-esteem with such aspects of the work as professional musician could be far unfavorable. Relatively high, stable level of self-esteem allows for fuller development because it allows peaceful receiving both praise and criticism.

The first results of the pilot study regarding the level of self-esteem show that professional musicians have more self-confidence and higher level of narcissism. The results can be used for future work on the psychological profile and expand multi-faceted research of professional musicians.

Keywords

Psychological profile, professional musicians, conductors, personality trails.

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Testing Vogel's Theory of Tonal Space

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ABSTRACT

Background

Martin Vogel (1975, 1993) presented an extension of Euler's Tonnetz, which includes three dimensions for fifths, thirds, and sevenths (prime numbers 3, 5, and 7) in its graphical representation, and four dimensions in its mathematical representation, considering also octaves (prime number 2). Vogel suggested a formula that should predict the consonance of such chords. This mathematical device can be seen as a pragmatic tool to guide the composer through this three-dimensional tone space. It also promotes composition rules for chords that are – to say the least – very different from those found in the last five centuries of western music.

Aims

The present contribution compares the predictions of Vogel's theory and of a psychoacoustical theory (Plomp's roughness theory of consonance, Plomp & Levelt, 1965) with consonance ratings given by musical experts.

Method

Twenty students of music theory in their first year rated 60 different chords (15 types of chords × 2 frequency centers × 2 intonations [just vs. Wolf]) on three scales (consonance – dissonance, familiarity, emotional valence [happy – sad]). In a second study ten very experienced keyboard players rated similar chords before and after a training session where they were trained to identify the presented chords.

Results

In accordance with Vogel's theory, and in contrast to the predictions following from Plomp's theory, consonance ratings depended little on register (frequency center) but strongly on intonation. However, minor chords set along Vogel's composition rules (low thirds) are rated as less consonant. This is paralleled by them being rated as unfamiliar. They are, however, rated as having a higher emotional valence than classical set minor chords. A correlational analysis revealed that the prime weights used by Vogel are not optimal to represent today's listeners' consonance perception.

The second study failed to demonstrate an effect of training. It revealed, however, an effect of expertise: The ratings of the experienced listeners were more in accordance with Vogel's composition rules.

Conclusions

Vogel's theory of tonal space can elucidate some aspects of consonance ratings not covered by a psychoacoustical theory of consonance. The deviations found to the predictions of this theory represent an interesting clue on the impact of centuries of composition history on today's listening habits.

Keywords

Intonation, Tonal Space, Euler's Tonnetz, Consonance, Familiarity, Valence, Roughness, Vogel, Plomp, Expertise

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Associations between social skills and ensemble performance in music majors

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ABSTRACT

Background

From the perspective of social psychology, such as theory of group dynamics or organizational behaviors, prior studies suggested that social behaviors in ensemble, including interpersonal communication skills, styles of handling interpersonal conflict, and leadership, contribute to performance quality (e.g., Murnighan & Conlon, 1991). However, one aspect remains unclear: can behaviors for musical interactions be regarded as identical to daily social skills? In accordance with Rose-Krasnor's (1997) review of social competence, the present study regarded daily social skills as skills-based approach to social competence.

Aims

The purpose of this study was to investigate whether social skills in daily life actually serve for successful ensemble performance by using quantitative scales for social skills. In the context of two processes in ensemble performance (namely, ensemble practice and actual performance), the author hypothesized as follows: (1) Social skills in daily communication relate to practice strategies (2) a causal sequence exist from daily social skills via appropriate practice strategies to evaluation of the ensemble.

Method

Sixty-eight female music majors voluntarily participated. Four students were excluded from the participant group because their ratings incorporated the same numbers through three types of questionnaires or provided many blank responses. This left us with a total of 64 participants ($M = 20.2$, $S.D. = 0.8$).

To specify performers' interpersonal communication during practice and performance, and evaluation of ensemble/solo performance, performance questionnaires were created. The original exploratory questionnaires incorporated 18 items.

The author employed five types of scales that were self-rated: two on social skills, one on nonverbal behavior, one on styles of handling interpersonal conflict, and one on leadership.

First, Kikuchi's Social Skills scale was used as the all-inclusive scale for social skills (Kikuchi, 1988). The author gauged holistic social skill using this scale. Second, Kato's (2003) scale of styles of handling interpersonal conflict was used. It incorporates five styles of handling interpersonal conflicts: Integrating style; Avoiding style; Forcing style; Yielding style; Compromising style. Third, a scale with items on leadership, including a life skill scale was used (Shimamoto & Ishii, 2006). In the present study, other results of two scales were omitted by a space constraint.

To assess the correlation among daily social skills, social behaviors during ensemble practice, and evaluation of performance, structural equation modeling was employed. The serial order of analysis was as follows. (1) To unify similar social behaviors during ensemble practice and avoid problematic multicollinearity, a principal component analysis was conducted on the items regarding social behaviors during ensemble practice. Two factors were obtained. These were denoted as follows: *democracy-oriented behaviors during ensemble practice* and *leadership-oriented behaviors during ensemble practice*. (2) An assumed model by predicting two causal correlations was created: Daily social skills → social behaviors during ensemble practice → evaluation of ensemble performance; evaluation of solo performance → social behaviors during ensemble practice/evaluation of ensemble performance. Subsequently, the final model was determined by eliminating insignificant items and paths from the assumed model, and then referring to the results of a Chi-square test or statistical indices of fitness. Analyses were done with R 3.0.2 software.

Results

To examine the association between daily social skills or styles of handling interpersonal conflict and strategies during ensemble practice (or performance), correlation coefficients between ratings were calculated (Table 1). In the holistic social skills (i.e., Kikuchi's Social Skills), positive correlations existed between the rating of the scale and social behaviors during ensemble practice. Significant positive correlations existed between the items on social behaviors during ensemble practice (i.e., those on equality and adequate discussion during ensemble practice) and *Integrating style* of handling interpersonal conflict. Pushing ideas, adequate discussion, and consensus in ensembles were associated with leadership.

Finally, to assess the correlation among daily social skills, social behaviors during ensemble practice, and evaluation of ensemble performance, structural equation modeling was used to test the causal model. The degree of fitness was low in the assumed model. After modifying the assumed model, the model depicted in Figure 1 was obtained ($\chi^2(17, N = 64) = 16.049$, $p = .520$; GFI = .941; CFI = 1.000; RMSEA < .000, AIC = 54.049).

Conclusions

The main findings are as follows: (1) social skills in daily communication relate to appropriate behaviors in ensemble performance and (2) the causal sequence, in which social skills influence ensemble evaluation via practice strategies, is likely

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to be valid. These results were in line with previous studies that performers with sociable personality were good at ensemble performance (Kawase, 2015; Keller, 2014).

Table 1. Correlation coefficients among daily social skills, strategies for interpersonal conflicts, and practice (or performance) strategies. The codes in Table 1 represent the following: I: Integrating style; A: Avoiding style; F: Forcing style; Y: Yielding style; C: Compromising style; L: Leadership.

	Holistic social skills	Style of handling interpersonal conflicts					L
		I	A	F	Y	C	
Respect for equality	.36 **	.56 **	.45 **	.14	.24	.40 **	.07
Postponing discussion	.30 *	.07	.30 *	-.20	.03	.05	.19
Seeking consensus	.47 **	.40 **	.24	-.08	-.07	.17	.34 **
Seeking satisfaction with performance	.39 **	.36 **	.14	-.13	-.04	.18	.19
Sufficient discussion	.49 **	.23	.14	.05	-.03	.23	.41 **
Imposing opinion	.28 *	.00	.03	-.04	.07	.12	.44 **
Nonverbal sensitivity	.24	.32 **	.15	-.05	.11	.20	.15
Employing nonverbal cues	.37 **	.20	.08	-.01	-.11	.05	.15
Sensitivity for sound balance	.37 **	.32 *	.11	-.18	-.04	.14	.25 *
Self-expression ability	.32 **	.33 **	.18	.33 **	.15	.35 **	.14
Sensitivity for audiences	.11	.08	.16	.18	.09	.24	.15
Flexibility for audiences' responses	.15	.07	.18	.22	.23	.25 *	.09
Satisfaction with ensemble	.15	.17	-.02	-.18	-.30 *	-.06	.36 **

**p<.01, *p<.05

Keywords

ensemble performance, social skills, interpersonal conflict, social behaviors during ensemble practice, musical communication, leadership

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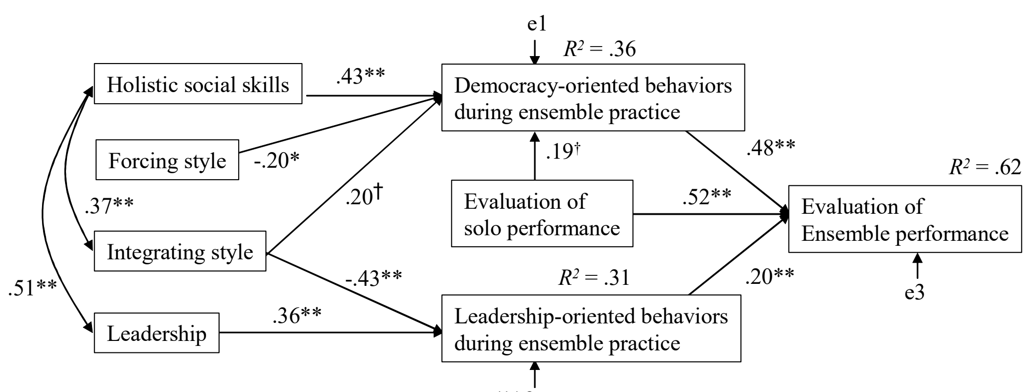

Figure 1. Final model of the correlations among daily social skills, social behaviors during practice, solo performance skill, and evaluation of ensemble performance. Numbers in the figure represent standardized beta coefficients (p < .01, *p <. 05, †p < .1).**

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Classical singing students and professional classical singers' performance preparation

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ABSTRACT

Background

In recent years, changes in society have led to a corresponding increase in competitiveness, and professional musicians have not been exempt from this. As technology develops, singers' public performances are increasingly more often compared to the digital recordings and high expectations of human voice, singers' external attractiveness and general endurance in today's public environment also place higher and more varied demands on performers and educational institutions where competitive performers are trained. Performance anxiety usually manifests itself in negative changes in mental and physical sense of self before the performance. LeBlanc (1994) offers three strategies for coping with performance anxiety: 1. through learning that sufficiently develops skills, 2. through mental orientation that minimizes negative cognitivity, 3. with medicine that reduces anxiety and excitement.

Aims

The aims of the study were to find out (1) how professional singers and singing students achieve and maintain psychological and physical optimal state needed for their performance, and (2) what pre-performance activities and exercises singers consider the most efficient before their performance on stage

Method

The study employed semi-structured interviews with professional classical singers (N = 12). The average duration of an interview was two hours. Interviews were recorded and later transcribed. To allow organization, categorization and analysis of the received information, the texts were processed with the qualitative research software NVivo 9. For the study with students (N = 60), an original questionnaire including 25 statements was used. The five point balanced Likert scale was used and results were analyzed making use of the SPSS software.

Results

According to the results, all vocalists had developed their strategies and personal routine of daily activities in order to maintain physical and psychological readiness for performing and ensure coping with performance anxiety. Breathing exercises, suitable diet, sufficient sleep and optimal use of voice were considered beneficial before a performance. The singing students' voice and singing were negatively affected by a bad mood, unfavorable conditions and rush. Students claimed that they try to find out on their own what gives them confidence before a performance. All singing students considered important the pre-performance psychological attunement.

Conclusions

The subject of preparing for performances continues to be topical for today's classical singers, because the modern requirements in the conditions of intense competition set very high expectations for singers, including their vocal-technical mastery as well as physical fitness. Concerning further research, new and enriching information about problems and issues of classical singing students could be gained through an international study.

Keywords

Performance preparation, classical singing students, professional classical singers, MPA, singing

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The application of video in supporting students'reflection in music instrument study

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ABSTRACT

Background

The usage of active learning methods is an inseparable part of contemporary music education (cf. e.g. Brown, 2008; Kährik, Leijen & Kivestu, 2012; Scott, 2011). Through these processes the learners broaden their existing knowledge and grow into independent musicians who perform as singers, instrumentalists, composers, improvisers and listeners. In line with the increased attention towards student activating learning methods, supporting students' reflection has also gained somewhat more attention in the music instrument pedagogy (see e.g. Draper, 2007) in recent years. The current study applies the previously validated model of supporting reflection (Kivestu & Leijen, 2014) in the context of music instrument study in one university in Estonia, Viljandi Culture Academy of Tartu University. The model consists of four cycles and is based on the main processes of reflection (describing, evaluating, relating, and reflecting on the reflection process (Procee, 2006)). According to previous research, in order to achieve one's study aim, reflection requires support and therefore the model has been designed to support all four reflection processes.

Aims

The aim of the study is to find out for what extent does the application of the model support students' reflection in music instrument study. The present research focuses on the first implementation of the model among students of music instrument studies and attempts to answer the following questions:

1. How do the reflection assignments developed according to the general processes of reflection support the learning process of music students in their perception?
2. How do the music students conceptualize the usefulness of applied reflection tasks for their professional development?

Method

The model for supporting reflection was applied by 11 students of a music department in an Estonian university, three of these students were studying at the Bachelor level of school music, six in applied higher education of jazz music, and two in applied higher education in traditional music. The model for supporting reflection consists of two phases: reflection and meta-reflection. The reflection phase consists of three cycles in itself – description, evaluating and relating (one cycle lasted for 3 weeks). The meta-reflection phase (lasting for 2 weeks) consists of reflecting upon the reflection process. The tasks of each cycle are supported by video, different supporting questions and peer feedback.

Regarding the reflection phase, the process of describing demanded the student to make a video of themselves playing their instrument, decide upon two aspects and describe their playing in accordance to those. In the process of evaluation the student was expected to compare their playing to the evaluation criteria provided. In the relation process students were asked to pose two questions they wished to receive feedback on from their peers. Regarding the meta-reflection phase student were asked to look back on the different cycles of reflection phase and think about their professional identity.

Two focus group interviews were carried out to collect data on students' experiences. The first interview was conducted with 5 students, the second with 6 students. Separate questions were asked related to every reflection task, as well as regarding the reflection model in general and possible areas for improvement. Both interviews were recorded and fully transcribed. Data was analysed following the thematic analysis principles.

Results

The results showed that students encounter problems with all processes of reflection and the developed support could facilitate overcoming these problems. More specifically, the participants pointed out that the reflection assignments helped them to take a more objective view on their practice and offered a detailed way for improving in a systematic manner, and helped to focus on specific goals and to target exact training needs as also noted in previous studies (see e.g. Kori et al., 2014; Leijen et al., 2009). All participants suggested that such reflection assignments should be integrated in regular instrument studies curriculum.

Conclusions

Research brought out that supporting reflection drives the students to take an active role in their music instrument study and give a deeper meaning to their studies.

Keywords

reflection, instrument study, constructivism, active learning

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The effect of social feedback and listening context on affective responses to music

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ABSTRACT

Background

Music is a powerful art form that can influence affective responses in listeners (Gabrielsson, 2002). Individuals listen to music during almost 14% of their daily activities (Mehl & Pennebaker, 2003) to regulate emotion and moods (Juslin, Liljeström, Västfjäll, Barradas & Silva, 2008), relieve stress (Sloboda & O'Neill, 2001), and for personal development and self-expression (Hargreaves & North, 1999). Music also plays an important role in our social worlds. It is integral to culturally significant social events, such as festivals and social gatherings (Rentfrow & Gosling, 2003), and is commonly used for social validation and bonding (Schäfer & Sedlmeier, 2010). With music being a prominent aspect of our social worlds, it is important to understand social factors that may influence affective responses to music. Emotion theories such as the Component Process Model of Emotion (Scherer, 2004) suggest that social factors, including social norms, values and beliefs, are evaluated when emotionally responding to external stimuli.

Previous research supports the notion that social factors can influence affective responses to music. However, previous studies have not considered or controlled for alternative influences on affective responses to music, such as familiarity, personal preferences and characteristics of music. Consequently, there is an apparent gap that still remains in the literature concerning whether social factors influence affective responses to music.

Aims

This study aims to address this gap in the literature, by investigating social influences on affective responses to music. Specifically, two studies are conducted to investigate the effects of social feedback and listening context on affective responses to unfamiliar music. In the present study, valence and arousal are measured in accordance with Russell's Circumplex Model of Affect (1980).

Three core hypotheses are tested: i) valence and arousal ratings increase/decrease with positive/negative feedback in comparison to ratings without social feedback; ii) valence and arousal ratings are higher for participants completing the task with another participant, in comparison to alone; iii) valence and arousal are higher for participants receiving positive social feedback and completing the task with another participant, and lower for participants in the alone and no social feedback condition, compared to other conditions.

Due to the careful selection of musical stimuli and piloting, it is hypothesised that familiarity and preferences for the music pieces would not differ across conditions. Furthermore, participants in social listening conditions would report less concentration compared to solitary conditions.

Method

A pilot study was first conducted to select appropriate music for the study proper. Specifically, music that ranged in likeability, was unfamiliar to participants and was balanced in terms of complexity, valence and arousal. Additionally, emotional responses to the selected music excerpts in the pilot study were used as social feedback in the study proper.

Ten Brisbane university students (M = 21.30, SD = 1.57) individually listened to 30-second music excerpts of 42 songs and answered questions concerning their music preference, familiarity and affective responses. Each participant listened to one of five pre-made randomised playlists, where all identifiable content was removed. After collating the responses from participants, songs that were somewhat familiar were automatically removed for the study proper. A range of songs reflecting various genres were kept as stimuli for the study proper. Social feedback was collected on valence and arousal scales for each music piece. For each item, a participant's response that was opposite to the average response was used as social feedback. A balance of both positive and negative social feedback for valence and arousal was collected for the study proper.

Following the pilot study, a 2 (listening context: alone or with a friend) by 2 (social feedback: social feedback or no social feedback control) between-subjects experiment was conducted to influence affective responses in listeners. This study controlled for attention (and aimed to promote concentration), using unfamiliar music from the pilot study.

120 Brisbane university students, (86 females, 34 males; M = 20.17, SD = 4.40) voluntarily signed up to the study with a friend and were randomly allocated to complete the study together or alone in adjacent rooms. Participants listened to each music piece and reported their subjective valence, arousal and emotion intensity. Music preference, familiarity and task concentration were also reported in randomly allocated response booklets. Two versions of the response booklet were randomly distributed to participants. However, at each session, participants received the same booklet. The social feedback booklet contained positive and negative social feedback on valence and arousal for each music piece. The no social feedback response booklet contained unemotional, factual album information.

Participants were informed that each song would automatically play for 30 seconds, followed by 20 seconds of silence during which responses were to be recorded in the booklet. Participants listened to one of five pre-made randomised playlists containing the carefully selected 28 music

pieces. Participants completing the study with a friend were informed that they could discuss each song, however they were to write their responses separately, without sharing them.

Results

As hypothesised, positive and negative social feedback influenced subjective arousal ratings positively and negatively. That is, when participants received positive arousal social feedback they reported higher levels of arousal compared to participants who received no social feedback. In addition, when participants received negative arousal social feedback they reported lower levels of arousal.

There was no effect of social feedback on subjective valence ratings. The social listening context did not influence affective responses to music.

As hypothesised, less concentration was reported in social listening conditions compared to solitary conditions. Furthermore, as predicted, subjective liking of the music was consistent across conditions. However, when social feedback was provided, higher levels of music familiarity were reported.

Conclusions

This study examined whether positive and negative social feedback and the social listening context influenced affective responses to music. In social gatherings where music is in focus, social feedback can influence individual affective responses. When the present study is considered in conjunction with previous research, there is certainly empirical support for the presence of social influences on affective responses to music. An important finding of this study is the effect that both positive and negative social feedback can have on personal experiences of music. Though social information can produce positive outcomes, the present research also demonstrated just how influential negative social information can be. This unique finding strongly suggests that social others play an important role in our emotional appraisal of music.

The present study also highlights how concentration can differ across social listening conditions. Social feedback and the social environment can influence task concentration, which subsequently influences how people emotionally appraise music. The present study also successfully controlled for music stimuli to prevent alternative explanations of the findings, such as familiarity and music preferences. However, the higher levels of music familiarity reported in the social feedback conditions was not expected. Participants may have reported more familiarity with the music when they received social feedback, simply because ratings from their reference group were provided. Participants receiving social feedback may have assumed that other university students were familiar enough with the music to rate it. Consequently, higher ratings of familiarity were reported to remain consistent with presumably higher levels of music familiarity by their reference group. Although the music pieces were quite unfamiliar to participants, this possible social desirability effect is an interesting find that should be investigated in future research.

The findings of the present study provide strong foundations for which future research can build upon. Research continuing to uncover relationships between social factors and emotion is crucial to better understand what information people appraise when emotionally responding to music. The findings of the present study warrants consideration for the use of music in everyday life, and the social influences on emotion.

Keywords

Music listening, emotion, social feedback, social context, circumplex model, task concentration.

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Towards an empirically based definition of piano touch: Touch/timbre relationship and key motion measurements

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ABSTRACT

The concept of touch in piano pedagogy is generally expressed through adjectival descriptors often linked to imagination and abstraction. Such a metaphorically based reflection determined a rather blurred definition of the term touch, sometimes confused with timbre, even within professional piano performance contexts. Although in last decades the improved MIDI-based data-collection technologies allowed to specifically measure key-control features, an empirically based definition of touch and its relationship with timbre still need to be further deepened. In this direction, the present research aims at 1) providing elements for an adequate scientific understanding of touch; (2) clarifying the relationship between touch and timbre; (3) defining to what extent the parameters of key-velocity, tempo and articulation may vary as a function of different types of touch. Through questionnaires 19 pianists provided a number of piano-touch quality descriptors; the five most used were proposed as example of touch qualities during a recording-session involving only 5 pianists, who played four music excerpts one time for each descriptor. The analysis of pianists' answers in questionnaires allowed an interesting conceptual classification of timbre/touch into five semantic categories: physical-motor, articulatory, sensory, emotional, aesthetic-stylistic. The analysis of recordings showed significant relations in pianists' performance control between key-velocity/articulation parameters and touch; timing-related aspects seemed to be less influenced by touch changes. As an initial step of investigation, this research provides practical basis for further theoretical developments benefiting both a scientific description of touch and pedagogical applications, going towards a deeper awareness about key-motion control among pianists.

I. INTRODUCTION

Belonging to the field of piano performance and especially focusing on the keyboard control, the present study aims at objectively describing the piano touch and at shedding light on the means with which it can be modeled, by: (1) providing elements for an adequate scientific understanding of touch; (2) clarifying the relationship between touch and timbre; (3) defining to what extent the parameters of key-velocity, tempo and articulation may vary as a function of different types of touch.

Since the 19th Century piano performers and pedagogues recognised the piano touch as a key element of musical expression; a very fascinating as much as precious means by which concert pianists are able to deeply express their own musical voice, by modelling sounds through the production of very subtle timbre nuances, colours and resonances, as well as of temporal movement variations, that consistently enrich the musical communicative processes. Naturally, one might say that touch parameters are barely constant in a piano execution, since their course and nuances are adjusted according to the specific performer's intentions and his/her physiological, cultural and psychological condition at the moment of performing. Nevertheless, such a controlled combination of elements in keyboard manipulation, also plays an essential role for achieving a high degree of expressivity in piano execution and phrasing. Moreover, the personal modalities with which pianists combine touch parameters during performance may also present some recurring features, as if responding to a sort of internal coherence: it is this coherence that makes any performer's sound and attitude towards the instrument typical and unique, and that may allow one to distinguish each pianist's touch and performance style independently from its correspondence to any physical or aesthetic characteristics of music. However, although easily recognizable through an instinctive and qualitative approach, such a spontaneous combination of elements in modulating touch still needs to be deepened and clarified in quantitative terms.

Until the first half of the 20th century, in fact, the speculation on touch-related aspects of piano performance developed in a very qualitative way, mostly resting on rather subjective methods of observation and judgement: an objective lack of adequate technological systems for measuring musical performance mostly lead researchers and piano pedagogues to approach the physiological mechanisms of piano technique from a primarily anatomical point of view (Breithaupt 1909, Schultz 1936, Kochevitsky 1967, Neuhaus 1973). Indeed, with the exception of very few studies on piano touch specifically undertaken within a scientific framework (Ortmann 1925), the historical piano schools of the 19th century used to express the concept of touch mainly through a large amount of imaginative and abstract metaphorical adjectives. Such a kind of literary approach, that frequently still exists in the contemporary piano teaching methods, although fascinating, contributed to consolidate a rather blurred definition of touch, sometimes confused with timbre, or even with sound, so that even professional pianists often show some uncertainty in discerning between, defining and describing these concepts.

However, in recent decades, technological developments have provided new directions and theoretical approaches to

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reflection on music performance. The paradigm of embodied music cognition (EMC) (Leman 2008), for example, and other studies on the performers' movements, opened up novel theoretical perspectives on gestural aspects of expressive performance: differently from the classical disembodied view, that considers physical action and perception as separate entities, the EMC paradigm particularly underlines the complementarity of action and perception in musical communication, focusing on the human body's central role in influencing these processes, by bringing together matter and mind. Also, studies have been carried out on expressive gestures in instrumental performance (Camurri et al. 2001, Canazza et al. 2004, Maes et al. 2013), in which the touch has been objectively investigated as the first step of a more complex analysis of piano skills, involving the entire body's movements. Such an innovative view leads us to reconsider the habitual modalities of musical analysis and to consider the point of contact between the performer's body, the instrument and the properties of sound to be a central aspect of any investigation on the processes involved in sound production.

In parallel, from a highly practical point of view as well, MIDI-based technologies have recently allowed the control of touch on the keyboard to be measured and analysed more objectively and in greater detail (Lee 1989, 1990, Salmon and Newmark 1989, Dalla Bella and Palmer 2004), by detecting subtle features of movement (total kinetic energy, position, velocity, acceleration, finger height, dynamic control, finger-joint force). Other studies have provided insights on timbre and touch, shedding light on the role of hammer velocity and intensity in sound production, and on factors involving gesture and key-control used by pianists to produce different nuances in timbre (Goebl et al. 2004, Bernays and Traube 2013), identifying specific patterns in terms of dynamics, attack, key-depression depth, pedalling and articulation.

Nevertheless, despite the big progresses made in measuring elements of musical performance, finally allowing the overcome of any literary based description of touch parameters, an unequivocal definition of touch specifically focusing on the relationship between touch and timbre still needs to be put forward. With this purpose, the present research intends to provide further elements for a scientific approach to the topic. In fact, by taking a distance from subjective, metaphorical and literary descriptions of touch, as passed on through historical piano schools, one particular aim is here to determine the extent to which key-control parameters (*key-velocity*, *articulation* and *tempo*) can be influenced by the pianist's ability to specifically focus on different qualities of touch.

So, *in what exactly does piano touch consist*, and *which features determine its difference from timbre?* Moreover, *how can we recognize pianists' touch only according to the aural features of their sound?*

II. METHOD

This study has been conducted in Italy and included an experimental part which was realised at the Centro di Sonologia Computazionale (Centre of Computational Sonology, C.S.C.) of the University of Padova. The research was articulated on a double analytical path, in order to approach on one side the touch-timbre relationship as it is theoretically conceived by professional pianists, and provide on the other side a more practical view on what pianists effectively do at keyboard while performing. Precisely, the procedure consisted in six steps: (1) acquisition of information on concert pianists' conception of touch and timbre, through a questionnaire; (2) analysis of questionnaires and selection of touch/timbre descriptors; (3) selection of piano pieces to be recorded; (4) recording of expressive performances by five pianists; (5) analysis of questionnaires; (6) extraction and analysis of the audio data. A quantitative approach was used for classifying touch descriptors and for midi-data analysis, and a qualitative method for interpreting questionnaires.

A. Participants

Nineteen concert pianists (four women and fifteen men, aged between 28-62), were asked to complete a questionnaire on piano touch and timbre. They were selected among professional musicians coming from and working in different areas of Italy, having an experience both as performers within international contexts, and as pedagogues at music schools and conservatories. After having answered the questionnaire, five of them were also asked to take part in the recording session, by playing some musical excerpts.

B. Questionnaire

The questionnaire consisted in two parts. The first one included a sets of questions aiming at gathering participants' professional information, such as education, concerts experience, recordings, teaching activity, etc.. The second part consisted in five questions asking for a number of definitions of piano touch and timbre, and a list of adjectival descriptors. Questions were presented as openly as possible, in order to leave the participants free to express their ideas.

C. Piano touch/timbre descriptors

The questionnaires supplied a list of 209 adjectival touch/timbre descriptors, which have been later evaluated by semantic proximity and then divided into five categories (physical-motor, articulatory, sensory, emotional, aesthetic-stylistic). The most recurring adjectives identified for especially defining touch were *legato*, *staccato*, *light*, *heavy* and *soft*. These five touch descriptors have been also used as a basis of the experimental part of this study, including a piano performance recording.

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D. Musical fragments

Four fragments were selected from various romantic and modern piano works of a medium level of technical difficulty: namely Grieg's *Wächterlied* from *Lyric pieces* op. 12, Mendelssohn's *Volkslied* from *Lieder ohne Worte* op. 53 and Takemitsu's *Clouds*. Tempo indications were conserved on the scores, while all agogic and dynamics signs were removed, in order not to influence pianists' interpretative intentions.

E. Equipment

A Yamaha Disklavier C3 grand piano was used for the recording session, equipped with optical sensors that enabled subtle keys movements to be measured (onset/offset time of keys, and the key-velocity of each note). The performances were recorded both as audio signals (microphone AKG C 414) and MIDI-data (Disklavier's optical sensors and control unit), and also video-recorded with a video camera (Canon MVX330i), capturing a lateral view of the performer's torso, arms and fingers.

F. Procedure

By answering a questionnaire, the nineteen piano performers were requested to give a general definition of keyboard touch and timbre, and to provide a list of their respective qualitative adjectival descriptors. The already mentioned five most often recurring touch adjectives (*legato*, *staccato*, *light*, *heavy*, *soft*) were then selected, and in parallel four musical excerpts were chosen and prepared for a recording session, which practically involved only five performers. The selected adjectives were so proposed to the pianists, each of them to be performed as an example of different touch qualities. The recording procedure consisted in six total executions of each musical fragment, initially played in a personal version (*ad libitum*), and afterwards repeated five more times, each time taking one of the five descriptors into account. It was strictly prohibited to use the pedals, so as to let performers concentrate on their fingers' activity.

III. RESULTS & DISCUSSION

G. Analysis of questionnaires: a view on the touch-timbre relationship

The participant pianists' written contributions on piano touch and timbre were very illuminating and allowed a rather realistic understanding of the complex conception of touch and timbre that can be generally found among professional piano performers, as well as the rather low degree of consciousness that they may show in the practical application of such a theoretical reflections to their piano performances. Globally speaking, in fact, although a number of pianists participating in this study provided very articulated, detailed and interesting reflections on the topic, most of them on the contrary gave brief and simple answers, expressing a rather generic knowledge about mechanisms of touch control. However, a recurring definition of piano touch emerged, conceived as the result of the relationship between three elements: (1) the expression of the performer's musical thinking, imagination and ability to communicate feelings and ideas; (2) his/her bodily awareness and capability to manipulate sounds, in order to acoustically achieve a musical idea, through gestures, movements and attitudes; (3) the influence that the physical properties of the instrument, as well as the environment acoustics, may have on sound control and production.

From a global view on questionnaires, the idea of touch and timbre seems to go well beyond a mere description of acoustical and physical-motor functions, as it also includes references to the sensory sphere, as well as to historical/aesthetic/stylistic categories. The pianists provided, in fact, an imaginative list of 209 descriptors, a large number of which was used to define touch (122), and a smaller number for timbre (87); in addition, some adjectives were used for representing both touch and timbre (26), as a demonstration of the blurred frames that usually enclose these concepts. According to the participants' answers and comments, it can be generally assumed that timbre and touch in piano performance are intended as strictly related to each other, although not perfectly coinciding, and timbre seems to be conceived as “deriving” from touch.

The analysis continued with the semantic classification of the descriptors: five main categories have been here identified, providing a multi-layered view on the subject, that seems to very well reflect the articulated conception of piano touch and timbre, and the different levels of abstraction normally occurring in their appraisal. Going into detail of each category, the physical-motor one includes the adjectives describing body parts, actions and movements; the articulatory makes a more direct reference to elements of musical phrasing, such as the length of sound/key-depression, the key-velocity attack and release, dynamic variations, etc.; to the sensory category belong adjectives related to the human senses, as well as to chromatic/thermal synaesthesias, and to qualities, dimensions and spatial features of matter; all evocative images and adjectives expressing feelings and sensations were listed in the emotional category; last, the aesthetic-stylistic one included formal and structural definitions linked to musical styles, traditional practices, authors, genres and instruments. The following table (Tab. 1) shows some examples from the list of descriptors used by pianists, divided by category.

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Table 1. Semantic partition of adjectives.

Semantic category	Description	Examples (touch and timbre adj.)	Touch adj.	Timbre adj.
PHYSICAL-MOTOR	body parts / movements	*by arm, by finger tip, by curved finger, by shoulder, from a distance, from the key, percussive, quick, slow, vertical*	35	4
ARTICULATORY	musical phrasing	***legato***, *tenuto, marked, pizzicato, portato,* ***staccato***	12	2
SENSORY	human senses / features of matter	*bright, clear, deep, definite, delicate, dense, electric, fluid, hard,* ***heavy***, *inactive, intense,* ***light***, *misty, pearly, penetrating, plain, rigid, smoothed,* ***soft***, *sweet, white*	38	64
EMOTIONAL	images / feelings	*aggressive, brutal, dark, deep, energetic, ethereal, evocative, harmonious, magic, nervous, open, persuasive, powerful, relaxed, tender, violent*	17	14
AESTHETIC-STYLISTIC	styles / traditions / genres	*approximate, Bachian, baroque, "beautiful", cantabile, classical, controlled, elegant, expressive, jazz, modern, Mozartian, imitating other instruments, romantic, "ugly"*	25	12

Interestingly, according to this classification – as the following graph shows (Fig. 1) – the touch descriptors are almost equally distributed among the five semantic categories, with a dominance of physical-motor and sensory ones; whereas on the other side timbre descriptors exclusively figure into the sensory, emotional, aesthetic-stylistic categories. Going in greater detail, the five most recurring adjectives identified for especially defining touch mainly belong to the articulatory (*legato*, *staccato*) and sensory categories (*light*, *soft*, *heavy*). Such a partition seems, thus, to suggest however a stricter connection between the idea of touch and the physical aspects of musical performance, as well as between the idea of timbre and the sensory, emotional and aesthetic spheres. Moreover, the central role of the sensory sphere seems here to be strongly stressed: in fact, the 26 descriptors commonly used by pianists to represent both timbre and touch were all placed in the sensory category, in between physical and cultural levels, as an ideal connection between the human senses and various aspects of matter (dimensional, spatial, chromatic and thermal).

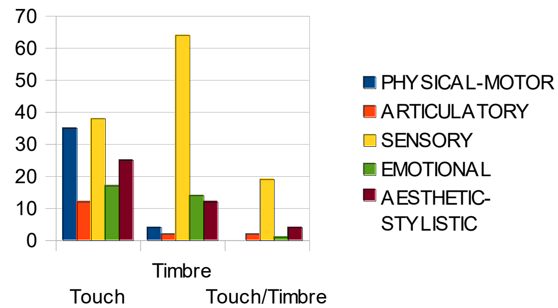

Figure 1. Adjectival semantic partition.

Although the most recent studies conducted on this subject tend to focus on physical parameters of touch (such as the key-velocity and the articulation control), however the complex outlook here expressed by pianists seems thus to suggest that an exhaustive definition of piano touch may not exclusively be based on measuring physical properties, but that it conversely needs to consider a multi-layered taxonomy of descriptors, based on various levels of abstraction: a lower level linked to physical properties (cat. 1-2), a medium and more abstract level (cat. 3-4), and a very highly refined level (cat. 5) that rests on conceptual judgements derived from specific cultural backgrounds. As such, the present study wishes to underline the need for integrating various perspectives while attempting to give a complete definition of touch, thus including both scientific-theoretical and artistic-practical reflections.

H. Musical data analysis

As regards the second investigative path of the present research, which considers an empirical view on piano keyboard control, an evaluation of the musical recordings was made. Here some precise touch parameters and nuances were extracted and quantified by measuring the onset/offset time between one key pressure and the subsequent one. Sound variations were captured in terms of: *key velocity* (KV), from a minimum value of 0 to a maximum of 127; *temporal duration* in beats per minute (BPM); the *articulation* interval between notes (A), where the value =1 expresses a standard *legato* (minimum onset interval in between notes), >1 a more *legato* effect (overlapping of subsequent notes), and <1 a less *legato* effect.

As the data clearly show, pianists are able to precisely control performance parameters in relation to the 5 different touch types, by translating definitions of touch into different

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sound nuances through a very subtle manipulation of the keys. Nevertheless, such an ability to obtain a detailed and expressive piano performance seems to be rather instinctive, as pianists frequently appeared not to be overly precise in verbally explaining touch mechanisms in terms of KV and A control.

A comparison of the pianists' recordings allowed a high degree of agreement to emerge with respect to the influence that the 5 touch qualities have on key-parameters: significant relations were found, in particular, between the touch descriptors and changes in intensity (KV manipulation) and articulation (A), thus allowing KV and A to emerge as highly characteristic aspects of touch. Conversely, the lesser degree of concordance between speed and touch descriptors suggests that metronome variation (BPM) is not as representative of touch as KV and A. The table below (Tab. 2) gives a global view of the results of the five pianists' executions.

Table 2. Total average and standard deviation of KV, A, BPM (KV: 0/127 scale; A: 1 = standard legato >1 = overlapping notes, <1 = separated notes; BPM = beats per minute).

Recorded version	KV		A		BPM	
	av	st_d	av	st_d	av	st_d
legato	52	11	**1,04**	0,3	95	20
light	43	6	0,74	0,25	101	18
soft	49	8	0,95	0,2	94	18
heavy	**77**	5	0,92	0,2	96	18
staccato	63	11	0,31	0,17	**111**	12
ad libitum	58	10	0,92	0,32	95	18

As the KV values provided here indicate, changes in intensity are apparently related to an idea of 'weight': the highest KV corresponds in fact to the *heavy* versions, and the lowest KV to the *light* versions. Also, another interesting perspective may be taken into account by comparing the descriptor-based performances (db) with the *ad libitum* ones (al), represented by the level "0" in the following graph (Fig. 2): here the greater difference in KV manipulation occurs in the *heavy* and *light* performances.

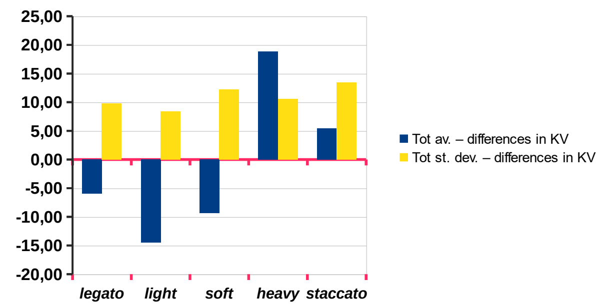

Figure 2. KV-comparison between db/al performances for all pianists (total average and standard deviation).

As regards the second parameter here considered, that is the articulation (A) (Tab. 2), the data show that in order to obtain a *legato* pianists homogeneously used the greatest number of overlapping notes (average of 1,04), whereas the *staccato* executions logically present the lowest A value (0,31). Also, again by comparing the db versions with the *ad libitum* ones (Fig. 3), the biggest divergence in A evenly appears for all the pianists in the *staccato* versions, followed by the *light*, *legato* and *soft*, whereas any difference seems to emerge between the *heavy* and *ad libitum* ones.

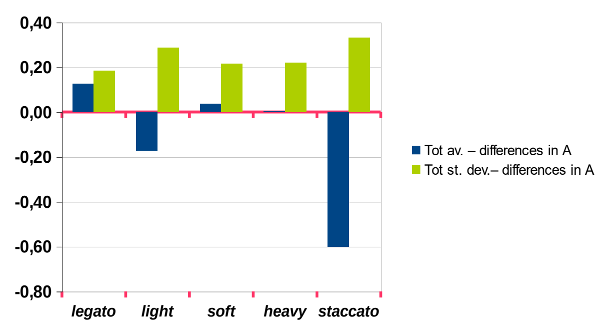

Figure 3. A-comparison between db/al performances for all pianists (total average and standard deviation).

Lastly, looking at the temporal variations of the performances, as mentioned earlier a lower degree of concordance can be identified among pianists: any evident connection between touch-descriptors and tempo (BPM) seems to emerge, thus suggesting that touch variations have a rather small influence on BPM, and that BPM may be not a very representative aspect of touch. However, from a comparison with the *ad libitum* version (Fig. 4), pianists seem to associate a fast tempo with the *staccato*/*light* descriptors, and a slow tempo with the *heavy*/*soft*/*legato* descriptors.

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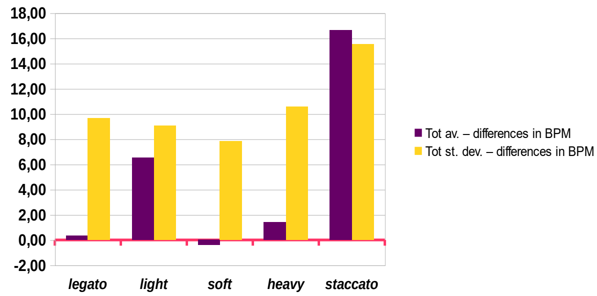

Figure 4. BPM-comparison between db/al performances for all pianists (total average and standard deviation).

IV. CONCLUSION

With a view to avoiding metaphorically based reflections, this research allows plausible and encouraging assumptions to emerge which may enable further theoretical developments. Especially by confirming the validity of the analytical and technological systems of calculation, this study can help stimulate pianists' reflection on touch-related technical aspects of piano performance, thus leading to a more fluent transmission even in pedagogical terms of specific knowledge concerning key control. Moreover, on the basis of the collected data, a preliminary definition of touch may be hypothesized as a result of a more or less homogeneous interaction between three aspects of key control: KV, A, BPM. So, it could be assumed that an individuation and measurement, in terms of relationship between KV, A and BPM, of that kind of 'internal coherence' which makes pianists' personal musical expression unique and recognisable, could provide a key towards a scientific understanding of touch, thus suggesting the development of a hypothetical paradigm for a its definition, allowing for an exact description of the complex interaction between acoustic, physical and emotional elements. However, although generally illuminating, these results can only constitute the initial step of a longer investigative path, and still need to be integrated with more data. Next research may include, for example, a deeper exploration of the specific touch/BPM relationship features, as well as further experiments involving a larger number of pianists, and a novel analysis of the video-recordings through a visually-based assessment of performers' bodily movements.

Finally, this study offered an interesting view on the topic from the practical perspective of piano performers', whose verbal contributions actually showed a much broader and more articulated conception of touch – related not only to physical and motor descriptions, but also to references to emotional and cultural-aesthetic spheres – thus providing significant insights that may however integrate any attempt to approach a scientific definition of touch, giving a more complete view on the subject.

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The influence of listening expertise and instrumentation on the differentiation between a real orchestra and orchestra sample libraries

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ABSTRACT

Background

In the last decade the sound quality of orchestra sample libraries (OSL) has increased significantly, and the music used in films or advertisements is often produced by means of these new technologies (Cooper, 2014). However, there is a paucity of research addressing the listeners' perception of musical works based on OSL. Thus questions arise as to which factors might influence the discriminability between OSL and recordings of live- or studio-performances (Russel & Jurgensen, 2007).

Aims

We investigate here the discriminability between music excerpts performed by means of a state-of-the-art OSL and those heard via a commercial recording of the same piece. Additionally, we address the respective influences of musical expertise and the composition's features.

Method

Ten short passages (duration about 30 s) from Igor Stravinsky's composition for a large-scale orchestra, *The Rite of Spring* (1913), were presented in two versions: (a) as a synthesis of sampled sounds from the Vienna Symphonic Library, and (b) performed by a traditional ensemble. Synthesised versions from the library were edited by a professional sound engineer and subsequently evaluated by professional conductors to achieve the best possible musical quality. The two versions were randomly presented for identification of the sound source (orchestra or computer) in an online experiment (forced choice paradigm). By means of signal detection theory, we then analysed a total of N = 702 valid data sets from participants who had different degrees of familiarity with library and orchestra sounds (e.g., conductors, composers, music arrangers and producers) and musical sophistication.

Results

On average, 69% of the OSL versions and 72% of the live recordings were identified correctly (mean $d' = 1.5$; $SD = 1.1$). Listening expertise had a significant influence on listeners' discrimination achievement: listeners dealing with sound professionally (composers/arrangers/orchestra musicians) showed a higher sensitivity ($d' = 1.94$) compared to non-musicians/hobby musicians ($d' = 1.3$). Additionally, all listeners were more able to recognize tutti passages in the OSL version higher than passages with more transparent instrumentation.

Conclusions

We conclude that orchestra and synthesised library sounds can be discriminated above chance even by non-experts. However, sensitivity to sounds is considerably influenced by listening expertise and the composition's features.

Keywords

sound libraries, signal detection, sound evaluation, empirical aesthetics

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The relationship between alcohol consumption behavior and music listening preferences

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ABSTRACT

Background

Research has increasingly focused on the relationship between music and alcohol usage behaviors (e.g., Dal Cin, Worth, Gerrard, Gibbons, Stoolmiller, Wills, & Sargent, 2009; Hart, Agnich, Stogner, & Miller, 2014; Jonker & Kuntsche, 2014). Similarly, the role of the music industry (as well as media more broadly) in exposing/ promoting alcohol use and consumption has been a topic of inquiry (e.g., Dal Cin, et al., 2009; Hardcastle, Hughes, Sharples, & Bellis, 2015; Primack, Nuzzo, Rice, & Sargent, 2012; Siegel, Johnson, Tyagi, Power, Lohsen, Ayers, & Jernigan, 2013).

Aims

The aim of this study was to ascertain the relationships between different types of music usage (and listening behaviors) and alcohol consumption behavior among young adults. It was hypothesized that there would be a positive correlation between music use factors (e.g., cognitive, emotional, social) and drinking expectancies (e.g., negative consequences, confidence, sexual interest).

Method

Participants completed an online questionnaire that comprised motives, preferences, and behaviors related to both alcohol and music listening.

Results

Finalized results are not available at the present time as the analyses are not yet complete. However, analyses will address the two main research questions: (1) how the use of music may relate to drinking motives; and (2) how preferences for the involvement of music in drinking settings (as well as the importance of controlling the music heard) might differ in different drinking settings (e.g., pre-drinking, drinking during an event, and post-event drinking). Relevant findings will be discussed, followed by a specific consideration of the patterns demonstrated specifically by excessive alcohol consumption behaviors.

Conclusions

The results are likely to provide a better understanding of how listening to music is intertwined with young adults' alcohol consumption motives and behaviors, with implications for the considering contextual elements accompanying (excessive) alcohol consumption behavior.

Keywords

Music listening; drinking, music in everyday life; alcohol consumption.

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How location and user control influence listeners' responses

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ABSTRACT

Background

Opportunities for interacting with music in present-day, western society have become more varied due to digital technology (North, Hargreaves, & Hargreaves, 2004; O'Hara & Brown, 2006). Consequently, the range of places, times and ways in which people experience music has increased dramatically (Heye & Lamont, 2010; Juslin, Liljeström, Västfjäll, Barradas, & Silva, 2008; Krause, North, & Hewitt, 2014, 2015; North et al., 2004; Sloboda, Lamont, & Greasley, 2009). In particular, such technological developments have influenced *where* listening can occur. With mobile devices, for instance, users have the ability to control what they hear, regardless of where they are.

This research addressed in-situ music listening using Mehrabian and Russell's (1974) Pleasure-Arousal-Dominance (PAD) model of environmental psychology. This model states that a person's interactions as well as his/her interpretation of the context results from variations in three factors, namely pleasure, arousal, and dominance.

Aims

This study specifically aims to consider how context-specific, everyday listening may be captured by Mehrabian and Russell's theory. A number of hypotheses were developed that considered how listeners would respond to the music, as well as how the participants would respond to the overall experience.

Method

Participants. 216 Australian university students, aged 17-51 years (M = 21.50, Mdn = 19, SD = 5.80), completed the study.

Research design. A 3 (location) x 2 (music) independent-subjects design was used. Participants were asked to listen to 15 minutes of music (from ether their personal collection or provided by the experimenter) in one of three contexts (at the gym, while commuting on public transportation, or in a conventional laboratory setting). Block randomization was used to allocate participants into one of the six conditions.

Measures. Participants completed a preliminary questionnaire prior to the music listening task. This questionnaire asked participants to provide demographic details, rate how important music and technology was in their lives, answer music identity items, complete Langford's (2003) measure of the Big Five personality traits, and indicate how they typically accessed and selected music to listen to. After completing the listening task, participants completed a short questionnaire on which they rated how they perceived the music they listened. Designed in line with the PAD model, participants rated how much they liked the music, how arousing the music was, how much control over the music they felt they had, (and also how familiar with the music they were). Three additional questions probed how they perceived their overall experience (the "episode"), also in terms of pleasure, arousal, and dominance.

Results

Six separate GLMM analyses addressed participants' responses to the music and the overall experience ("episode"). Results will be discussed in more detail in the presentation; however, a brief overview of the findings specific to the PAD model follows:

Liking ratings for the music. As expected, personal music was liked significantly more than the experimenter-music. Interestingly, music was liked significantly more in the laboratory than the gym.

Arousal ratings for the music. Experimenter music was rated as significantly more arousing than personally chosen music in both the laboratory and public transportation settings (there was no significant difference for music experienced at the gym).

Dominance ratings assigned to the music. The location main effect was non-significant. However, as hypothesized, personally-selected music was associated with significantly higher dominance ratings than the experimenter-provided music.

Episode pleasure ratings. A significant interaction between location and music type indicated that participants who listened to experimenter-provided music in the laboratory rated their experience as more pleasurable than the participants who listened to their personal music. However there was no difference in the other two locations (at the gym or while commuting).

Episode arousal ratings. Both music type and location gave rise to significant main effects. Episodic arousal ratings were significantly higher at the gym in comparison to both the laboratory and while commuting. Additionally, the experimenter-provided music was associated with higher overall arousal ratings than the personally-chosen music.

Episode dominance ratings. As might be expected, significantly higher dominance ratings were found for the gym when compared to the laboratory and public transportation. Importantly, higher dominance ratings for the music were associated with judgments of higher dominance overall. While music-type was non-significant, it seems that the concept of dominance is important to a person's everyday listening experience. Dominance is likely a more nuanced concept than simply whether the music has come from a person's personal collection or been given to them.

Conclusions

Importantly, this study provides evidence concerning context-specific music listening from a theoretical perspective. By taking an experimental approach and using experimenter-manipulation of both the location and music type variables, the results demonstrate that Mehrabian and Russell's PAD model is a useful framework for understanding everyday contextualized music listening. Though previous work focused on pleasure and arousal, the current findings indicate that the role of dominance cannot be ignored. The results indicate that self-selected music was associated with higher dominance ratings than experimenter-provided music (and also this difference in control was related to how much pleasure the participants experienced); however, this difference was not related to a person's overall experience in terms of dominance. Therefore, the role of dominance, operationalized as control/choice concerning music in the present study, requires further consideration in future research. It is possible that any feeling of control is intertwined with perceptions of *musical fit* – or how the music relates to the particular situation. Regardless, further consideration of dominance will be important in order to explain people's everyday experiences with music.

Keywords

Everyday listening; PAD model; dominance; control; location.

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Psychophysiological responses to 'happy' and 'sad' music: A replication study

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ABSTRACT

Background

Emotional responses to music listening have been studied extensively over the past decades (Juslin & Sloboda, 2010; Swaminathan & Schellenberg, 2015). Some theorists have argued that music may evoke (Juslin, 1997) or even induce basic emotions including 'happiness' and 'sadness' (Kreutz, Ott, Teichmann, Osawa, & Vaitl, 2007), while others have sought for evidence to differentiate these emotions at physiological levels (e.g., Krumhansl, 1997; Kreutz, Bongard, & Jussis, 2002).

More recently, Lundqvist and colleagues (2008) found that 'happy' and 'sad' music induces distinct patterns of autonomic responses for each emotion category in adult listeners. For example, 'happy' music was associated with greater zygomatic facial muscle activity and greater skin conductance than sad music. However, it has remained unclear whether these findings generalise across different styles of music other than vocal music, and to what extent musical sophistication might modulate affective responses (Bigand, Vieillard, Madurell, Marozeau, & Dacquet, 2005; Kreutz et al., 2002).

Aims

The present study sought to replicate and extend previous findings by Lundqvist et al. (2008). In particular, while these authors used excerpts from vocal music, in the currents study exposed listeners to instrumental film music. In addition, a recently developed measure of music sophistication (Gold-MSI; Schaal et. a., 2014) was applied to investigate whether this trait might modulate individual emotional responses.

Method

A total of 32 participants (16 female: mean age = 26.25, SD = 2.18 years; 16 male: mean age = 26.31, SD = 3.57 years) listened to 16 excerpts of instrumental music via headphones and tested individually. Participants rated each music excerpt using Izard's Differential Emotion Scale (Izard, 1981; German version: Merten & Krause, 1993), while peripheral physiological responses were recorded using a NeXus MKII polygraph. Physiological measures included facial electromyography (EMG) at the zygomaticus and corrugator muscles, skin conductance, blood volume pressure, heart rate, respiratory rate and finger temperature. In addition, participants filled out the Gold-MSI, which is a multi-factorial inventory measuring five different facets of music sophistication (and additionally general sophistication, which represents the most informative items).

Results

Results suggest that the replication was overall successful, showing differential responses to 'happy' and 'sad' music excerpts across emotion processing components including both psychological and physiological measures, with the exception of finger temperature. Even in the light of some remaining substantial methodological differences between the previous and the present study. In addition, influences of musical sophistication were negligible.

TABLE 1 Means and standard deviations of emotional experience ratings (0-300) before and after listening to happy and sad music.

Scale		Pre	Music	
			Happy	Sad
Interest	*M*	224,88	182,13	150,39
	SD	2,32	6,87	4,09
Happiness	*M*	213,50	195,58	93,56
	SD	1,50	3,27	4,56
Surprise	*M*	76,19	61,42	25,00
	SD	4,20	9,84	3,84
Sadness	*M*	20,31	9,39	70,68
	SD	0,56	2,09	5,87
Anger	*M*	16,91	11,30	11,94
	SD	4,35	3,16	1,10
Disgust	*M*	6,42	7,52	14,08
	SD	0,49	2,41	4,52
Fear	*M*	9,06	5,93	27,58
	SD	0,78	0,49	7,89

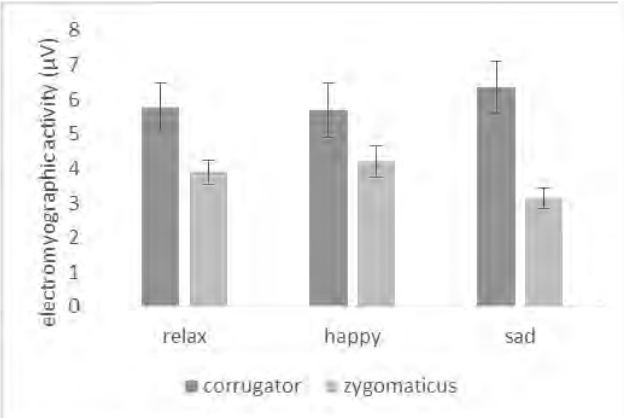

FIGURE 1 Mean values of corrugator and zygomatic activity during the different phases (relax, happy music, sad music). Error flags indicate Standard Error of Means (SEM).

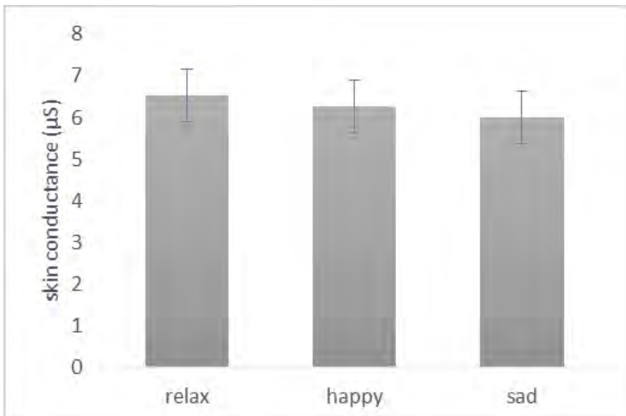

FIGURE 2 Mean values of skin conductance activity during the different phases (relax, happy music, sad music). Error flags indicate Standard Error of Means (SEM).

FIGURE 3 Mean values of respiratory rate during the different phases (relax, happy music, sad music). Error flags indicate Standard Error of Means (SEM).

Conclusions

Taken together, these results further support the hypothesis that music induces autonomic emotional responses in healthy adults. These associations were unaffected by music sophistication. Therefore, it is likely that emotions induced by music resonate with more general affect systems in the human brain. The findings also highlight the importance of replication as well as the future potential of multi-site studies to strengthen the empirical basis of fundamental issues in music psychological research.

Keywords

music and emotions, film music, autonomic response, zygomaticus, corrugator, skin conductance, heart rate, respiratory rate, skin temperature.

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Chasing an effect of background music on foreign vocabulary learning: A futile undertaking?

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ABSTRACT

Background

As tantalizing as the idea of background music's beneficial effects on cognitive task performance may seem, there is—partly due to a lack of theory-driven research—no consistent evidence to support this notion. Background music has even been shown to have detrimental effects, posing severe issues for educational contexts (e.g. study habits). Some studies have suggested that the variation in the findings of background music's effects on cognitive task performance might be explained by inter-individual differences in extraversion.

Aims

In this study we investigate whether background music affects foreign vocabulary learning. Based on Eysenck's theory of personality we predicted that introverts—reported to possess a lower optimal level of cortical arousal than extraverts—perform poorer when learning with background music compared to silence. Extraverts, on the other hand, should be unaffected by background music or benefit from it.

Method

Extreme intro- (N = 16) and extraverts (N = 15) were tested in a paired-associate learning paradigm consisting of three learning rounds, each immediately followed by a word recall task, as well as a delayed recall task one week later. Cortical arousal was assessed with spontaneous EEG measurement in silence prior to the learning rounds. The background music consisted of Bach's Brandenburg Concerto No. 4 and was played during the learning rounds, but not the recall tasks. This musical excerpt has previously been shown to enhance performance in a similar vocabulary-learning paradigm.

Results

Results revealed no interaction between extraversion/cortical arousal and learning condition (background music vs. silence). Instead, we found an unexpected main effect of cortical arousal in the beta band on recall, suggesting that individuals with high beta activity perform better than those with low beta activity. To substantiate this finding we conducted an exact replication (N = 38). Whereas the main effect of cortical arousal vanished, a beneficial main effect of background music appeared. Although a combined analysis (N = 69) of original experiment and exact replication considerably increased the power, the results suggest that there is no effect of background music on foreign vocabulary learning.

Conclusions

In light of these findings, we discuss whether searching for an effect of background music on foreign vocabulary learning—independent of other factors such as inter-individual differences and task complexity—might be a futile undertaking. Importantly, our findings emphasize the need for more exact replications of theory-driven experiments when studying the effects of condition and personality on task performance.

Keywords

background music, foreign vocabulary learning, Eysenck's theory of personality, extraversion, cortical arousal, replication

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The special role of music in wellbeing

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ABSTRACT

Background

Contemporary industrialised society presents multiple challenges to health and wellbeing, including stress, increased pace of life, and increased social isolation. Much is known about the positive effects of engaging in musical activities, with a particular focus on the individual benefits music can bring (such as on quality of life, satisfaction and emotional wellbeing; Clift, Hancox, Morrison, Hess, Kreutz & Stewart, 2010 and on physiological measures of physical health such as cortisol levels; Kreutz, Bongard, Rohrmann, Hodapp & Grebe, 2004). In addition the social benefits of engaging in music have also been much studied, with evidence that music brings people together, and provides opportunities to reduce loneliness and isolation as well as bringing together communities (Bailey & Davidson, 2005; Clift & Morrison, 2011; Dingle, Brander, Ballantyne & Baker, 2013; Murray & Lamont, 2012, Teater & Baldwin, 2012).

However, while this research converges on an acknowledgement of the benefits of music-making, what is lacking is an explanation for *why* music should have such a range of positive effects. To achieve this some kind of theoretical framework is required. The current paper explores the potential of two different approaches to understanding this topic.

Firstly, Seligman's approach within positive psychology (Seligman, 2002; 2011) suggests that balanced wellbeing is only possible as a result of a balance between five different components: positive emotions; (2) engagement, absorption or flow; (3) social relationships; (4) meaning (going beyond oneself); and (5) accomplishment. Elements of this approach have been found in both listeners' and performers' strong musical memories (Lamont, 2011, 2012), suggesting they may also have resonance when considering the impact of music making.

Secondly, Juslin's BRECVEMA framework provides an explanation for how and why music evokes emotions, According to Juslin (2013) seven mechanisms can be identified that lead to an eighth outcome, an aesthetic response. These range from the primitive brain-stem response to sound (a vestige, it is suggested, of the orienting response evolutionarily designed to keep humans out of danger) through to highly-developed complex musical expectations set in the listener's mind by the complexity and patterning of the musical structure itself. Some of these are generally applicable, such as the patterns of evaluative conditioning within a given culture whereby certain musical signs denote particular emotional conventions (for example, the use of minor mode in Western tonal music to signify sadness, or trumpets to signify ceremony), the rhythmic entrainment generated by actions of some kind being undertaken in synchrony, or the emotional contagion that listeners or performers catch from each other or from the music itself. Others are more personal, such as the episodic memories embodied in Davies's (1978) 'Darling They're Playing our Tune' theory (one person's 'tune' being different from the next) or the visual images that listeners or performers might generate alongside a particular piece of music. Juslin argues that these different mechanisms may be linked to different patterns of activation in the brain, and although they have yet to be exhaustively empirically tested the overall approach has considerable potential in explaining how music evokes emotions (Juslin, Harmat & Eerola, 2014), and may thus also help explain how music-making, and potentially other kinds of activity, can make people feel good.

Aims

The current study explores the relevance of Seligman's PERMA approach to wellbeing and Juslin's BRECVEMA framework for understanding music and emotion through a comparison of amateur musicians and those who take part in knitting and crafting activities.

Method

The study consists of an online survey and follow-up interviews with people engaged in the two types of activities. The survey asked background questions about the activities undertaken, length of time engaged in, level of skill and so on, as well as administering the modified BBC subjective well-being scale (Pontin, Schwannauer, Tai & Kinderman, 2013) which measures psychological wellbeing, physical health, and relationships, and the short Subjective Happiness Scale (Lyubomirsky & Lepper, 1999). Interviews explored the role of the activity in the person's life and touched on aspects of skill, social and personal engagement, and benefits. Participants are referred to here by names they chose themselves for the research.

Results

Data have been gathered from a large sample of knitters and crafters (N=836) and a smaller sample of musicians (N=125). Preliminary analysis shows that the knitters and crafters have significantly higher levels of subjective happiness although both groups have higher than average scores (on a 1-7 scale, mean knitters 5.475, *SD* 1.206, mean musicians 5.076, *SD* 1.315, $t(959)=3.411$, $p<.001$). However there was a trend towards a significant interaction between the three components

of subjective wellbeing between groups ($F(2,1792)=2.796$, $p=.061$). Musicians scored slightly higher on physical health, while knitters and crafters scored higher on relationships and slightly higher on psychological wellbeing. Open ended comments indicate many of the components of Seligman's framework for both music and knitting: for example, Elise talked about how "Knitting is way to relax. It helps to maintain social binds with others who knit. It is a creative outlet and establishes a sense of accomplishment." Similarly Chloe reported "I think I feel a sense of achievement when I have learnt a new piece of music, probably enhancing my self esteem, and making myself feel better about me in general. I also think I am a more relaxed person because of it, and generally happier, as I really enjoy playing." There was considerable emphasis on overcoming technical challenges which was found to evoke emotions such as flow and achievement, as a musician, Woobie von Fruitbat, reported "It generally gives me a sense of enormous wellbeing. - - Even if I have to practice & I don't want to, once I get started I am completely out of time and space and just living in the music. I can forget about everything else and just concentrate on what I'm playing, and what else is being played and just be in the moment. - - Sometimes I get frustrated if I can't play something that's technically difficult for me, but if this happens just keep practicing until I can play it, and then I feel good that I have defeated it!".

Conclusions

Analysis is ongoing and full results will be reported at the conference. However, to date the results suggest considerable power of the combination of Seligman's and Juslin's frameworks for understanding why and how music makes people feel good. The lack of substantial differences between the two groups suggests considerable overlap in the mechanisms, with many common features such as social interaction, learning skills and accomplishment, and engaging in a rhythmic skilled activity that has the potential to engender flow. The main differences uncovered to date are that knitting seems to be an activity which can be carried out intermittently and in many different locations (although at a cost, as many knitters referred to spending too much money on yarn) while music requires more effort and time to maintain a level of skill, as well as sufficient time and space to engage with it fully, but is something that can be continued at low cost after initial outlays on equipment and instruments.

Keywords

Music-making, amateur, wellbeing, satisfaction, knitting.

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Listeners' tolerance when listening to melodic performances

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ABSTRACT

Background

The evaluation of pitch accuracy is mainly based on the precision of pitch intervals and the respect of the tonal center of a melody (Larrouy-Maestri, Lévêque, Schön, Giovanni, & Morsomme, 2013). This finding confirms that listeners rely on the relationship between the tones of a melody in order to judge the quality of a melodic performance. In addition, we found that a deviation (i.e., error in the relation between two tones) of ~20 cents constitutes a threshold for layman listeners to qualify a performance as "out of tune" (Beeken, Morsomme, Larrouy-Maestri, 2014). However, this finding does not reflect the tolerance of music experts, who show particularly low discrimination thresholds in isolated contexts (see Schellenberg & Weiss, 2013 for a review). Also, the generalization of this finding is complex, since the material of Beeken et al. (2014) was limited to non-familiar melodies.

Aims

Two experiments were proposed in order to elucidate the concept of pitch accuracy in melodies. A first experiment (a) aims to clarify the effect of music expertise when listening to familiar vs. non-familiar melodies. The second experiment (b) aims to quantify the perceptual thresholds of music experts when listening to melodic performances.

Experiment (a)

Methods

Participants: 30 non-musicians and 30 music experts, matched in age and gender, were recruited from the Belgian population. For the non musicians, the following inclusion criteria were applied: bilateral hearing threshold of 20 dB SPL at usual frequencies; no history of choral singing and no history of formal musical training (or maximum 2 years of musical training and no practice during the past 5 years); no deficit in music perception (tested with the Montreal Battery of Evaluation of Amusia, Peretz, Champod, & Hyde, 2003) and the ability to perform the song Happy Birthday with respect to appropriate melodic contour.

Material: Familiar (i.e., Happy Birthday) and non-familiar (i.e., alternative version) melodic sequences were manipulated, from "in tune" (deviation of 0 cent) to "out of tune" (10 to 60 cents, in 10 cent steps). Figure 1 illustrates the manipulations for the familiar melody.

Procedure: The tolerance of listeners was examined with the method-of-limits procedure (Figure 1), in a test/retest paradigm. For each condition, participants were asked to specify whether the presented singing performances were "in tune" (answers represented by solid lines) or "out of tune" (answers represented by dashed lines).

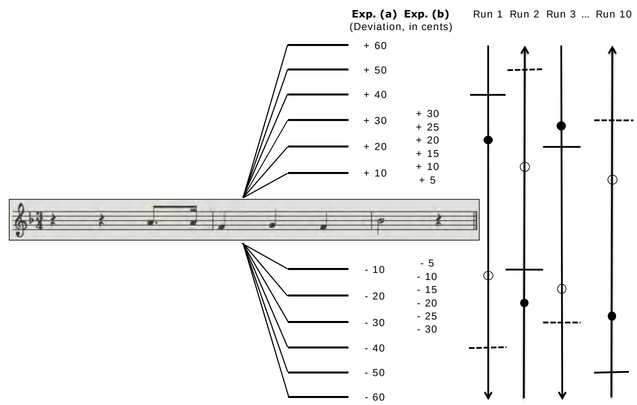

Figure 1. Method-of-limit procedure used in Experiments (a) and (b). For each condition (familiar versus non-familiar), 10 separate runs containing 13 melodies (12 out of tune and 1 in tune) where proposed. For each run, the solid line (for Exp. a) or black circle (for Exp. b) represents the melodic sequence which is first defined as "in tune", whereas the dashed line (for Exp. a) or white circle (for Exp. b) represents the melodic sequence which is first defined as "out of tune".

Results

We observed a highly significant correlation between the perceptual thresholds at the test and the retest ($r(60) = .91$, $p < .001$). The tolerance was lower at the retest ($M = 15.80$, $SD = 8.30$) than at the test ($M = 17.33$, $SD = 9.63$), $t(59) = 2.92$, $p = .005$. Note that the direction of the deviation (i.e., enlargement vs. compression of an interval) did not affect the mean tolerance threshold ($t(59) = .-96$, $p = .34$).

As illustrated in Figure 2, there was an effect of expertise ($F(1, 116) = 139.11$, $p < .001$, $\eta^2 = .54$) on the perceptual thresholds but no effect of familiarity ($F(1, 116) = 2.74$, $p = .10$) and no interaction ($F(1, 116) = .60$, $p = .44$).

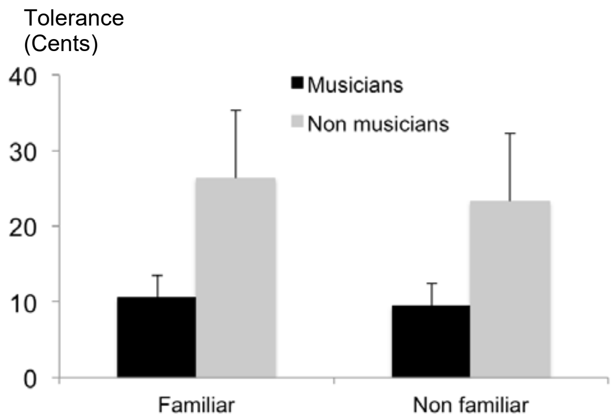

Figure 2. Mean and Standard Deviation (error bars) of the tolerance (in cents) according to the expertise of the participants (non musicians vs. musicians) and the melody evaluated (familiar vs. non familiar).

These results highlight the low tolerance of all listeners when listening to melodies slightly out of tune (less than a quarter tone). Interestingly, even for a familiar song highly known by the participants (i.e., Happy Birthday), the effect of music expertise was still highly significant.

Experiment (b)

Method

Participants: 30 music experts (new participants) were selected on the basis of detailed biographical questionnaires.

Material: The melodies of Experiment (a) were manipulated from “in tune” (deviation of 0 cent) to “out of tune” (5 to 30 cents, in 5 cent steps), as illustrated in Figure 1.

Procedure: As for Experiment (a), participants were asked to specify whether the presented singing performances were “in tune” (answers represented by solid circles) or “out of tune” (answers represented by white circles).

Results

When proposing melodies with small manipulations to music experts, we still observe a highly significant correlation between the perceptual thresholds at the test and the retest ($r(30) = .86, p < .001$) but no difference anymore ($t(29) = .91, p = .37$) between the two sessions (i.e., no training effect). There was an effect of the direction of the deviation ($F(1, 116) = 10.64, p < .01, \eta^2 = .08$) on the perceptual thresholds but no effect of familiarity ($F(1, 116) = .25, p = .62$) and no interaction ($F(1, 116) = .77, p = .38$). In line with the results of Experiment (a), the mean tolerance threshold was about 10 cents, with $M = 7.85$ ($SD = 2.61$) for the compressed intervals and $M = 10.01$ ($SD = 4.06$) for the enlarged intervals.

Conclusions

These experiments support that listeners are consistent when categorising melodies as “in tune” or “out of tune”, whatever the familiarity of the melody and their musical training. In addition, music experts show less tolerance when listening to melodies and seem to be particularly sensitive to interval compressions. All together, these findings yield the opportunity to refine objective tools for the evaluation of singer pitch accuracy but also to provide pertinent material to investigate the music perception process.

Keywords

Singing voice, Pitch perception, Vocal accuracy, Music expertise, Melodic evaluation

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Effect of music and language expertise on the implicit learning of musical and linguistic structures

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ABSTRACT

Background

The cognitive consequences of music and language expertise are rarely compared. Recently, we observed different profiles in music and language experts in implicit learning of linguistic structures of sung material (Larrouy-Maestri, Leybaert, & Kolinsky, 2013), with music experts performing better than language experts. This supports the idea that the effect of musical expertise cannot be reduced to a general effect of expertise and confirms the cross-domain transfer impact of music expertise. However, this finding was surprising, as music and language training both improve executive functions (Bialystok & DePape, 2009), which are involved in such tasks (François, Tillmann, & Schön, 2012). Yet, the language experts of our previous study were speech therapists. These experts develop a high sensitivity to linguistic information through a formal and late (graduation) training, unlike the music experts examined in the previous study. Indeed, the latter started music training early and reported informal practice in music, in addition to the formal training provided by music institutions. Therefore one can wonder whether the response pattern previously observed would differ as a function of specific language expertise (formal late vs. informal early training). In addition, if informal language training had the same effect as music training on implicit learning of linguistic sequences, it is also necessary to examine the effect of both expertise types on implicit learning of musical sequences.

Aims

We aimed at comparing informal vs. formal language training and at examining the effect of dual expertise (in music and language) on the implicit statistical learning of linguistic structures. In addition, we aimed at clarifying the cross-domain transfer effect by comparing the implicit statistical learning of musical structures. We therefore used the sung material created by Schön, Boyer, Moreno, Besson, Peretz, and Kolinsky (2008) to test the ability of music and language experts (formal vs. informal training) as well as of dual experts to implicitly learn the linguistic and musical structure of this material.

Method

Participants: 14 music experts, 14 bi- or multi-linguals, 14 speech-therapists and 8 dual experts (bi- or multi-linguals also experts in music) were selected on the basis of detailed biographical questionnaires.

Material: The material of the learning phase consisted of a continuous stream made out of 6 trisyllabic nonsense "words" sung on 6 three-tone melodies. There was a consistent mapping of linguistic and musical statistical information (Figure 1a: each syllable was associated with one pitch). Therefore, each "word" (defined by transitional probabilities) carried its specific melody, leading to a superposition of linguistic and melodic transitional probabilities (see Figure 1b).

Figure 1. Illustration of the material created by Schön et al. (2008): (a) correspondence syllable/pitch; (b) 6 trisyllabic nonsense "words" sung on 6 three-tone melodies.

Procedure: After listening attentively to 7.30 min of the continuous stream of sung "words", we tested participants' learning of the linguistic or melodic structure with a two-alternative forced-choice that required choosing between "words" and "partwords", either spoken (in the linguistic test) or instrumental (in the music test).

Data analysis: For each test, we examined the percentage of correct responses (CR) of each group with one-sample t-tests (chance level: 50%) as well as the difference between the expertise groups with one-way ANOVAs.

Results

Expertise modulated performance in the linguistic test when including the speech-therapists of our previous study ($F(3, 49) = 5.92$, $p = .002$, $\eta^2 = 0.28$). Post hoc analysis with Bonferroni correction showed that only the speech-therapists differed from the other groups. In addition, as illustrated in Figure 2, their percentage of CR did not differ from the chance level whereas the music experts, bi-multilinguals and dual experts performed above chance (p = .041, .001, .009 respectively).

In the musical test, there was no significant group effect ($p = .25$), but one-sample t-tests showed that only the dual experts performed above chance, with 62.5% correct ($p < .01$). As represented in Figure 2, this was not the case of music experts, bi- or multi- linguals and speech-therapists (p = .180, .464, .215 respectively).

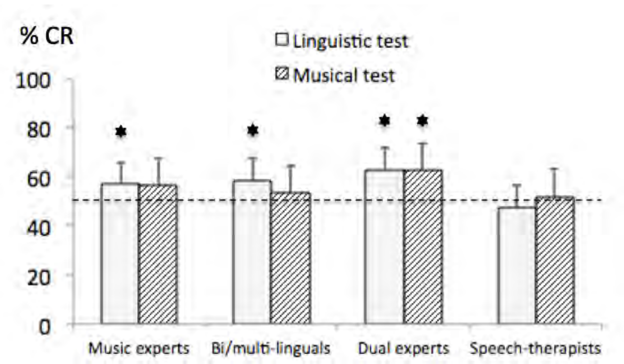

Figure 2. Average percentages of correct responses (in %; error bars represent standard deviations) at the linguistic and musical tests, for the four types of experts (music experts, bi- or multi-linguals, dual experts and speech-therapists). The dashed line represents the chance level. Stars indicate performances above the chance level.

Conclusions

Whereas informal language training and music expertise lead to similar abilities to implicitly learn linguistic - but not musical - structure, this was not the case of formal language expertise. The combination of music and informal language expertise led to a particular profile, namely the ability to simultaneously learn the musical and linguistic structures of sung material.

Keywords

Statistical learning; Song; Music expertise; Bilinguals, Multilinguals

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Musical deficits and specific strengths among Polish dyslexic children

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ABSTRACT

Dyslexia is a specific learning disability characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. The causes of these problems have been debated. Current data strongly supports phonological theory of dyslexia, indicating an impairment in phonological functions as the main cause, responsible for difficulties with creating and using mental representations of speech sounds. Not all explanatory theories, however, assume a pure linguistic deficit to be the major problem underlying dyslexia. There has been evidence of timing and temporal processing problems with neurobiological origin, which result in an impairment of auditory and motor abilities, which underlie reading and spelling skills. The present study aims at further examining the nature of dyslexic disturbances and describing selected aspects of musical perception in the context of reading and writing problems. Research has shown deficits of dyslexic students in musical skills. We attempted to identify the relationship between dyslexia and certain measures of musical hearing. 17 dyslexics from primary schools in Tricity in northern Poland and 11 chronological age controls were tested with a battery of phonological, reading and psychoacoustic tests. Children were matched in terms of IQ. The results have shown an impaired rhythm perception in dyslexia, which indicate a short-term musical memory deficit. Thus the STM deficits in dyslexia are not limited to phonological disturbances. It also seems that the ability to recognise pitch structure might be enhanced in dyslectic individuals. This conclusion must be tentative, but it could be a particular strength of this group.

I. INTRODUCTION

To recognise dyslexia we may refer to the International Dyslexia Association's definition, which describes the disorder as specific difficulties in reading and writing, caused by deficits in phonological processing (Lyon Reid et al., 2003). At the roots of dyslexia are deficits of phonological functions, including phonological awareness and the mechanisms of phonological processing of speech and language units, such as sounds/phonemes and syllables. Individuals with dyslexia are reported to have an impaired ability to creating and using mental representations of speech sounds, which is reflected in reversing and omitting letters, slow reading speed and low reading fluency. These disorders originate from neurological changes in the brain.

The mechanism underlying dyslexia has long been debated, which is reflected in the abundance of explanatory theories. The theories point to one major cause or a set of complementary causes of the disorder. Hypotheses supported with the most empirical evidence include: the magnocellular deficit hypothesis, which indicates abnormal development of neurons and nerve fibres forming the magnocellular pathways in the visual and aural systems (Tallal et al., 1993; Stein, 2001); the phonological deficit theory, which emphasises the role of difficulties in precise processing of speech sounds (Liberman & Shankweiler, 1985; Frith, 1997; Snowling, 1997); the double deficit theory, which suggests that dyslexia is caused both by phonological deficits and problems with temporal integration of different modalities (Wolf & Bowers, 1999); and cerebellar deficit theory or automaticity deficit theory (Fawcett & Nicolson, 2001; Nicolson & Fawcett, 1999; 2008; 2011).

Researchers who developed the last listed theory assume that all problems experienced by individuals with dyslexia result from structural and functional abnormalities of the cerebellum. The dysfunctions of this region are responsible for speech problems, imbalance, the impairment of visual-motor coordination, as well as identifying and learning sequences of stimuli. Studies conducted by Nicolson & Fawcett (1999; 2008; 2011) have supported the cerebellar deficit theory, showing that dyslexic individuals have difficulties with automatisation of many abilities, both cognitive and motor.

To conclude, most of the theories describing and explaining dyslexia propose functional grounds of the disorder, including phonological awareness deficits, the impairment of short-term memory and temporal processing deficits (Ramus, 2004; Snowling & Hulme, 2012). Problems with timing and temporal processing observed among dyslexic students (Overy, 2000) result in the deterioration of numerous motor and cognitive functions, including language, visual and auditory skills. Researchers indicating neural origins of dyslexia argue that it is the cerebellum which plays the crucial role in the process of making auditory perceptions, especially when they are based on rhythmic organisation of sounds (Parsons et al., 1998). These findings provide a rationale for further observation and creating a relevant profile of dyslexic students' cognitive functioning in other domains.

Learning music is an extremely complex activity. It entails fine motor performance, manipulation of symbols and developing auditory skills, such as analysis and synthesis of sounds. Not surprisingly, research shows that dyslexic students have difficulties in developing strictly musical abilities (Oglethorpe, 1996; Overy, 2000; Overy et al., 2003; Miles & Westcombe, 2001). Dysfunctions which are typical for dyslexia, such as impairment of motor abilities and coordination, disorders in lateralisation and automatisation of activity, low functional capacity of working memory, problems with understanding syntax, and observable deficits in procedural learning, all contribute to considerable difficulties in rhythm and music training. These problems might result in an impaired ability to play an instrument with hands moving in opposite directions, difficulties with sight-reading, slow learning of both names and signs of musical notation (and slow memorising pieces) and problems with musical memory (particularly when the motor coordination is poor). What is more, some research

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shows that dyslexic individuals might have serious problems with scale recognition (Baldeweg et al., 1999). On the other hand, certain data suggests that musicians with dyslexia recognise scales more accurately than their non-dyslexic counterparts (Backhouse, 2001). The profile of the problems of dyslexic music students, which can be constructed from these results, is ambiguous and inconsistent, and as such encourages further research and discussion.

II. MATERIALS AND METHODS

A. Aim of the Study

The aim of the study is to analyse the relations between selected aspects of music perception and specific problems in learning music. As previous studies have shown, students with dyslexia have difficulties in the development of strictly musical skills (Oglethorpe, 1996; Overy, 2000; Overy et al., 2003; Miles & Westcombe, 2001). So far numerous research has been conducted to describe and explain similar problems which students with dyslexia have in learning English. There is, however, scarce data on the relation between specific difficulties in Polish literacy skills and musical abilities. Thus, the aim of the current study is to provide a framework for comparing the results on specific problems in reading and writing, both in Polish and English (which differ in the level of transparency), with the data on reproduction and perception of basic elements of music. What also encourages further research, is the contradiction and the inconsistency of the previous results, e.g. the data obtained in a study on the relation between dyslexia and scale recognition. The present study is intended as a part of this debate, and its purpose is to complement and, above all else, extend the body of knowledge about dyslexia.

Based on the analysis of the studies on dyslexia, two specific research questions were formulated: Are dyslexia and the deficits in certain measures of auditory skills correlated? Are there any areas of musical perception in which students with dyslexia are better than controls? The value of the approach emphasising strengths and abilities of individuals with specific problems in reading and writing is reflected in the definition proposed by the European Dyslexia Association (EDA), which despite specific cognitive disorders involved in dyslexia calls it ‘a difference’, not a difficulty, in acquiring literacy skills (Bogdanowicz et al., 2012). Consequently, many authors treat developmental dyslexia as a different way of processing information (cf. West, 1997; Davis & Braun, 2010).

The main independent variable in our study is the occurrence of dyslexia diagnosed in a psychological evaluation. The additional variables include age and sex. The dependent variables encompassed the level of cognitive executive functions for selected musical features: pitch, melody, rhythm, and chords.

B. Participants

28 children from primary schools in Tricity metropolitan region in northern Poland participated in the study. The experimental group consisted of 17 children with dyslexia, the control group of 11 children without one. Children were matched in terms of age (M age = 11 years, SD = 1;3) and school-level. The tests were held in two weeks in 2015 and were structured in two phases, differing in the type and style of the materials used. In both phases each participant completed tasks in the presence of an investigator. In the first part of the study the students were diagnosed with paper-pen tests. The data obtained in this and next part was analysed with diagnostic methods widely used in Poland: Łatysz (Bogdanowicz et al., 2008) – a nonwords reading test (71 nonwords, timed), Zetotest (Bogdanowicz et al., 2008) – a short-term phonological memory test (repeating single nonwords, comparing and analysing paronyms, analysing and synthesising syllables and phonemes, phonological memory), Unknown Language Test (Bogdanowicz et al., 2008) – a syllables blending subtest, a Dictation to test writing skills. The participants were also tested on intelligence. No significant differences were found between the experimental and the control groups in terms of IQ (as measured with 4 Wechsler Intelligence Subscales: Similarities, Vocabulary, Blocks, and Object Assembly) and the groups were found to be homogenous in this respect. All these results are presented in Table 1.

In the second, group phase, the participants were gathered in a laboratory, where they completed an auditory skills test, Bentley’s Measures of Musical Abilities (1966). This psychometric tool focuses on the perception of changes of various musical features: pitch, melody, rhythm, and chord. To help students concentrate only on one element at a time, each task was presented in a separate subtest and dealt with only one musical feature. The test is adapted for both group and individual use. Afterwards, the participants completed Stambak Auditory Motor Test (1951), which measures rhythm reproduction (repeating rhythmic patterns). This method is used to examine executive functions.

Table 1. Selected characteristics of the sample

		Descriptives		**M-W test**		
		M	SD	U	p	ε
Łatysz	Controls	43.1	11.7	227.0	.006 **	.41
	Dyslectics	34.2	5.4			
Unknown language	Controls	78.0	10.5	247.0	.003 **	.51
	Dyslectics	65.3	9.2			
Zetotest	Controls	37.6	1.8	285.0	<.001 ***	.71
	Dyslectics	29.9	7.3			
IQ Similarities	Controls	18.5	3.8	186.5	.229	.20
	Dyslectics	16.9	4.8			
IQ Vocabulary	Controls	12.0	2.1	199.5	.109	.27
	Dyslectics	11.3	5.7			
IQ Blocks	Controls	26.2	4.0	176.5	.373	.15
	Dyslectics	24.9	4.8			
IQ Object Assembly	Controls	35.5	7.6	191.0	.179	.22
	Dyslectics	31.1	5.8			

Note. *p < .050 **p < .010 ***p < .001

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III. RESULTS

In order to estimate the differences between mean ranks in the compared groups, and to calculate the Mann-Whitney U test and two measures associated with it, the significance level and the effect size (ε), bootstrapping was used (Howell, 2010). Bootstrapping is a kind of a resampling method, which involves random taking with replacement 10,000 new samples from the original one, which is treated as a population. The size of the bootstrap-resamples is the same as the size of the 'real' sample. In effect any parameter can be estimated, based on the assumptions of the central limit theorem, as a mean of estimators calculated in each of the bootstrap sample. The confidence interval can be estimated as a relevant percentage of the bootstrap estimators' distribution. This procedure is recommended for solving statistical problems when the assumptions of the actual statistical test are not met (Manly, 1997), as in the present study, in which the sample size was insufficient and the dependent variable was not distributed normally.

Table 2. Scores of dyslectics and controls in Stambak Rhythm Reproduction Test

		Descriptives		M-W test		
		M	SD	U	p	ε
Rhythm reproduction	Controls	17.3	2.2	215.5	.037 *	.24
	Dyslectics	15.6	2.6			

Note. $^{*}p < .050$ $^{**}p < .010$ $^{***}p < .001$

Table 2 presents the results of the Stambak Rhythm Reproduction Test. This tool measures the development of auditory perception, working memory and executive functions. Published sources suggest that the results achieved in Stambak tasks should correlate significantly with the results in tests examining reading skills (cf. Dellatolas et al., 2009; Tierney & Kraus, 2013). Stambak Rhythm Reproduction Test consists of 21 different rhythmic patterns, ordered by increasing difficulty. An investigator taps a given rhythmic pattern, and the subject is supposed to repeat it. In case of an incorrect answer, the investigator taps the pattern once again. If the subjects again gives an incorrect answer, the investigator marks an error on the answer sheet. The analyses conducted in the current study show a significantly higher score of the control group on Stambak Rhythm Reproduction Test (Mann-Whitney U = 215.5, p = .037).

Table 3. Rhythm perception

		Descriptives		M-W test		
		M	SD	U	p	ε
Rhythm perception	Controls	17.27	2.20	215.5	.037 *	.35
	Dyslectics	15.56	2.58			

Note. $^{*}p < .050$ $^{**}p < .010$ $^{***}p < .001$

Here we shall proceed to the results of the analyses conducted with Bentley's Measures of Musical Abilities. Table 3 presents the results in the test of the memory of rhythmic structures examined with Bentley's tasks. This scale consists of 10 tasks including rhythmic sequences, which are played twice to the subject. The participant of the study has to determine if the rhythms were identical or different, and in which section they differed. Presentation of each rhythm is preceded by a loud count-in of four bars. Each correct answer is scored as one point. The analysis of the data featured in Table 3 indicates statistically significant differences between individuals with and without dyslexia in terms of rhythm perception. The controls scored higher on this dimension of the perception of the elements of music (Mann-Whitney U = 215.5, p= .037).

Table 4. Chords perception

		Descriptives		M-W test		
		M	SD	U	p	ε
Chords perception	Controls	4.7	.60	38	.019 *	.42
	Dyslectics	3.5	1.6			

Note. $^{*}p < .050$ $^{**}p < .010$ $^{***}p < .001$

The results of the last phase, which concerned chords perception, are presented in Table 4. The subjects were asked to complete 20 tasks. In each they were played a chord for 3 seconds and had to determine if it comprised of two, three, or four sounds. For each correct answer they received a point. This part of the study provided evidence for statistically significant differences between the compared groups in terms of chords perception. The dyslexic students received lower score than the controls (Mann-Whitney U = 38, p= .019).

Table 5. Melody perception

		Descriptives		M-W test		
		M	SD	U	p	ε
Melody perception	Controls	17.5	4.9	41.8	.047 *	.42
	Dyslectics	11.0	6.8			

Note. $^{*}p < .050$ $^{**}p < .010$ $^{***}p < .001$

The next analysed scale was used to test melodic memory. It consists of 10 tasks with melodies built on 5 tones of the same rhythmic value. Each melody is presented twice to the participant, and the presentations may differ in one tone. The subject has to decide if the melodies are identical, and if not, determine which tone has changed. For each correct answer the subject is given a point. Melodic memory is yet another dimension on which a statistically significant difference was observed between the controls and the dyslexic students, who scored lower from their counterparts (Mann-Whitney U = 41.8, p= .047) (Table 5).

Table 6. Pitch discrimination

		Descriptives		M-W test		
		M	SD	U	p	ε
Pitch discrimination	Controls	2.7	.70	23.3	.004 **	-.65
	Dyslectics	4.3	1.1			

Note. $^{*}p < .050$ $^{**}p < .010$ $^{***}p < .001$

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The results presented in Table 6 were obtained in the pitch discrimination test. The participants were asked to determine if the presented tone has the same, or a different pitch. If the pitches differed, the subject had to decide if the second one was higher or lower than the first one. The tasks were ordered by increasing difficulty. For each correct answer the subject was given a point. The analyses showed that the dyslexic participants scored significantly higher than controls in this testing procedure (Mann-Whitney U = 23.3, p=.004).

IV. DISCUSSION

The ability to make music is as natural as the ability to use language. This capacity, universal and specific to the human species, develops spontaneously and unconsciously (Ayotte et al., 2002). Playing music is a complex behaviour, associated with fine motor activity, auditory skills, using symbols, and, at advanced levels, harmony perception (the analysis of the relationship between different tones). Musical skills develop along with cognitive processes based on synthesis and analysis (Bentley, 1966). Initially, humans respond to rhythm and try to coordinate their movements with the pulse of the music. With experience, children begin to perceive sound elements, based on pitch, as separate melody intervals. They learn the skill to synthesize: recollect and render longer fragments of melodies exactly and accurately in terms of pitch and rhythm. Further practice (improvised singing, playing an instrument) develops the skill to analyze: recognize and discriminate culturally specific rhythmic or melodic intervals. Such elementary perception results from the ability to combine components (e.g., pitch and the duration of sound) together. The ability to distinguish between changes in the various elements of music is a prerequisite for correct intonation in singing and playing instruments. The conducted research demonstrates that specific problems with learning to read and write in Polish are accompanied by disturbed perception of melody, chords and rhythm. Results indicate impaired functioning of musical short-term memory, that is the ability to auditorily memorise musical sequences. This results correspond with the analysis of memory functions carried out with e.g. Zetotest, which allows for the evaluation of the functioning of phonological loop or short-term phonological memory. As the obtained results show, there is a statistically significant difference in phonological memory performance between dyslexic and non-dyslexic individuals (Mann-Whitney U = 285, p<.001). Interestingly, deficits in temporal perspective also affect executive functions examined with Stambak Rhythm Reproduction Test. The rhythm reproduction task requires working memory and grouping events in meaningful chunks, even though the sequences were not long and simple. Already one of the earliest research concerning problems with reading has proven that among 50 individuals with poor reading skills, 8 found it difficult to reproduce the presented rhythmical pattern with tapping (Creak, 1936). In the course of the following years Atterbury (1985), as well as Tierney et al. (2013) confirmed that people with dyslexia have problems with reproducing rhythmical structures. Other research has demonstrated a lower activation of the cerebellum in dyslexic individuals during the acquisition of motor skills, such as learning certain tapping sequence (Stoodley & Stein, 2011). In our study, the correlation between the motor tasks which we have used (such as rhythm reproduction and non-word repetition) might also refer to auditory and short-term memory processes, as it basically represents the measure of the quality of output realisation and this motor component makes it a plausible candidate for an indicator of cerebellar dysfunction (Chen et al., 2005).

To conclude, the gathered data refers to perceptive and motor skills, as well as abilities based on the analysis of time perspective (timing skills). Overy (Overy, 2000; Overy, 2003; Bishop-Liebler & Overy, 2009) states that students with dyslexia and dysorthography may have problems with the analysis and synthesis of musical elements, and with temporal perspective (rapid and motor timing skills), which is crucial for motor control, especially in the development of its fluency and automatisation (Thaut et al., 2001). Research has shown that specific difficulties in reading and writing affect rapid temporal processing of auditory stimuli, rapid naming of visual stimuli, evaluation whether a tone is higher or lower than the referenced one, rhythmic finger tapping, and exploring rhythmic structures in speech (cf. Overy et al., 2003).

On the contrary, already cited Backhouse (2001) demonstrated that dyslexic musicians interpret the pitch better than people without dyslexia and dysorthography. Also Overy (2003) demonstrated that dyslexic children scored higher in pitch skills. However, the dyslexic participants of this study had a slightly greater musical experience than the controls, which may explain the superior pitch skills. The results obtained in a sample of Polish students with specific problems in learning are in keeping with the above reports, pointing to enhanced pitch discrimination skills among individuals with dyslexia.

Taking into account that dyslexia is a disorder with varying degrees of severity, we might tentatively assume that the pitch discrimination skill, which is the greater, the more severe is dyslexia, could be what Overy calls one of „particular strengths" of the participants (2003). If we remember that pitch is analysed mainly by the right hemisphere, while the elements of music associated with time, such as metre or rhythm, are processed by the left part of the brain (Zatorre, 2001), we might recognise a certain link here: a weak left and a strong right hemisphere (cf. Overy, 2003). Here we must note that the participants were homogenic in terms of musical training, as the sample comprised students who followed the curriculum of primary music education. Individuals without formal musical training respond to a pitch comparison task with the right frontal lobe and the right inferior temporal gyrus activation (Evers et al., 1999). However, this simple correlation is complicated by the fact that certain structural elements of music are processed not only by the left, but also right hemisphere (e.g. Popescu et al., 2004).

Certain structural abnormalities, which might influence cognitive functioning, were discovered in research on post-mortem brains of adult dyslexic individuals (cf. Bogdanowicz et al., 2012). A greater number of connections between the right and the left hemisphere, as well as a smaller asymmetry between the planum temporale of the both sides of the brain were reported. The tonality is analysed by the right hemisphere (Zatorre, 1985), while the abnormalities in cortex functioning which are associated with dyslexia occur in the left (Galaburda et al., 1985; 1987). Proving that language processes do not interfere with the memory of tonality, Deutsch (1977) suggested that these two skills engage different cognitive structures. The author also showed that left-handed individuals have greater capacity of tonality memory than right-handed and ambidextrous individuals (what is more, the latter often experience difficulties in learning to write, e.g. Zurif & Garson, 1970). These results should be confronted with the data showing inconsistent correlation between the processes of tonality identification and the processing of speech prosody (Patel et al., 1998).

Due to impaired physical abilities, misunderstanding of instructions and disturbed orientation in body scheme, dyslexic students have problems with rhythm. This results in the assumption that various forms of therapy using rhythm might be an effective remediation for specific difficulties of these individuals (Goswami, 2011; Patel, 2011). Thus, since making music is an extremely complex activity, requiring the development of auditory, visual and sensory-motor abilities, it might ameliorate the problems associated with dyslexia (Overy, 2003; 2008).

V. CONCLUSION

The presented study focuses on Polish dyslexic students and is an attempt to create a profile of their abilities to perceive elements of music. The obtained results confirm the formulated hypotheses. Dyslexic deficits might be reflected in problems with the acquisition and development of strictly musical skills. The conducted analyses might allow for better understanding of the essence of dyslexia and its links with musical abilities. The article, however, does not exhaust the topic, and it rather serves as an inspiration for further research. We must remember that the small size of the examined samples might have limited or distorted the relations between the tested variables, which should be taken into consideration in further research. Moreover, although we have extensive data on dyslexic high school students' performance in musical tasks, few studies have focused on dyslexic students' musical achievements on various levels of music education.

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How to get somewhere in Music - 25 years of research on expert performance and deliberate practice

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ABSTRACT

Background

Although skill acquisition is a central topic in music education, it has also attracted much attention in cognitive psychology. Fuelled by a much-cited publication by Ericsson, Krampe & Tesch-Römer (1993) and a lesser-known preceding publication by Ericsson, Tesch-Römer & Krampe (1990), critics and supporters of the expertise view on expert and exceptional performance have been engaged in controversies. The central concept of Ericsson, Krampe & Tesch-Römer, namely "deliberate practice" (DP), has been widely accepted as a potent predictor of performance in different domains of expertise, ranging from sports to games and music performance. DP denotes the task-specific structured training activity that plays a key role in skill acquisition and helps us explain individual differences in expert performance.

Aims

In my presentation I will offer an overview of recent research related to DP and address some common misconceptions. Furthermore, I will advocate future research in this important area at the intersection of music psychology and music education.

Main Contribution

Recently, the first meta-analyses for music have shown that deliberate practice is the best available long-time predictor of performance. The currently highest aggregated effect size is at r_c = .61 (95% CI [.54, .67]) for the relation between task-relevant practice and corresponding performance (Platz, Kopiez, Lehmann & Wolf, 2014). Despite its importance, a number of misunderstandings exist regarding the essence of DP: namely, the qualitative aspects and methodological issues related to measuring DP (Ericsson et al., 2007; see also special issue of the journal *Intelligence* entitled "Acquiring Expertise: Ability, Practice, and Other Influences"). Given that training durations can only be regarded as proxies for optimized practice (measuring non-optimal practice at the same time), great care has to be taken in assessing relevant training activities and corresponding outcomes.

In order to better understand expert performance, two aspects of research have been helpful: (a) practice-based research (attempts to study in detail practice habits, efficiency of practice, preparation of performance in experts or long-term effects of practice (especially in the work by Chaffin et al.[2002] and Ginsborg et al. [2012]), and (b) the study of contextual factors surrounding the development of young musicians (e.g., McPherson, Davidson & Faulkner, 2012; Lehmann & Kristensen, 2014). Clearly, much interest in expert performance research in music education is motivated by the wish to identify promising young musicians and foster their development (as in sports). Therefore, we have to investigate under which conditions the mechanisms postulated for expert performance are applicable to sub-expert performance and skill acquisition.

Implications

Researching task-specific practice in music and its context offers great potential for basic research in psychology/ musicology as well as for practical research with applications in music education. While the concept of DP was first developed in the domain of classical music, it can and should be adapted to other music-related activities. Unfortunately, the current lack of longitudinal studies regarding practice in novices hampers advances in our understanding of DP. In sum, the lasting focus of research on training-related activities has provided, and will hopefully continue to provide, benefits for all involved in skill acquisition and expert performance.

Keywords

Deliberate Practice, expert and exceptional performance, practicing, music cognition, music education

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Using auditory feedback for the rehabilitation of symmetrical body-weight distribution after ischemic stroke or brain trauma

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ABSTRACT

This paper addresses the development and preliminary user test of the Music Balance Board, an auditory force plate feedback tool for weight-shift training in patients with impairment in balance function. This newly developed system provides auditory feedback based on real-time sonification of weight distribution. In an exploratory study, twelve patients after ischemic stroke or brain trauma performed standing weight-shifting activities guided by the system. This study aimed at: (1) exploring the potential of interacting with a musical environment as a way to retrain how to keep equilibrium while standing, (2) investigating usage strategies of the Musical Balance Board, and (3) studying various sonification modes with different levels of complexity. A model involving associative, explorative and anticipative sonification strategies was tested. The model supports exploration of the ability of using auditory feedback to facilitate reinforcement learning for technology-assisted rehabilitation. Our results suggest that important requirements for designing sonification modes for balance training in people with brain damage are comprehensiveness, simplicity, attractiveness of the soundscape, and most of all musical pleasure.

I. INTRODUCTION

A. Weight-Baring Asymmetry

Patients with brain damage after stroke and traumatic brain injury lose motor, sensory and cognitive functions, which causes diminished balance. The inability to properly shift body weight leads to unsafe gait and falls. Apart from muscle weakness, other problems that can affect balance are loss of sensation on the affected side, lack of concentration, neglect, ataxia and side effects of medication.

Because disturbance in balance increases the level of dependency for activities of daily living, there is a clinical demand for new treatment options. We believe that training with auditory biofeedback is one of the promising opportunities. However, the integration of auditory feedback in motor rehabilitation systems for training symmetrical body-weight distribution is rarely investigated.

Since weight-bearing asymmetry towards the nonparetic leg is common, training of weight-bearing symmetry has been a major focus in post-stroke balance rehabilitation. Cheng et al. (2001) have suggested that body-weight distribution training is a good strategy for fall-prevention in stroke rehabilitation. In a study on the adaptability of the human motor system, Mulder and Hochstenbach (2001) have stressed the crucial role of sensory input and a learning environment for treatment after damage of the neuromotor system. Most of the reported studies on symmetrical body-weight distribution focus on investigating causal relationships between different deficits, but little evidence was found for such relations. For example, in a review of the literature on the relationship between weight-bearing asymmetry and postural instability after stroke, Kamphuis et al. (2013) concluded that whether adopting an asymmetric weight distribution in favour of the nonparetic leg is disadvantageous or beneficial for both static and dynamic postural stability after stroke, still requires investigation.

Our approach starts from the assumption that concepts from the fields of embodiment, musical sensorimotor integration and learning may be used for improving balance rehabilitation (Leman and Maes, 2015). With musical sensorimotor integration we refer to the involvement of perception-action coupling during interaction with a musical environment. Our focus is on the development of a music-supported balance training system based on these concepts.

B. Music-Supported Therapy

Over the past two decades research evidence has been provided for the benefit of using music-supported therapy for motor, speech/language, and cognitive intervention techniques in stroke rehabilitation. For example: Thaut et al. (2007) showed significantly higher improvements in gait with rhythmic auditory stimulation over neurodevelopmental therapy in hemiparetic stroke rehabilitation; Schneider (2010) provided data supporting the advantage of therapeutic instrumental music playing for fine motor recovery post stroke over conventional physical therapy training; Grau-Sanchez et al. (2013) demonstrated that therapeutic instrumental playing leads to neuroplastic changes in the sensorimotor cortex of stroke patients; and Van Vugt et al. (2014) suggest that music-supported stroke rehabilitation can improve fine motor control and mood, not only individually but also in patient pairs.

Moreover, it has been show that simply listening to music in the early stages after stroke can improve patients' recovery. Särkämo et al. (2008), for example, showed that music exposure significantly enhances cognitive functioning in the domains of verbal memory and focused attention.

Surprisingly, the use of music-supported training in rehabilitation of symmetrical body-weight distribution is rarely investigated. Rodriguez-Fornells et al. (2012) explain this gap by the fact that auditory-motor integration is somewhat impaired in stroke patient populations. However, evidence for this is based in the finding that chronic patients do not exhibit motor activation during passive music listening prior to therapy.

According to Häusler and Levine (2000) it is a common experience that stroke patients seldom complain about hearing

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dysfunction. In the vast majority of cases, when hearing disorders are present they are subtle (e.g. tinnitus, auditory hallucinations, loss of auditory sensitivity). In contrast, visual problems such as difficulty focusing, double vision, eye movement problems and blind patches are quite common after stroke.

C. Force Plate Biofeedback

Although visual problems may have important implications for rehabilitation, interventions that seem promising for weight-shift and balance training include visual biofeedback (Stanton et al., 2011; Yang et al., 2014), often combined with technology- assisted training such as using a moving platform or force plate (Barclay-Goddard, 2004). There are for example indications that training with visual biofeedback might enhance motor control (Ghomaschchi, 2014; Khalaff et al., 2014) and learning after stroke (Chen, 2002). Other studies have revealed that, because music and motor control share circuits, music can improve movement in patients who have suffered a stroke or who have Parkinson's disease (e.g. Thaut & McIntosh, 2010).

We developed an auditory force plate feedback tool, the Music Balance Board (MUBB), for balance training by weight-shift and present a user study that explores this tool. With auditory feedback we here refer to the use of an auditory signal that is adapted to a performed action (i.e. weight shift), accordingly to the real-time calculation of weight-distribution.

With this study we aimed at (1) exploring the potential of interacting with a musical environment as a way to retrain how to keep equilibrium while standing, (2) investigating the usability of the Musical Balance Board, a new interface that provides auditory feedback based on sonification of weight distribution, and (3) studying different sonification types.

II. THE MUSIC BALANCE BOARD

A. Auditory Feedback System

The Music Balance Board is a force plate system that was designed in house. Recent developments in technology-assisted training have resulted in the commercial availability of numerous force platforms for the retraining of balance function. However, these systems are mostly designed to provide visual feedback to patients regarding the focus of their centre of force or centre of pressure. Some systems allow auditory feedback, in addition to the visual feedback, consisting of simple sounds in response to errors in performance. We are not aware of systems providing solely auditory feedback to guide the patient with weight shifting.

The hardware of the Music Balance Board monitoring system consists of 2 separate wooden force plates, each resting upon 4 strain gauge load sensor sets. This allows the weight on each plate to be determined. An Arduino Due board reads all sensor values at 100 Hz and transmits these to custom software written in MAX-MSP for calculating the body weight distribution of the participant (i.e. the weight ratio between left and right force plate) Finally, the resulting data is send to a Pure Data (Puckette, 1996) patch for sonification.

B. Sonification Modes and Strategies

The current application features 8 different sonification modes (i.e. stable-noise, scratcher, instruments, continuity, rhythm, minor-major, train, sentence) for the communication of body-weight distribution data. These sonification modes were divided into 3 sonification strategies: associative, exploratory, and anticipative. The associative strategy induces associative behaviour in the patient, the exploratory strategy induces investigative behaviour, and the anticipative strategy induces goal-directed behaviour. In table 1 a summary is provided of the used modes, stimuli and strategies.

The choice for developing associative, explorative and anticipative strategies relies on aspects of the relationship between musical pleasure, the rewarding aspect of music listening and theoretical principles of reinforcement learning. In a study with normal subjects Gold et al. (2013) explored the practical implications of music pleasure through its ability to facilitate reinforcement learning. It was shown that musical pleasure was able to influence reward-based decision making and that the shape of this effect depends on group and individual factors. Our aim was to develop a framework to investigating reward in view of practical applications for retraining weight symmetry.

Mode	Stimulus	Strategy
Scratcher	Familiar song	Associative
Instruments	Instruments	Exploratory
Continuity	Piano tones	Exploratory
Rhythm	Drum rhythm	Exploratory
Minor-Major	Harmonic progressions	Exploratory
Stable-Noise	Pure tone-noise	Anticipative
Train	Train riding –steam trumpet	Anticipative
Sentence	Known text	Anticipative

Table 1. Sonification modes, stimuli and strategies.

1) Scratcher. The 'scratcher' mode is task-related: by shifting their body-weight patients are requested to play a familiar song in the correct pitch, much like controlling the speed of a record player. Distributing the weight away from a predefined centre speeds up or slows down the playback. The physiotherapist can adapt the intensity of the scratcher effect on the music dynamically. New pieces corresponding with the patient's musical preferences can be loaded.

2) Instruments. By trying to find a predefined symmetrical body-weight distribution point, the patient completes the instrumentation of a tune. The tune contains 6 separate instrumental parts (bass, drums, melody, harmony (guide-tones), counter-melody (bell sound) and arpeggios). As the participant moves closer to the balance point, parts are gradually added, resulting in the complete arrangement at the center. The physiotherapist can change the progression of added parts.

3) Continuity. By changing his/her weight distribution the patient plays a virtual piano-like instrument. A new note is

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played as soon as the change in pressure on the balance board surpasses a predefined threshold. The note choice is relative to the direction in which the weight distribution evolves: an upward melody is created by moving the centre of weight from left to right, and a downward melody by moving in the other direction.

4) Rhythm. This mode plays rhythm that gains and looses clarity as the participant moves to or away from the symmetrical body-weight distribution point. This is achieved by modifying the virtual space in which the drum sounds are heard. Away from the centre the drums are perceived far away in a large room, and close to the centre of balance, the drums are perceived close-up in a small room.

5) Minor-Major. In this mode harmony evolves from minor to major, reflecting a generally positive mood when the center is reached (major) and more negative moods when leaving the centre. The number of voices in the harmony can be changed dynamically, between 1 and 4 voices.

6) Stable-Noise. The participant's goal is to achieve a pure tone (sine wave at 400 Hz). As the weight distribution on the balance board reaches a predefined balance, the sound becomes more stable. The sound becomes unstable by variations in pitch introduced when leaving the predefined balance point.

7) Train. In the 'train' mode, the sound of a riding old-fashioned steam locomotive is heard. The patient's goal is to slow down the train until it stops and a steam trumpet is heard. The speed of the train is inversely related to the difference value between foot pressures. More difference speeds up the train. When the train remains at its slowest speed for a predefined time, the sound of the engine letting of steam is heard.

8) Sentence. This mode uses a well-know sentence from a narrated fairy-tale (i.e. Snow white). A mixture of voices is heard simultaneously, making it difficult to understand what is being said. When a small range around the balance point is held for a predefined amount of time, the masking voices stop, leaving one sentence out of the chaotic speech to continue and become intelligible.

C. Graphical User Interface

For the physiotherapist, a graphical user interface (GUI) is provided with standard Pure Data GUI objects, except for the 'button' object (for activating/deactivating modes) from the ggee external library. A secondary display of incoming data is shown on the lower end of the interface. Left/right foot pressure and difference are shown in the bottom three fields of the GIU (see Fig. 1)

The sonification modes can be activated separately or in any combination. Each mode has its own volume knob by which the experimentor can adapt the volumes during use.

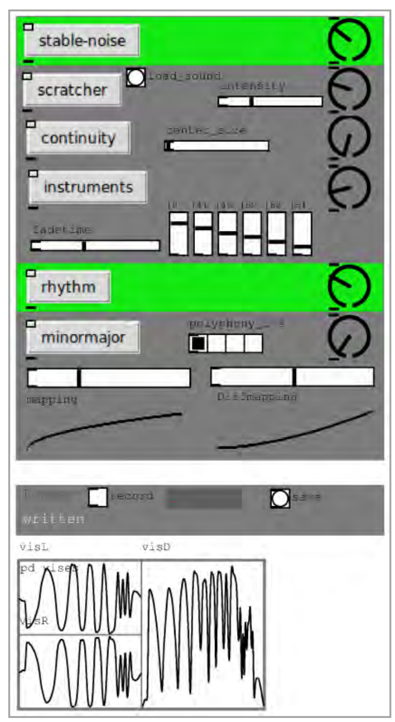
Sliders and graphical representations are offered in the GUI, allowing the application of mapping curves to the incoming data of the balance board. This permits for lowering or raising the general difficulty. The evolution of the pressures and the difference in pressure (lower is closer to balance point) can be mapped onto exponential or inverse exponential curves. In practice this is perceived as widening and narrowing the target area of symmetrical body-weight distribution. The slopes are adapted by changing the exponential that creates the curve. An exponential of 1 gives a linear slope (no change). Exponentials <1.0 raise the difficulty, because pressure difference between feet grows faster at the beginning of the curve. Exponentials >1.0 lower the difficulty, because the difference grows slower at the beginning of the curve.

D. Logger: Recording Functionality

In addition to the sound functionality, the recording section allows to record log data from the experiments. The audio generated from the activity during the experiment is recorded, along with 3 additional tracks of data from the balance board (left foot pressure, right foot pressure and difference), normalized to a range of -1 to +1 (16-bit float values).

Log data from the balance board activity is recorded along with the audio into a 5-channel audio file in the WAV format at 44.1 kHz sampling rate. This audio sampling rate is far above the sampling rate of the data received from the balance board, and therefore results in larger files than necessary. The important benefit of this method is guaranteed synchronization of the recorded pressure data to the recorded audio, and easy importing of all synchronized channels into many standard audio editors or analysis environments.

Another recording facility was added in the second version of the application, allowing recording video in addition to the stereo audio and 3 data channels. This video recording



functionality was programmed using the Gem external library

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for Pure Data. The video is recorded at 30 frames per second, with a timestamp inserted at the bottom of each frame.

Figure 1. Graphical user interface of the first version of Music Balance Board. Top: sonification modes. Bottom: incoming data (left/right foot pressure and difference).

III. METHODS AND RESULTS

A. Participants

A mixed group of 12 individuals (8 women and 4 men) with hemiparesis caused by traumatic brain injury (N=5) or ischemic stroke (N=7) explored the system. They were aged between 22 and 67 years old (M=45.92, SD=14.50). All patients were recruited in the rehabilitation clinic of Ghent University, where the test was incorporated in their regular rehabilitation program. Physiotherapists working at the rehabilitation centre selected the patients. Inclusion criteria were: a full range of motion in the lower extremity; the ability to stand safely with or without an assistive device for a minute at least; being able to communicate with the experimenters; and having good visual and auditory acuities. Physiotherapists (N=2) participated as well in the study. They provided support during the training, observed the patients' behaviour and participated in the discussions following the sessions.

B. Procedure

As the central goal of this ongoing study is the creation of an auditory biofeedback system that has both utility and usability, a participatory design approach is taken that puts the users at the centre of the design process.

The experimental procedure was performed at the rehabilitation clinic of Ghent University and was assisted by experienced physiotherapists. Ethical confidentiality for the patients was ensured. Participants gave their written informed consent to participate in the study and approved video recording before the training started. All patients explored the system during one session, in standing position, for about 15 minutes. Session duration was established in consultation with the physiotherapists to enable an adequate number of weight shifts without causing fatigue effects. The patients stood with their feet parallel on two separate balance boards, integrated into a single plate. The board was positioned with the long axis aligned with the length of the subject's foot (see Fig. 2).

Figure 2. Experimental setup: subject exercising with the musical balance board.

In accordance with the 3 sonification strategies, subjects either received verbal instruction on the task (associative), or were instructed to shift weight to both sides while listening to the music (explorative strategy) or heard the target sound in advance (anticipative strategy). During the test the patients explored the effects of their weight shifts in different modes until they reached a predefined target, or until it was clear that they no longer enjoyed the exercise. On average the total duration of a session, including filling in of questionnaires, was 30 minutes.

The following protocol was monitored: (1) demographic data on all subjects and information on their musical background was gathered, (2) before the activity, a short introduction was given by the experimenter on the kind of exercise they would do, (3) supervised by the physiotherapist the patients were auditory challenged to shift their weight using the different sonification modes. The test was executed in 2 steps. In the first pilot 7 patients explored a first version of the MUBB including 6 modes (stable-noise, scratcher, instruments, continuity, rhythm, minor-major). Based on the observations of the first pilot, in a second version of the patch 2 anticipative modes (train, sentence) were added and tested by another 5 patients.

C. Data Collection

The study was based on an experimental pre-post design. Two short questionnaires were used: a pre-questionnaire assessed participants' interest in music and musical background (e.g. musical education, preferred genre), and a post-questionnaire assessed patient's experience with the music balance board and the auditory feedback system. For the latter, a 7-point Likert scale was used to check the degree of: perceived difficulty of the exercise; clearness of the task; difficulty of interacting with the soundscape; pleasantness of the exercise; controllability of the sound; and the use of headphones. Video en audio recordings were made for further observation and discussion.

In addition clinical information was gathered on the type of brain injury (Traumatic Brain Injury or Ischemic stroke) paretic side of the participants (L/R), period post attack, and Berg Balance Score (BBS) (Berg et al., 1995). This test scores the independence and quality of activities while sitting down, standing up, standing, turning etc. Detailed descriptions of characteristics and demographics of the participants are listed in Table 2.

Table 2. Characteristics and demographic data of the participants.

Age	Sex	Type	Paretic side	B.B. Score	Days post IA/TBI
51	M	Isch	L	46R/39L	138
40	M	TBI	L<R	46/46	304
48	M	Isch	L	Not available	238
58	F	Isch	R	34R/56L	136
67	M	Isch	L	38R/37L	95
60	M	Isch	L	38R/33L	143
22	M	TBI	L<R	36 BI	472
37	F	Isch	R	47R/50L	134
30	F	TBI	BI	18 BI	230
53	F	TBI	BI	55 BI	157
27	M	TBI	L<R	Not available	55
58	M	Isch	L	47R/46L	62

D. Results

One assessment was completed in 12 patients with brain damage after ischemic stroke or traumatic brain injury. On average, patients trained with the Music Balance Board system for 12 minutes (stdev =2,36 min). With regard to their musical background, 10 out of 12 reported that they like music, and 4 were musically educated. While 7 patients found exercising with headphones not bothersome and pleasant, 5 patients were hindered to use headphones and heard the music through loudspeakers.

Ratings on a 7-point Likert scale of perceived qualities of the auditory feedback system revealed that the participants understood well what they had to do (M=5.25, SD=1.86); enjoyed exercising with music (M=4.83, SD=2.08); and that they had the impression that they could control the music well by shifting weight (M=4.58, SD=1.88). The qualities that assessed the difficulty level of the exercise (M=3.50, SD=1.57) and of interacting with the music (M=3.58, SD=1.51) got the lowest scores (see Fig. 3).

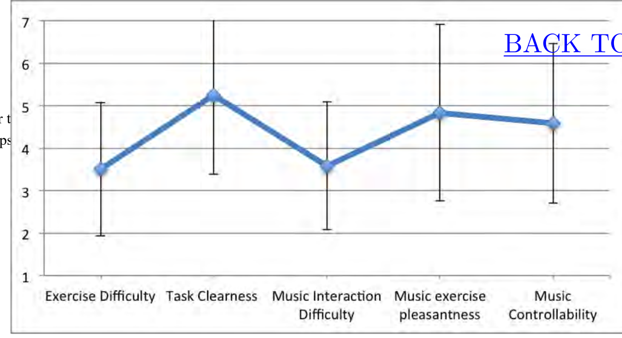

Figure 3. Mean scores and standard deviation for perceived qualities of exercising with the Music Balance Board

Responses to an open question on how patients experienced the music that was presented indicated that the music was appreciated positively: it was stimulating, and pleasant.

Preference of sonification strategies was evaluated by observation of participant's behaviour using video recordings, and narratives of interviews with the participants and physiotherapists. All patients who exercised with the first version of the system (N=7) clearly preferred the scratcher mode (associative strategy). This can be explained by its use of a song with positive mood that was well known to all participants (i.e. Pharell Williams, Happy). All patients showed general enthusiasm about playing their favourite music. The exploratory strategy was evaluated less empowering because some modes, such as 'instruments' and 'minor-major', seemed to be too complex to understand for the target group. The anticipatory strategy worked well enough to challenge participants to find the target. However, in the first pilot there was only one sonification mode for this strategy. The 'stable-noise' mode was experienced less exiting. Therefore, in the second version 2 modes (train, sentence) using the anticipative strategy were added. These soundscapes are characterised by simplicity and familiarity. The patients who tested these modes (N=5) appreciated the rewarding effect of goal-directed training positively.

IV. DISCUSSION AND CONCLUSION

The present user study focused on weight-shift training with real-time auditory biofeedback for two reasons: firstly, the use of music-supported training in rehabilitation of symmetrical body-weight distribution is rarely investigated, and secondly we believe that auditory-induced motor performance might enhance motor control and learning in patients with difficulties maintaining balance caused by brain damage.

Given these goals and the fact that this is a first exploratory study using a newly developed tool, we made our inclusion criteria rather unrestricted. This enhanced heterogeneity of participants. Our study also included two types of neurological injuries: ischemic stroke and traumatic brain injury. However, despite differences in the underlying etiology of stroke and traumatic brain injury, the disabilities share common functional changes caused by motor deficits, gait problems, impaired balance control and frequent falls. Some of these problems, such as impaired balance and the high risk of falls, are not only present in the acute phase, but remain a considerable health concern throughout the life span of these patients (Weerdesteyn et al., 2014). Our choice for heterogeneity of patients is also motivated by the ability of music to work as a motivator for movement and guider of movement adaptations (Amengual et al., 2013). Therefore it can be assumed that balance training with auditory feedback could offer new treatment options for a wide range of patients with neurological impairment. Such treatment could support patients to regain the ability to independently perform activities of daily living.

A drawback of the presented study is that our results are based on a relative small number of patients (N=12). In the exploratory phase, which addresses tool development and user experience, access to patients was limited. Meanwhile, cooperation with multiple rehabilitation centres is being setup, so that future work will include larger trails.

The shift of focus from visual to auditory biofeedback is a new and important addition to previous work on balance training. In the last decade, force plate biofeedback approaches to treating motor impairments caused by neurological injuries received much attention (Avanzi et al., 2009; Brückner, 2014). But, work is still needed that addresses challenges related to the usability of systems and tools. The advantage of our study is that it takes a person-centred and participatory design approach as a premise for delivering interventions that are efficient and agreeable as well.

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Another issue is related to the auditory feedback mechanisms and strategies. A critical asset potentially offered by auditory biofeedback is that music can foster optimal experiences and motivation. Up to now it has not been clear whether any auditory feedback, such as simple beep tones, would have a similar effect on motor rehabilitation, or whether explicit musical parameters such as a sophisticated pitch and time structure, are prerequisites for the success of music-supported training (Schneider et al., 2010). Apart from using different sonification types, going from pure tones to familiar melodies, our model also includes 3 behavioural strategies. Our intention is to create a game-like context that makes the exercise more challenging and rewarding. Our ultimate goal is to obtain better insight into the possible effect that auditory feedback in combination with a reinforcement learning approach might have on functional recovery induced by training. According to our observations, the associative strategy using well know, pleasurable melodies was most motivating for the patients involved in the study. This is in line with research findings that link enjoyment of music to the dopaminergic reward system an its influence on reinforcement learning (Gold et al., 2013). However, more studies with different designs involving a variety of sonification modes are needed to provide evidence for our observations.

At last, it should be noted that, because our sample was rather small, we did not control for severity of brain injury. It is important to keep in mind that this variable can affect a patient's performance on various types of musical feedback. This will be a point of attention in future work.

In conclusion, our results indicate that using auditory biofeedback is a promising strategy for the training of symmetrical weight bearing. Patients and physiotherapists unanimously agreed that weight-shift training with real-time auditory biofeedback is pleasant and motivating. They even preferred auditory feedback to visual feedback. From patient's evaluations of qualities of auditory feedback it can be suggested that important requirements for designing sonification modes and strategies are comprehensiveness, simplicity, attractiveness of the soundscape, and musical pleasure. Future work will focus in systematic investigation of the effect of linking auditory feedback strategies to the theory of reinforcement learning.

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Learning novel music systems through short exposure

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ABSTRACT

Background

Evidence suggests that we form implicit knowledge about the musical structure of our native music through everyday exposure, such as the statistical regularity of pitch intervals or metrical patterns (Eerola, Louhivuori, & Lebaka, 2009; Marmel, Tillmann, & Dowling, 2008). Music with unfamiliar pitch structure was found harder to perceive and remember. For instance, Trehub, Schellenberg, and Kamenetsky (1999) found that adult listeners were better at detecting relative pitch differences between a pair of pitches that were generated with the familiar major scale than those that were generated with the other two unfamiliar musical scales (artificial scales with 7 equal steps or with 7 unequal steps arranged in a different way from the major scale). In the current study, we were interested in understanding the capacity of learning new music systems. Specifically, we explored whether non-musicians could learn novel music systems through a short exposure task. It was postulated that systems that are structurally similar to the listener's familiar system (Western 12-tet system) would be better learned.

Aims

We aimed to examine the effectiveness of exposure in learning novel, microtonal music systems that varied in their level of structural similarity to the Western 12-tet system. These systems are mathematically generated, with unfamiliar pitch interval structures that carry novel relational pitch information. For example, one of the to-be-learned systems was the 11-tet system, which is a system that divides an octave into 11 equal steps. This creates larger interval sizes with different relative pitches from the 12-tet system.

Main Contribution

Consistent with our previous experiment that examined the learning of one novel music system (81 primes scale (Dean, 2009)), we found that listeners might be able to differentiate the three to-be-learnt systems after exposure, as implied by their goodness-of-fit (GOF) ratings.

We recruited 30 non-musicians from the University of Western Sydney and randomly allocated them into an Exposure group and a No Exposure group. Exposure was introduced by a melody discrimination task where participants were asked to detect any deviant tone in the second playing of the same melody. In other words, they were required to remember the first playing of each melody in every trial in order to perform well, and the melodies carry information about the pitch intervals and relative pitches of the system that the melodies was generated from.

After the melody discrimination task (exposure task), the Exposure group then performed a GOF task where a melody was presented followed by a probe tone, and they were asked to rate how well the probe fits with the just presented melody. We expected that ratings on probes from the same system as the melody would be rated higher than those from the alternative systems if the exposure had induced learning. The No Exposure group performed the GOF task without participating in the melody discrimination beforehand.

General results showed a significant main effect of exposure, that the Exposure group gave higher GOF ratings than the No Exposure group overall. For 11-tet and Well-formed melodies (two systems that are moderately similar to 12-tet), the Exposure group rated probes from the same system as the presented melody significantly higher than the No Exposure group, which implied that after exposure, participants considered probes from the same melodic system as being a better match.

Implications

We found that exposure to novel music systems leads to higher GOF ratings and the results suggested that participants may be able to differentiate the systems that they were exposed to as shown by the systematic differences in their GOF ratings on different types of probes (from the same or different system from the melody). Additionally, the level of structural similarity to the familiar music system might also play an important role in learning, as shown by higher GOF ratings for the 11-tet and Well-formed melody conditions than for the more dissimilar 81 primes scale.

Keywords

Learning, tuning systems, microtonality, musical expectations

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Role and effects of retrosequential practice (RSP) on skill acquisition in deliberate music practice

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ABSTRACT

Background

In everyday life musicians of all genres and levels are faced with multiple challenges practicing their instruments: mastering difficult passages, increasing tempi, improving metric/rhythmic precision, expanding or memorizing repertoire, sight-reading...etc. The research of related sciences, particularly from the fields of motor- and language learning, showed, that accomplishing those tasks strongly depends on the degree of automatization of a musician's motor and cognitive skills. Therefore most educational methods suggest start practicing in lower tempi – usually from the beginning of the musical piece, section or phrase. Nevertheless, the design of anterograde practice (AP) seems to bear some problematic implications, which may impair the efficiency of the musical learning process. Consequently, Retro Sequential Practice (RSP) draws some attention as a music practice method, trying to approach those problems more successfully by focusing on the primary automatization of the terminal sequences of a musical object and its stepwise (sequential) backward (retro) oriented expansion.

Aims

The study aims to answer the question: Does RSP have objectively advantages in comparison to other - namely anterograde - practice methods, and if so, what are they due to and how can they be explained?

Method

The study is conducted in the form of a still continuing empiric field study and includes students of differing ages, levels of expertise and musical goals. All participants were tested on the independent and/or guided application of RSP and AP onto either appropriately selected pieces, or these they currently studied, or technical etudes. The lessons respectively the practice sessions were videotaped and supplemented by oral interviews.

The analysis of the footage firstly helped to indicate the main problems in anterograde practice methods.

Furthermore, to point out the distinct differences between AP and RSP, its key features were portrayed, analysed and discussed.

Finally, in order to explain the possible advantages of RSP in comparison to AP, the empiric findings were interpreted and discussed by relying on implementation, application and adaption of the related neuroscientific research results.

Results

As a first result, it could be showed that there are similarities and differences between the concerned methods of AP and RSP. While the commonalities are due primarily to the application of general principles of learning in both methods, the differences are particularly concerning the following aspects:

- Design of practice
- Physical condition and concentrativeness and
- (mis-) interpretation/judgment of the achieved capability

The empirical results suggest and their neuroscientific interpretation supports, that RSP positively affects the learning process, particularly regarding to:

- Accomplishing of complexity and structuring of learning content
- Specifying of perception and sharpening of imagery
- Enhancing of retention and accelerating of skill development
- Strengthening of self-confidence, intrinsic motivation and improving stage presence

Conclusions

RSP optimizes the musical learning effect by conclusively aligning instrumental practice according to neurophysiological and neuropsychological facts, conditions and phenomena.

Keywords

Music Practice, Music Education, Music Performance, Deliberate Music Practice

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Speed on the dance floor: Visual and auditory cues for musical tempo

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ABSTRACT

Background & Aims

While the McGurk effect (MacDonald & McGurk 1976) is perhaps the best known example of auditory-visual "mis-integration," Schutz & Kubovy (2009) have shown how performers gestures affect perceived duration and argued that causal inferences best explain the influence of vision on audition in contexts where visual information is clearly relevant to the auditory cue. Here we show how a meaningful visual array can affect tempo judgments.

Method

Six classic American R&B songs at 105, 115, or 130 BPM were the audio stimuli. Point-light animations of dancers who performed slow/relaxed vs. fast/vigorous interpretations of each song were the video stimuli. Stimuli were presented in audio only, audio+video (A+V), and video-only conditions. Participants rated the tempo in each trial on a 7-point scale.

Results

Significant effects of presentation condition ($F(1.88, 100.089) = 22.385$, $p < .001$, $\eta_p^2 = .297$) and BPM (F 1.966, $104.193) = 53.119$, $p < .001$, $\eta_p^2 = .501$) were found. In the audio-only condition participants were able to rank the stimuli in accordance with the three BPM levels. In the A+V condition there were significant main effects for dance interpretation ($F(1, 26) = 28.171$, $p < .001$, $\eta_p^2 = .520$) and BPM ($F(1.784, 46.379) = 59.221$, $p < .001$, $\eta_p^2 = .695$): while slow dance interpretations were rated at the same speed as in the audio-only condition, the fast dance interpretations were rated faster. In the video-only condition participants were unable to make consistent tempo ratings.

Conclusions

Just as musical tempo involves more than BPM (Drake, Gros, & Penel 1999; London 2011) here we show it involves more than just the auditory modality alone. While audition may prime vision for some temporal judgments, on the dance floor visual cues influence our judgments of tempo, as they are meaningfully yoked to levels of activity, energy, and effort.

Keywords

Tempo, Beat Rate, Dance, Motion Capture, Cross-Modal Perception.

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Chronic profession-limiting problems in musicians: Underlying mechanisms and neuroplastic routes to recovery

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ABSTRACT

Background

Musicians are subject to a wide range of medical problems related to the physical and psychological demands of their profession. Increasingly, such problems are acknowledged to result from multiple intrinsic and extrinsic factors acting synergistically, and multidisciplinary approaches are recommended. However, analysis of problems in relation to holistic factors is usually descriptive, with mechanistic under-pinning largely absent. Consequently, in practice, approaches to rehabilitation tend towards the more conventional, and regard both causes and solutions as specific. Methods commonly involve direct treatment to reduce inflammation, physiotherapy to address muscle weakness and imbalances, and a graded return to playing.

Aims

The approach presented here considers the working hypothesis that problems arise from mal-adaptive selection within a perception-selection-action feedback loop, and that breaking the loop at the point of selection gives the possibility of preventing potential, and overcoming existing problems. The aim of this study is (i) to establish whether in playing, violinists and violists exhibit a common diagnosable musculokinematic pattern unnecessary for performance, and (ii) to compare practical and ultrasound methodologies for revealing and reducing that pattern in individuals

Method

Twenty-one violinists/violists repeated seven progressively demanding playing tasks in six series involving two external feedback interventions (ultrasound feedback of the neck muscles and expert verbal feedback of movement) based on principles of minimising task-irrelevant a priori selections, and three necessary controls.

Results

At significance $p<0.05$, multivariate discriminant analysis of full-body, kinematic and electromyographical data showed progressive reductions in the extent to which a common musculokinematic pattern was exhibited using ultrasound and verbal interventions. Differences were characterised by reductions in most muscle activities and key movements, including elevation and internal rotation of the shoulder, axial rotation of the torso, and anterior and caudal movement of the head. Expert verbal feedback produced more extensive change to the same pattern as ultrasound feedback.

Conclusions

Violinists and violists exhibit a common, diagnosable whole-body musculokinematic pattern that is unnecessary for performance and associated with chronic profession-limiting injury. External feedback, targeted at minimising individual *a priori* musculokinematic selections unnecessary for performance is efficacious in achieving individual change. This methodology has potential for reducing problems resulting from accumulative feedback of mal-adaptive selections within a perception-selection-action feedback cycle, including limitations in performance, and sensory input predisposing occupational dystonia and profession-limiting injury

Keywords

Performance-related problems; profession-limiting injury; dystonia; rehabilitation; maladaptive

Practical Demonstration

The practical demonstration shows application of ultrasound feedback targeted at the neck muscles and expert verbal feedback during the violin-playing tasks reported during this symposium.

There will be opportunity for extended discussion.

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Does the neck have hierarchical influence in motor performance: Can proactive-selective inhibition targeted at the neck break the vicious cycle?

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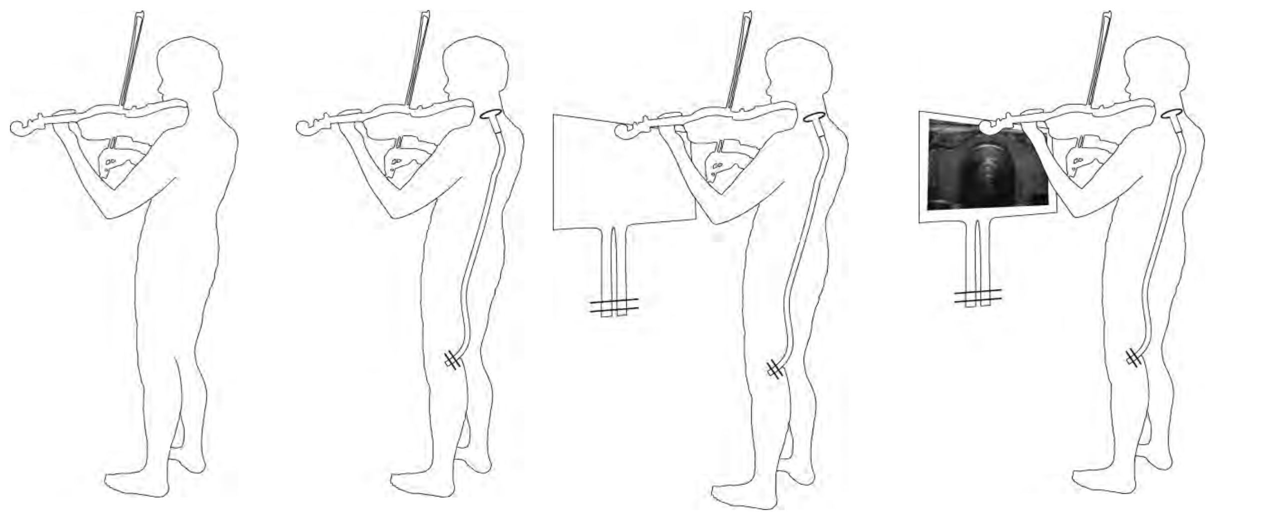

Figure 1 Experimental Design: Discriminating effect of neck feedback from gaze alignment

Tasks were carried out in five experimental conditions designed to separate the effects of gaze alignment and US neck feedback from the effects of wearing the US probe and familiarisation with the US information.
Series A: Normal task performance with no intervention.
Series B: Using the laboratory violin with an US probe attached to the participant's neck.
Series C: Aligning the gaze.
Series D: US familiarization.
Series E: Using US mediated neck feedback.

ABSTRACT

Background

While the function of individual muscles is known, during musical performance individual muscles combine in complex ways that are only partially understood. For reasons of proprioception, neuromuscular organization and proximal-distal synergies, the neck may be hierarchically important to coordination of the whole muscle system.

Aims

We seek to understand the relationship between regulation of neck muscles and control of head, trunk and limbs?

Method

Our approach is to use ultrasound feedback of the neck muscles to minimize neck muscle change during task performance and observe the indirect effect on whole-body coordination.

From a common neutral configuration, twenty-one violinists/violists repeated six progressively demanding tasks including picking up, holding and playing their instrument. Tasks were repeated using neck feedback, and during control series testing for wearing the probe, gaze alignment, and ultrasound familiarization. For the change between initial and sustained playing configuration, we report independent analyses ($p<0.05$) of: Ultrasound (10 segmented neck muscles), Movement (17 joints, 51 rotations), Analogue (skin-conductance, violin-strain-gauge, 15 EMG).

Results

Neck feedback resulted directly in general reductions in anticipatory, transient and sustained neck muscle change while allowing successful, task performance. Gaze alignment had a different, lesser effect on the neck muscles. Neck feedback had an indirect global effect reducing anticipatory, adjustments,

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complex involuntary trunk referenced movement patterns and skin-conductance/EMG cost. This effect is distinct from the effect of gaze alignment which increased physiological cost and reduced laboratory referenced movement.

Conclusions

These results demonstrates a causal relationship between regulation of neck muscles and global control of the head, trunk and limbs. The importance for body function in health and disease is evidence for a feedback loop in which neck muscle behaviour can reflect and regulate global motor function.

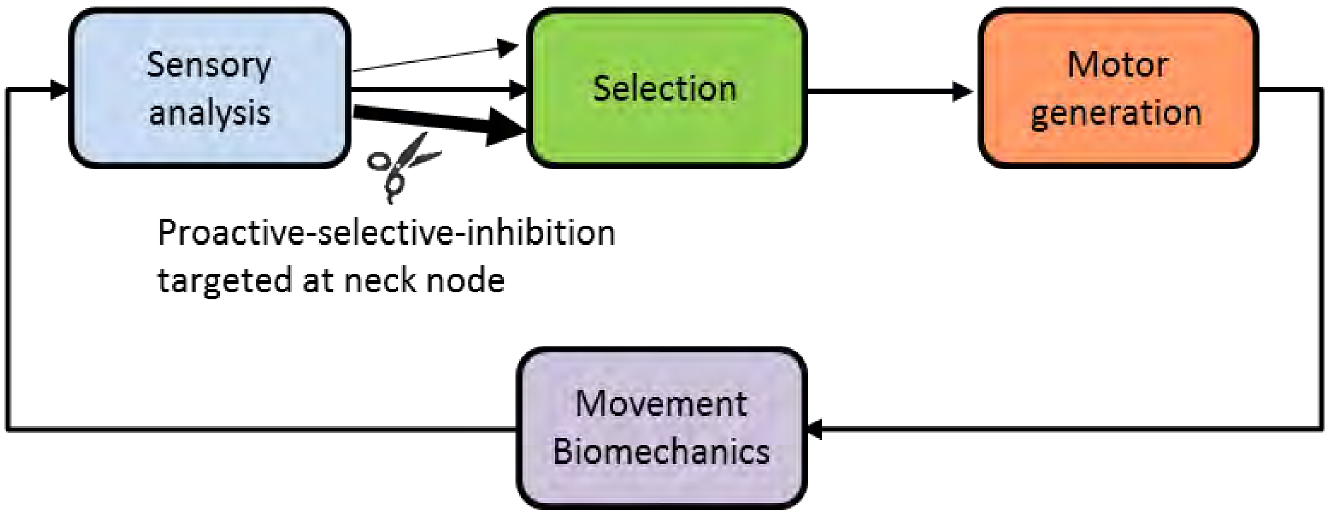

Figure 2 Hypothesis: Targeted inhibition of feedback loop operating on consequences of selection process.

This version of the perception-action cycle shows sensorimotor control operating as a closed loop process selection occurring inside the feedback loop.
Sensory analysis: following integration and association analysis of all internal and external sources, multiple potential responses become potentially active in the frontal cortex (Cisek & Kalaska, 2005).
Selection: motor responses are activated from selected potential inputs. Highly facilitated (automated) potential responses (thicker line) evoke motor responses trans-cortically, bypassing the slow frontal-striatal selection loops. Given sufficient global or specific inhibition slow frontal-striatal loops have time for goal evaluated selection (Yin & Knowlton, 2006).
Motor generation: global output is organized and distributed to generate muscle forces.
Movement biomechanics: interaction between muscle forces and environment produces movement.
The "**scissor**" indicates the effect of proactive-selective-inhibition targeted at the neck muscles to inhibit highly facilitated, automatic, sensory-motor associations.

All processes, sensory analysis, selection, motor generation, movement biomechanics adapt according to their prevailing input and output. Feedback has the potential to amplify and diminish the consequences of selection. Results show that proactive-selective-inhibition of neck muscle can regulate global motor function. The testable hypothesis is that proactive-selective-inhibition of neck muscle can regulate vicious positive feedback leading to pain, injury and performance limitation.

Keywords

Neck, ultrasound, proactive inhibition, performance, vicious cycles, violin playing.

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"Unexpected, innovative, emotional, fascinating, organised": Exploring implicit theories of creativity in music

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ABSTRACT

Background

Musical creativity comprises various forms of making and using music; the result of such musical behaviour (compositions, improvisations, representations) as well as the necessarily corresponding skills and their acquisition are considered theoretically and empirically for conceptualising creativity in music (Hargreaves, Miell & MacDonald, 2012). As an action-oriented construct creativity indicates certain features of persons and products in order to be recognised as 'creative' in a social field. Explicit theories grounded in scientific research suggest novelty and originality being the most important criteria in doing so (Plucker, Beghetto & Dow 2004). Yet, implicit theories of creativity resulting from individual belief systems with high ecological validity may well differ, they have been researched rather rarely so far (Sternberg, 1985; Runco & Bahleda, 1986; Runco, 2011). In defining musical creativity, implicit theories have not yet been taken into account (Lothwesen, 2014). The qualitative approach taken here is a first attempt to make implicit theories of creativity in music visible and comparable to those of other domains.

Aims

This study aims at exploring implicit theories of musical creativity by 1) collecting free associations to different domains, 2) checking their features for domain specific differences, 3) making inherent structures visible (i.e. exploring similarities and differences of domains specific implicit theories).

Method

Following Runco and Bahleda (1986) subjects were open-ended questions asking to list attributes of creativity in science, arts, and everyday life. The study at hand added the domain of music in order to differentiate within the field of arts, and to check for characteristic features of musical creativity. Subjects were also asked to give a self evaluation regarding musical sophistication (Ollen, 2006) and affectivity (Watson et al., 1988); data were collected via online-questionnaire.

The associations collected were analysed by means of content analysis (Mayring, 2003), sorting associations to inductively form categories. The resulting categories were then quantified and checked for nearness using correspondance analysis to reveal the domains' characteristic attributions in a comparative design.

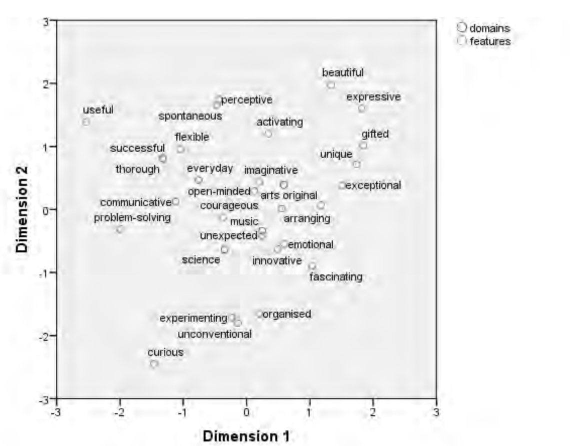
Results

In total 106 persons took part in the survey (61.3% female; AM 29.2 years [SD 11.05, range 12–58]), the majority of subjects considered themselves as musicians at least on an amateur level (55.7%).

1) Content analyses: 686 different attributes given by the subjects were coded, the amount of these codings differs regarding the domains in question. The codings were inductively sorted in categories, and pooled into meta-categories drawing on features discussed and commonly agreed on in creativity research as well as drawing on categories taken from Runco & Bahleda (1986). Following that, 27 categories including subcategories were built inductively (activating, arranging, beautiful, communicative, courageous, curious, emotional, exceptional, expressive, fascinating, flexible, gifted, imaginative, innovative, open-minded, organised, original, perceptive, problem-solving, spontaneous, successful, experimenting, thorough, unconventional, unexpected, unique, useful)

2) Correspondance analysis: To check for nearness of the associations collected in the whole sample a correspondance analysis (row principal normalisation) was conducted. This procedure revealed a solution with two dimensions accounting for 78.6% of inertia with a good fit (singularity for dimension 1: .522, and for dimension 2: .452). The results show clear differences between the domains of science, arts, everyday life, and music regarding the attributed associations (Table 1).

Table 1. Correspondance analysis (row principal normalisation).



The axes of the two dimensional judgmental space are determined by the domains of "everyday" (Dim1) and "science" (Dim2), and the attributes "problem-solving" and "useful"

(Dim1), and "thorough" (Dim2); the domain of "everyday" appears as opponent to "science" on Dim1 resp. "arts" on Dim2. The attributes collected display divergent impacts on the particular domains. Some attributes form clusters supporting proximate domains, e.g. a "science"-cluster "experimenting", "curious", "unconventional", and "organised".

Conclusions

The results presented here display specific associations distinguishing not only artistic domains (arts, music) from others (science, everyday life), but also areas within the field of art itself (arts vs. music). This may point at commonly shared stereotypes of creativity in non-academic contexts, e.g. creativity in science being experimental, creativity in arts being original, exceptional, and expressive. These particular concepts of creativity appear to be related with specific demands of certain domains and can overlap with explicit conceptualisations in creativity research (Bear, 2012; Runco, 2011). The domain of everyday life takes a core role in the data analysed here since it dominates in the judgmental space. It may thus serve as a reference for creative behaviour in other domains.

Regarding the data collected, implicit theories of creativity appear to be domain specific but comparable as a limited amount of features may well represent differences between domains. In this regard, the results from Runco & Bahleda (1986) could be confirmed and even enhanced by adding specific features characterising the domain of music. Applying correspondence analysis enabled to reveal structures of stereotypical associations in a judgemental space.

The analysis is ongoing, the data are to be checked for group differences regarding musical expertise of lay persons and (amateur and professional) musicians. Further research in the field should account for implicit theories in conceptualising domain specific understandings of creative behaviour in music, and check these for potential implications in theoretical conceptualisation and pedagogical approaches in defining and fostering creative behaviour in music.

Keywords

musical creativity, implicit theories, music and aesthetics in everyday life

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Comparison of quality of life of older adult choir singers and the general population in Finland

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ABSTRACT

Background

Recently several papers have been published about the impact of choir singing on choir singers' quality of life (QOL) (Balsnes, 2012; Clift, 2012; Johnson, et al. 2013). The difference between impacts of choir singing versus other cultural activities, such as going to movies, theatre and art exhibitions, is not much studied. Comparison of the impact of choir singing with other cultural activities would give valuable information of the special characters of choir singing.

Aims

The overall aim of the study is to compare quality of life (QOL) of older adult choir singers with culturally active (theater, movies etc.) older adults from the general population in Finland.

Method

To compare the choir sample with older adults (60-93 years of age) from the Finnish general public, we utilized data from a large population study in Finland (HYPA) that included the same quality of life (QOL) questionnaire used with the choir sample and administered by the Finnish National Institute for Health and Welfare (THL). Case control methods were used to match a sample of 109 older adult singers with a sample of 307 older adults from the general population. The choir sample was compared with general population (HYPA) who reported being active or not active/slightly active in other cultural activities.

Results

After controlling for socioeconomic variables, the older choir singers reported significantly higher ratings on the physical QOL, compared with matched older adults from the general population. Choir singers reported also higher QOL (general satisfaction to quality of life and health), compared to general population (HYPA) participating actively in other cultural activities.

Conclusions

The results suggest that singing in a choir as an older adult may promote wellbeing. The case control methods and controlling for socioeconomic variables helped address the concern that the reports of higher QOL in choral singers were driven primarily by their relatively higher socioeconomic status. The comparison between impact of choir singing and other cultural activities suggested that choir singing might have more positive impacts on QOL.

Keywords

Choir, older adults, quality of life, music, health promotion, case control methods, cultural activity.

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Deficits in Melodic Contour Visualization in Individuals with Congenital Amusia

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ABSTRACT

People with congenital amusia have difficulty with melodic contour processing, even when the pitch changes involved exceed their threshold for pitch discrimination. Patel et al. (2005) proposed the "Melodic Contour Deafness Hypothesis", which posits that congenital amusia results from insensitivity to the direction of pitch movement rather than impaired processing of pitch change detection. Given that melodic processing requires both accurate perception of pitch change direction as well as the capacity to represent a succession of contour changes, it is unclear whether impairments in melodic contour processing observed in individuals with congenital amusia occur at a perceptual stage or at a stage of representing a contour pattern in memory. To disentangle these two stages, the present study examined cross-modal mapping using an audio-visual mismatch detection task. Twelve participants with congenital amusia and 12 matched controls were presented with tone sequences (tonal and atonal) and visual contours that corresponded to the melodic contour of the tones (i.e., sequences of dots that vary in spatial height corresponding to pitch changes). Participants were asked to respond as quickly as possible when they detected an audio-visual mismatch. Compared with control participants, amusic individuals made more errors in both tonal and atonal sequences. The finding suggests that individuals with congenital amusia are impaired in perceiving the up-down pattern of a melody. Furthermore, all participants showed a better performance on tonal sequences than atonal ones. In other words, tonal structure facilitated melodic contour processing.

I. INTRODUCTION

Melodic contour, the up-down pattern of intervals within a melody, is a dominant cue for melody recognition (Dowling, 1978; Dowling & Fujitani, 1971; Mikumo, 1992). On hearing a piece of music, people remember little about the absolute pitches or the precise pitch intervals, but are sophisticated at remembering the pattern of upward and downward shifts between notes (i.e., contour processing) (Attneave & Olson, 1971; Dowling, 1978; Dowling & Fujitani, 1971; Edworthy, 1985; Hébert & Peretz, 1997). Evidence suggests that both musical pitch (Connell, Cai, & Holler, 2013; Lidji, Kolinsky, Lochy, & Morais, 2007; Rusconi, Kwan, Giordano, Umilta, & Butterworth, 2006) and melodies (McLachlan, Greco, Toner, & Wilson, 2009; Prince, Schmuckler, & Thompson, 2009) can be represented in a spatial way, where pitch is characterized through a multimodal spatial representation (Marks, 1989; McLachlan & Wilson, 2010). The similarity of melodic and visual contour allows non-musicians to encode the pitch change directions of a short melody as a visual contour. Furthermore, individuals can make fairly accurate drawings of the contours of melodies they have just heard (Davies & Roberts, 1975). Such observations suggest that there are common processes involved in the perception of pitch relationships and spatial relationships in visual space (Mikumo, 1997).

Individuals with congenital amusia, a disorder that impacts one's ability to discriminate musical pitch (Peretz & Hyde, 2003), show impairment in melodic contour processing for both tonal melodies (Gosselin, Jolicoeur, & Peretz, 2009; Tillmann, Schulze, & Foxton, 2009) and atonal sequences (Albouy, Schulze, Caclin, & Tillmann, 2013a), even when pitch changes exceed their pitch change detection thresholds (Foxton, Dean, Gee, Peretz, & Griffiths, 2004). To account for this impairment, Patel and colleagues (2005) proposed the "Melodic Contour Deafness Hypothesis", which holds that congenital amusia is caused by high-level processing deficits, including pitch direction *discrimination* (Liu, Patel, Fourcin, & Stewart, 2010), rather than a low-level impairment in pitch change *detection*.

However, given that efficient melodic contour processing requires both accurate perception of pitch change direction as well as the capacity to represent a succession of contour changes, it is unclear whether melodic contour impairments in congenital amusia occur at a perceptual stage or at a stage of representing a contour pattern in memory. If the deficits were caused by impaired auditory memory rather than a failure in perceiving the up-down pattern, one would expect an unimpaired *real-time* visual-spatial representation for tone sequences in amusics, which would place no burden on memory. However, we predict that their poor melodic contour processing results from an impairment perceiving the up-down pattern of temporal sequences.

To test the "Melodic Contour Deafness Hypothesis", the present study examined two stages of melodic contour processing using a cross-modal mismatch detection paradigm. Our main hypothesis is that the deficit in melodic contour processing observed in congenital amusics arises from abnormal perceiving of up-down patterns within a melody. In other words, individuals with congenital amusia are unable to extract the direction of changes between adjacent notes, and therefore fail to form an accurate representation of melodic contour. This hypothesis is primarily motivated by the observation that amusics exhibit elevated threshold for pitch change direction discrimination but normal threshold for pitch change detection (Liu et al., 2010). Moreover, it has been suggested that the pitch processing and short-term memory deficits observed in amusia can be traced to early brain responses during melodic encoding (Albouy et al., 2013b).

Our second hypothesis is that structural regularities in tone sequences (i.e., tonality) may facilitate performance by amusics on melodic contour tasks, as previous studies have suggested that amusics show intact implicit processing of tonal structure to some degree (Albouy et al., 2013a; Tillmann, Gosselin, Bigand, & Peretz, 2012). Indeed, tonal structure can improve the maintenance of tone sequences in short-term memory for typical (unimpaired) listeners (Schulze, Dowling, & Tillmann, 2012), thereby enhancing melodic contour processing. Thus, we expect that amusics will exhibit better melodic contour processing for tonal sequences than for atonal sequences.

II. METHOD

A. Participants

Twelve participants (5 females), whose composite score was at or lower than 65 out of 90 (less than 73% correct) in three pitch-based subtests (Scale, Contour and Interval) of Montreal Battery of Evaluation of Amusia (MBEA; Peretz, Champod, & Hyde, 2003) were diagnosed as congenital amusics. As shown in Table 1, their performance on all three subtests were significantly worse than the performance of 12 matched control participants (6 females), ps < 0.01, whereas two groups did not differ significantly in age, years of education, years of private music training or hours of music listening daily, ps > 0.05.

To explore the influence of pitch perception on cross-modal matching (e.g., see Jiang, Lim, Wang, & Hamm, 2013), we measured the threshold for pitch discrimination using 3 alternative forced choice (3AFC) and "3-down 1-up" staircase paradigm (Levitt, 1971) implemented in the Psychoacoustic MATLAB toolbox (Soranzo, & Grassi, 2014). In line with previous studies (Foxton et al., 2004; Hyde & Peretz, 2004; Tillmann et al., 2009; Liu et al., 2010), amusics (83.45 ± 98.44 cents) showed elevated pitch threshold when compared with controls (12.04 ± 16.50 cents), p < 0.001. All participants reported no history of auditory, neurological or psychiatric disorders. Written informed consent was obtained from all participants prior to the study. The experimental protocol was approved by the Ethics Committee of Macquarie University.

Table 1. Participants' characteristics and the mean percentage of correct (Mean ± SD) in pitch-based subtests of MBEA. *p<0.001.

	Amusics (n=12)	Controls (n=12)	t-value (two-tailed)
Age	21.05 ± 2.93	23.62 ± 11.27	0.73
Years of Education	14.50 ± 1.69	13.55 ± 1.75	1.30
Years of Musical training	0 ± 0	1.17 ± 2.03	1.99
Hours of music listening daily	2.06 ± 1.79	1.83 ± 1.29	0.35
MBEA (%)			
Scale	0.69 ± 0.11	0.92 ± 0.06	6.50 *
Contour	0.68 ± 0.06	0.82 ± 0.13	3.47 *
Interval	0.63 ± 0.08	0.82 ± 0.08	5.49 *
Composite score	0.67 ± 0.06	0.85 ± 0.04	8.99 *

B. Stimuli

As illustrated in Figure 1, auditory stimuli were 7-note sequences with grand piano timbre, comprising 36 tonal and 36 atonal short melodies. The tonally structured sequences followed the western tonal system and were constructed by using tones from the C major scale (C, D, E, F, G, A, and B), whereas the atonal sequences were constructed using a set of tones that do not belong to any major or minor scale (C, C#, D#, E, F#, A, A#, and B). We measured the tonality of the sequences using the key-finding algorithm (Krumhansl, 1990) implemented in the MIDI MATLAB toolbox (Eerola & Toiviainen, 2004), where the maximum positive correlation provides an indication of the most strongly established key. As expected, the maximum correlation for each tonal sequence was with the C major key, the mean r = 0.81 (ranged from 0.66 to 0.92), ts > 2.77, ps < 0.05, whereas the atonal sequences were not significantly correlated with any key. Two additional auditory stimulus sets were generated by shifting up or down all notes of each sequence by 4 semitones. Thus, there were 108 tonal sequences and 108 atonal sequences.

Visual stimuli consisted of 7 white dots (50 × 50 pixels) that varied in spatial height and that were displayed on a black background and connected by white lines. Each dot represented a single note of the sequence. The first dot was fixed in the left vertical centre of the display, and the rest were presented successively from left to right simultaneously with the presentation of each tone in the sequence. The fourth, fifth or sixth dot of each sequence was manipulated such that the visual contour sometimes conflicted with the corresponding pitch change direction of the melodic sequence. Thus, the stimulus sets were constructed such that melodic and visual contours were either congruent or incongruent with one another. The interval change between the target notes (i.e., the notes with a mismatched visual representation) and its preceding notes were 1, 2, 3, 6, 7 or 8 semitones.

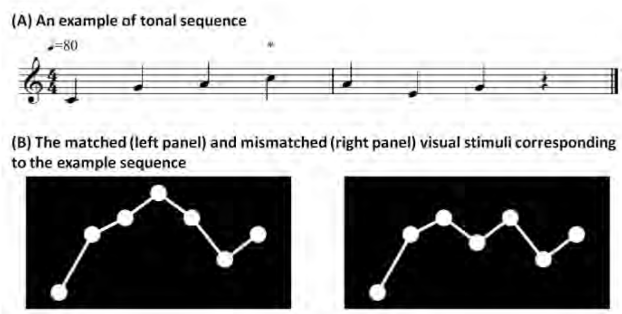

Figure 1. Illustration of the auditory (A) and visual (B) stimuli. * refers to the note that is either congruent (left panel) or incongruent (right panel) with the visual representation. In the incongruent condition, the change in the vertical position of dots is inconsistent with the change in direction of pitches in the accompanying melody.

C. Procedure

Participants were tested in a quiet room and all auditory stimuli were delivered via a noise-cancelling headphone (Sennheiser PXC 350) at a comfortable hearing level. On each trial, a fixation cross appeared on the left vertical centre of the display for 1 s with a 300 ms warning tone, after which the tone sequence and visual representation were presented simultaneously at a tempo of 80 bpm. Participants were required to respond by pressing on the spacebar of a computer keyboard as quickly as possible when they detected an audio-visual mismatch. In the matched trial condition the visual and melodic contours always matched, whereas in the mismatched trial condition a dot in the visual contour went in the opposite direction to the direction implied by the pitch change. Tonal and atonal trials were delivered in separate blocks, and the matched and mismatched trials were scrambled within each block: 36 matched trials and 108 mismatched trials. In other words, 75% of the trials within each block were mismatched trials and the rest were matched trials. Both amusic and control participants participated in both blocks.

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Half of the participants completed the tonal block followed by the atonal block; the other half completed the two blocks in the reverse order. Twelve practice trials were presented before each block. Feedback was provided during the practice trials but not the experimental trials. The experiment was programmed and presented by SuperLab 4.5 (Cedrus Corporation, San Pedro, USA).

III. RESULTS AND DISCUSSION

Performance was evaluated using mean reaction time (RT) on mismatch detection and d-prime (d') (Macmillan & Creelman, 2005). Detection of a mismatch was defined as a "hit" and a key-press response either on a matched trial or before an audio-visual mismatch appeared was defined as a "false-alarm". Repeated-measures ANOVAs were conducted with Tonality as a within-subject factor and Group as a between-subject factor.

As shown in Figure 2 (Panel A), amusics showed reduced sensitivity to the audio-visual mismatch in comparison with controls, as revealed by a significant Group difference on d', $F\ (1, 22) = 6.66$, $p < 0.05$, $\eta^2 = 0.23$. Since participants were required to respond immediately after they detected the mismatch rather than to remember the whole melodic contour in order to compare it with the visual contour, successful performance on the task should not rely on auditory short-term memory. Thus, our finding suggests that the impaired melodic contour processing observed in congenital amusia is most likely to arise from a failure in accurately perceiving the changes in direction within melodies. This deficit could be the root of higher-order deficits in congenital amusia, such as impaired memory for melodies (e.g., Gosselin et al., 2009; Tillmann et al., 2009). Moreover, we found the log-transformed threshold of pitch discrimination significantly correlated with d' and RTs in tonal condition across groups, $r = -0.57$, $p < 0.01$ and $r = 0.44$, $p < 0.05$, respectively, as well as with d' in atonal condition, $r = -0.65$, $p < 0.04$. Such findings suggest that pitch perception plays a role in real-time cross-modal spatial mapping, even though most pitch change intervals in the stimuli exceeded pitch discrimination thresholds.

Nonetheless, rather than claiming that pitch discrimination difficulties in congenital amusia lead directly to impaired auditory memory (Jiang et al., 2013), we argue that pitch perception impacts auditory memory because it leads to an unstable spatial representation of pitch and melody. That is, an elevated pitch threshold reduces the stability of mental representations of pitch and melodies in amusics, which leads to impairments at higher-level processing.

With regard to our second hypothesis, all participants performed better on tonal sequences when compared with atonal ones, as expected, $F\ (1, 22) = 6.38$, $p < 0.05$, $\eta^2 = 0.23$. There was no interaction between Tonality and Group, $F\ (1, 22) = 0.40$, $p = 0.54$, $\eta^2 = 0.02$, suggesting that the facilitation effect of tonality in melodic contour processing and cross-modal mapping is consistent among individuals with or without congenital amusia. This finding further supports the claim that individuals with congenital amusia preserve implicit knowledge of tonal structure (Albouy et al., 2013a; Tillmann et al., 2012).

It should be noted that the group difference on task performance and the tonality effect reported in the present study cannot be explained by a speed-accuracy trade-off, as an analysis of reaction time revealed no significant group difference, $F\ (1, 22) = 1.31$, $p = 0.27$, $\eta^2 = 0.06$, and no main effect of tonality on reaction time, $F\ (1, 22) = 2.54$, $p = 0.13$, $\eta^2 = 0.10$, see Figure 2 (Panel B).

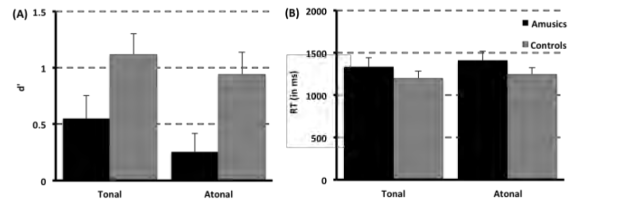

Figure 2. Task performance evaluated by d' (A) and mean reaction time on mismatch detection (B) on both tonal and atonal sequences of two groups.

IV. CONCLUSION

Using a cross-modal mismatch detection task, the present study provides the first evidence that impaired melodic contour processing in congenital amusia may result from the inability to perceive the up-down pattern of intervals within a melody. We also found that tonal structure can facilitate melodic contour processing in individuals with or without congenital amusia. However, it should be highlighted that uni-modal contour processing may differ from cross-modal contour processing. Specifically, melodic contour processing is thought to be holistic (Trehub & Hannon, 2006), whereas the cross-modal contour processing task that we examined required fine-grained processing that may be affected by pitch perception. To fully understand cross-modal contour processing in congenital amusia, further studies are needed.

It has been suggested that sensitivity to contour is not specific to pitch and melody, but can also be observed with patterns in loudness and brightness (McDermott, Lehr, & Oxenham, 2008). Thus, one way to test cross-modal contour processing in amusia is to evaluate visual-spatial representations for other auditory attributes, thereby excluding any potential influences by impaired pitch perception. If amusics show impairments in perceiving contours of loudness and brightness, it would indicate a general deficit in auditory contour encoding.

ACKNOWLEDGMENT

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Ginsborg, J., Lamont, A., Phillips, M., Bramley, S. (Editors)

Comparing perceived emotions while expressing and listening to music

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ABSTRACT

Interviews, questionnaires and also neurophysiological studies support the assumption that music evokes emotions in the listeners. A group of four professional musicians were instructed to be aware of their emotional state while performing the improvisation which was recorded and later played to a sample group. Both, the musicians and the sample of 32 non-professional-musicians listened to the piece. Simultaneously the state of valence and arousal were recorded continuously while listening to the recorded music. The musicians could be separated into two groups (positive or negative in valence or arousal) that each had similar trend curves. This means that some of the musical sequences triggered positive feelings in some subjects and negative feelings in other subjects. The main trends of the musicians were also found in the sample but again a clear distinction between two groups was visible. To interpret these findings, one could question whether a principle of inner-emotional balance in music, which is reflected in the musicians as well as in the mean curve, applies.

I. Introduction

Interviews, questionnaires and also neurophysiological studies support the assumption that music evokes emotions in the listener. Thereby various subcomponents like cognitive or bodily changes are involved (e.g. Juslin & Västfjäll, 2008). Furthermore, findings indicate that the emotion expressed in the music itself correlate with the induced emotions of listeners (Lundqvist et al., 2009) and that different instructions of performance-foci (e.g. expressing a feeling or focusing on expressivity) lead to different auditory results (van Zijl et al., 2014).

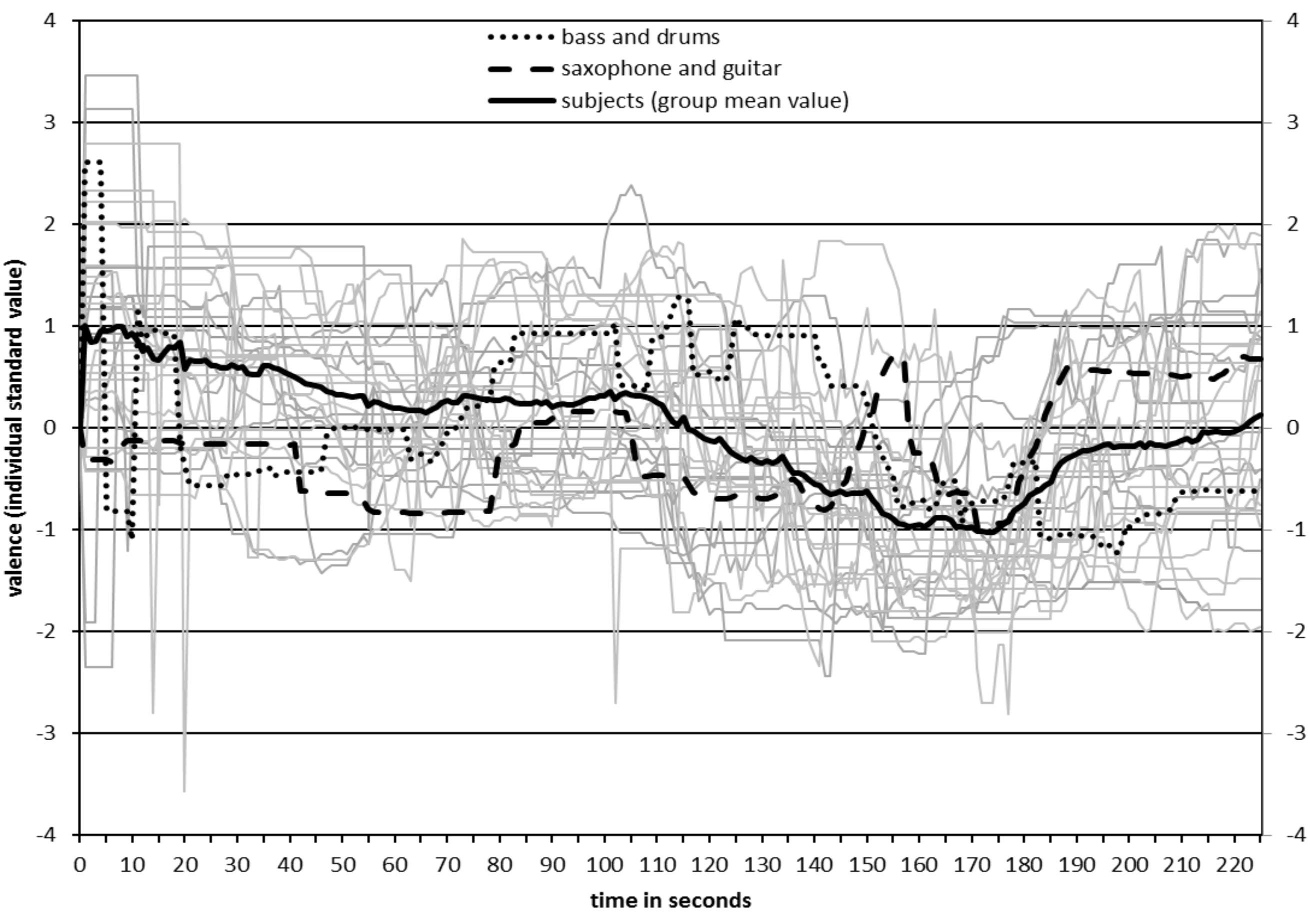

Figure 1: standard scores of valence for the musicians and subjects

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II. AIMS

Within the scope of our study our main goal was to prove the hypothesis that the emotions felt by the musicians during a free-improvisation are transferred to the audience while listening to the music. The choice to let musicians improvise should minimize the probability that reactions to music are predetermined by social and cultural learning processes of the meaning of different musical structures (e.g. major goes along with positive and minor with negative affect). In opposite the free-improvisation should enable the musicians to use the music as a medium to express their genuine emotions.

III. Method

Four professional musicians (baritone-saxophone, bass, guitar, drums), who have a nodding acquaintance with each other, were instructed to improvise freely while being aware of their emotions and integrating them in the improvisation. After warming up a couple of minutes (approx. 4 min) they were instructed to start with the improvisation and the recording was started. They should autonomously end after approximately 3 minutes. Afterwards the musicians got to hear their piece of improvisation individually and were thereby asked to reconstruct their personal experience of valence and arousal by the use of a software, called EmuJoy (Nagel et al., 2007), which continuously recorded their state of valence and arousal. They were instructed to 1. rate their personal feelings and 2. to rate the overall impression of the piece.

They were also assigned to work on several questionnaires. They filled in the PANAS to determine their state of mind before and after the improvisation was played. After completing the EmuJoy-evaluation they filled in the NEO- FFI, self-designed questionnaires, asking for their emotions they had while playing, and the STOMP to get familiar with their fondness and taste of music.

In a second step 32 non-professional-musician subjects had to rate their emotional experience listening to the same recording and filling in the same questionnaires described above. The use of EmuJoy made the experiences of the musicians and the subjects comparable and also relatable to the musical structure or single events. After collecting data we analyzed the EmuJoy-results by turning them into graphical illustrations and time series analysis.

Additionally, the musical compositions were analyzed to get a better insight in the musical structure. In order to compare the outcomes of both the musicians and the listeners we separated the four professional musicians into two groups (bass and drums/guitar and baritone-saxophone) because they showed accordance in their graphics. Furthermore, we used trend

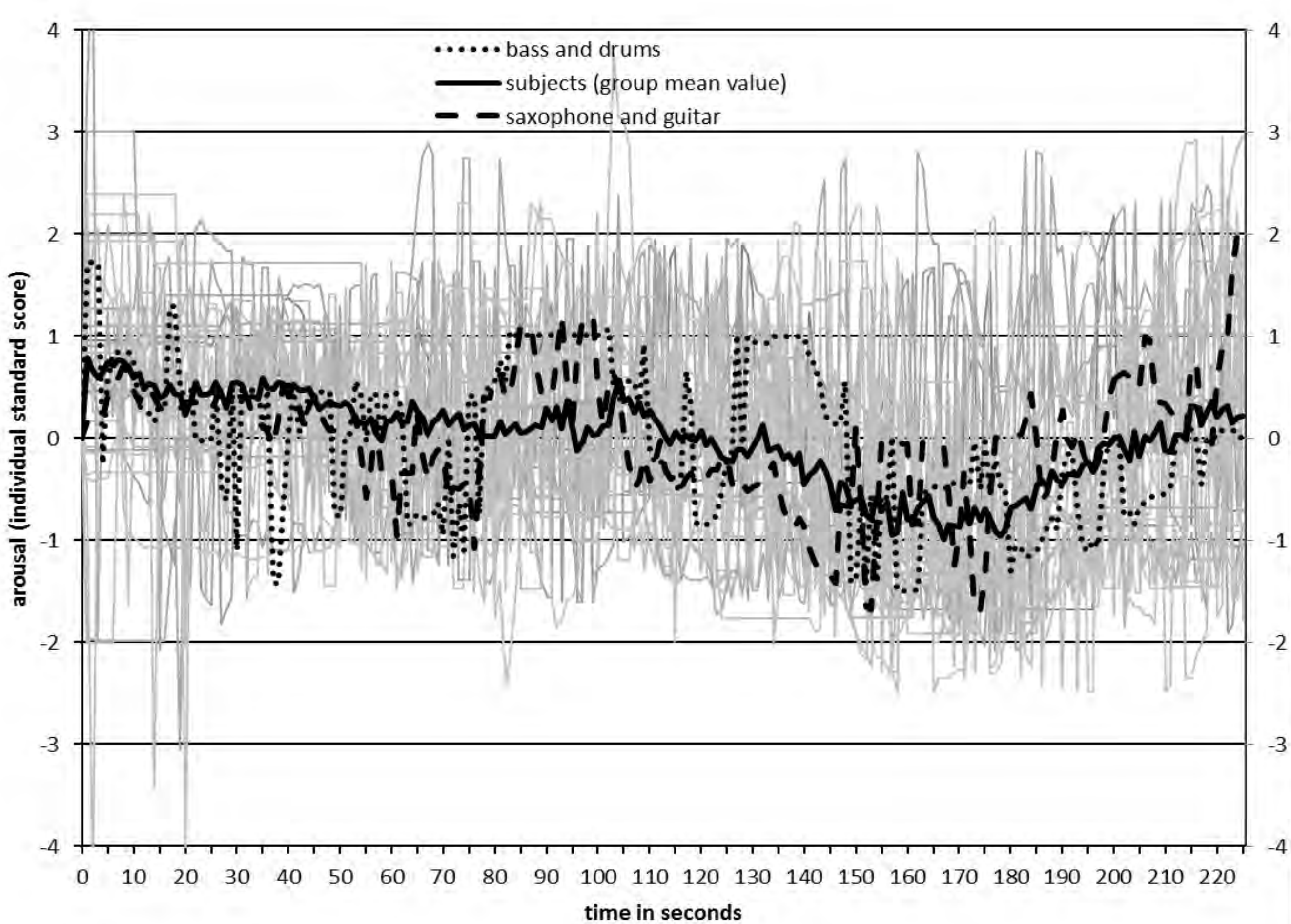

Figure 2: standard scores of arousal for the musicians and subjects

curves to gain a better overview of the general tendencies. Some of the extreme spikes were eliminated to avoid a deformation of the diagrams.

IV. RESULTS

Analyses of the figures show two main trends. There are differences in the perceiving of valence and arousal, hence, there were parts where the curves differed from each other (mainly positive versus negative in arousal/valence). That means that some of the musical sequences triggered positive feelings in some subjects and negative feelings in other subjects. Although the overview seems rather disordered, it is apparent that the two groups of musicians often seem to be opposite to each other ("mirrored-like"), whereas the mean trend curve of the subjects appears to be in the middle of these two curves.

V. Conclusion

In order to interpret these findings, one could question whether a principle of inner-emotional balance in music, which is reflected in the musicians as well as in the mean curve, applies. Further studies and cross-cultural comparisons could investigate in finding an answer of whether the curves of free-improvisation reflect genuine emotions or rather cultural learning processes, including musical clichés.

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Affect from art: Subjective constituents of everyday pleasure of music and pictures. Overview and early results

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ABSTRACT

Research on the affective reactions to music and pictures has increased, but current knowledge on the subjective mechanisms underlying the emotion-related rewards of everyday art engagement is still fragmented across disciplines. The overt focus of the experimental paradigm on the stimulus properties is also becoming outdated in face of the increasingly personalized usage of the digital audiovisual environments. This paper presents a recently launched research project *Affect from Art - Subjective Constituents of Everyday Pleasure of Music and Pictures,* which aims for a better mapping of the relevant individual and contextual features that explain the everyday life affective experiences drawn from music and pictures, in order to provide grounds for multidisciplinary and elaborate investigation of the relevant features. The paper presents the results of the project's first pilot study. The study was executed as a semi-structured online questionnaire (N=109) in order to provide a detailed description of the subjective experience and the engagement features to the music and pictures that the respondents consider significant in their daily life. The preliminary results of the study are presented in this paper, specifically focusing to the questions concerning the subjects' personal affective relation to the object of their choice. The results will be used in further development of the projects' research questions and methods.

I. INTRODUCTION

The pressing questions about the wellbeing-impact of music listening, pictures, and new audiovisual environments to the emotional health of young generation have repeatedly been approached with a traditional strategy of focusing on the stimulus properties. It has been approached, for example, through the genre of music (North & Hargreaves, 2012; Mulder et al, 2007), the properties of visual images (Di Dio & Gallese, 2009), and the content of computer games (Ferguson & Olson, 2014). The experimental paradigm, with a range of subjective, physiological, and neural measures, can afford reliable ways of investigating the affective reactions, but overt focus on the researcher-selected stimulus properties as the explanatory factor (Di Dio & Gallese, 2009) is not responding to the need of understanding the increasingly personalized usage of various digital audiovisual environments. It is also in stark contrast with most theories of art and aesthetics, which embrace the relevance of considering the role of subjective interpretations (Berlyne, 1971; von Bonsdorff 1998; Carroll, 2001; Merleau Ponty, 1945; Mäki-Petäjä, 2014; Saito, 2007; Tuan 1974).

Furthermore, many of the theoretical contributions in art and emotion focus on specific strong experiences (e.g. Gabrielsson, 2001) even though it is the daily, mundane, engagement that encompasses and majorly impacts the everyday life (Clarke et al, 2009; Sloboda, 2009).

Affective reactions to music and pictures are an excellent forum for investigating the everyday subjective engagement factors and their interactions with stimulus properties, because people show high similarity in recognizing the intended emotional content of music (Juslin & Laukka, 2004; Gabrielsson & Lindström, 2010) but great individual differences in their felt responses (Gabrielsson, 2002), based on features such as preference (Istok et al, 2009), personality (Kallinen, 2006; Vuoskoski & Eerola, 2011), emotion regulation style (Miranda et al., 2012; McFerran & Saarikallio, 2013), subjective level of engagement (Greasley & Lamont, 2011), and contextual factors (Randall et al, 2014). Similarly, the affective experiences of pictures emerge as a dialogue between visual material and the experiencing mind in which the individual features are connected to earlier life experiences, cultural background and value systems (Kuuva & Maksimainen 2014; Maksimainen 2011). The relevance of the subjective factors (e.g. familiarity, expertise, attention, intentionality, liking) has also been acknowledged in the context of neural encoding of aesthetic enjoyment (Brattico et al, 2013; Brattico & Pearce, 2013), but, overall, little empirical research on the topic exists and knowledge on the comparative impact of various factors is lacking.

Grounds for creating a comprehensive understanding of the dynamics behind the affective experiences drawn from music and pictures can be drawn from emotion research, and pioneers have successfully implemented theories of basic emotions and affective dimensions to musical expression (Juslin & Laukka, 2004; Gabrielsson & Lindström, 2010), theories from psychology and neuroscience to musical emotion induction (Juslin & Västfjäll, 2008), and theories of general emotion regulation to musical affect regulation (Sloboda & Van Goethem, 2011). However, art-induced subjective affective experiences may not be completely explained by the general emotion theories and may even fundamentally differ from the everyday emotions. Music-induced emtoions have shown to be more positive, aesthetic (Zentner & Scherer, 2008), and self-reflective (Frijda & Sundararajan, 2007), and their regulation be more influenced by positive mood and aesthetic pleasure (Saarikallio, 2008; Van Den Tol & Edwards, 2014) than everyday emotions in general. Furthermore, there is a serious lack of understanding the art-specific features also from the viewpoint of different art forms. In general, it has been proposed that the fundaments of affective processing and communication are inherently a modal (similar across visual, auditory and tactile modalities) and manifest themselves in similar shapes of vitality in various forms of art (Stern, 2010), but there may still be significant differences and art-form specific characteristics, calling for an integrative and comparative scholarly dialogue between music and visual arts.

Based on these notions, in the *Affect from Art* project, we call for a reshaping of the current tradition of investigating emotional responses to music and pictures through a) a better mapping of the relevant individual and contextual features that impact the elements of affective experiences b) a change in focus away from peak and/or aesthetic experiences of particular art objects to the mundane pleasure experiences of everyday life and c) a theoretical integration between the general emotion research and the art-form specific research on music and on visual culture. The results will contribute to the theoretical integration of general emotion theories with art form specific understanding.

II. PROJECT

A. Project objectives

Affect from Art project proposes a subject-driven approach to studying the daily experiences of pleasure and enjoyment drawn from music and pictures. The main objective of the project is *to map the key subjective constituents of the everyday pleasure experiences of music and pictures.* The project addresses three research questions:

- What is the nature of the daily pleasure experiences drawn from music and visual stimuli?
- How are these pleasure experiences explained by the engagement features, i.e. aspects of the individual and the context?
- What are the common versus modality-specific characteristics of the engagement?

The project primarily aims at theory development of the above mentioned features through creating comprehensive, integrative, and rigorously tested models of how subjective-contextual factors explain and predict the affective impact of music and visual images in everyday life. The models will particularly explain how the *engagement features* (reasons for engagement, values, moods, memories, levels of embodiment, emotion regulation/induction mechanisms, contextual and situational factors) interact with each other (and with *object features* such as symmetry or consonance) to impact the *experience* features of subjective pleasure, arousal, and aesthetic enjoyment. All this will be approached from the particular viewpoint of elaborating the common versus art-form specific characteristics of music and visual images in order to provide grounds for comparative and complementary perspectives. In addition to the theory development, the project engages in developing the measurement of the key concepts by introducing novel technologies and methodologies from cognitive science, neuropsychology, and psychometrics to research on music and visual culture.

B. Current state

The project begun in January 2015 with a literature review and a preliminary questionnaire study, which are currently taking place during the first half of 2015. The current paper describes the results of this preliminary questionnaire study. The questionnaire data was collected through the first quarter of 2015 through a semi-structured online questionnaire that was designed to compile detailed information of the respondents' subjective emotional experiences, specifically the experiences of pleasure, and the engagement features related to the musical piece or visual object of their choice. Based on the results of this preliminary questionnaire, the results of a simultaneously conducted literature review, and the related development of a novel web-based mixed-method data collection interface, a large-scale international data collection will be conducted during the latter half of 2015. This international data collection is planned to take place in Finland, in United States, and in Japan.

III. STUDY

C. Study objectives

The current study piloted questions that will be included in the main study to be conducted in the latter half of 2015. The questionnaire was exploratory on nature and investigated the emotions that the individuals relate to musical pieces, pictures, and visual environments in their everyday life. The focus was placed upon the subject's personal relation to the object of their choice. The study was designed in line with the general project objectives aiming to describe the nature of the experiences and their affective characteristics, in order to provide grounds for a more detailed investigation of interconnections between features and comparison between music and picture/visual environments.

D. Method

Data collection was executed during three weeks time period in first quarter of 2015. The online questionnaire was delivered to potential participants through social media (Facebook), and three mailing lists of the student associations of the University of Jyvaskyla. Volunteering participants answered the questions online, using as much of time they wanted. The questionnaire consisted of three separate pages and the estimated answering time was 15minutes. Confidentiality and anonymity was stressed to the subjects. They were not given any incentives.

The respondents were first instructed to select one object that could be a) a musical piece, b) a particular visual object (e.g. picture or artifact), or c) a wider visual environment that could be urban or other constructed environment, natural or digital environment (e.g. gaming environment, particular web site or application). Respondents were instructed to choose an object that they considered to induce pleasure and be meaningful in their daily life. They then answered to the rest of the questions considering the chosen object.

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E. Participants

The primary interest was on young adults, but respondents in all age groups were encouraged to fill the questionnaire. As the study was a pilot, and not aimed at comparing individual differences, the demographic questions were limited to define respondents' gender and age. It was also asked whether the respondents had professional training or other affiliations, like hobbies in the fields of music, visual arts or other visual field.

The sample (N=109) mostly represented young adults. Age of the participants ranged from 18 to 64. The gender distribution within the sample was 84 females (77%) and 25 males (23%).

The mean age of male respondents (N=25) was 30 years. Within female respondents (N=84) the mean age was 28 years. Median count was 25.0 within both genders. The sample consists mostly of students at the University of Jyvaskyla.

4% of the respondents reported that they had professional education in music, while 24% respondents reported to hold professional training in the field of visual culture and/or arts. 61% of the participants informed to have hobbies or practice other interests related to visual culture and/or arts. 52% of the respondents had such involvement with music.

F. Measures

The questionnaire was designed to measure such emotions and conceptions that the respondents related to the object they had chosen. Except two non-obligatory open questions, other questions were obligatory structured questions, for which a seven-point answering scale was applied.

In the first set of questions the respondents were asked to evaluate the strength of the emotions related to the object through 53 emotion terms. The selection of terms was influenced by a variety of research traditions and approaches in art-related emotion research (e.g. Juslin & Laukka, 2004; Zentner & Scherer, 2008), but the aim was not to strictly conform to any particular pre-identified model. Instead, the aim was to provide a novel, data-driven, and interdisciplinary basis for conceptualizing and measuring this phenomenon. For this paper, the emotion terms were translated from Finnish to English using back-translation.

This paper focuses on the abovementioned set of questions targeting the emotion terms. In addition, the questionnaire contained two other sections. The second set of questions focused specifically on measuring the experience of pleasure based on Lionel Tiger's (1992) model about the motivational basis of pleasure. In Tiger's *Four Pleasure model*, pleasure is divided into physio-, psycho-, socio- and ideo-pleasure, and approached through its' role in evolution and survival. The third set of questions used the semantic differential (SD) method to measure the meanings attached to the object. The method (e.g. Osgood et al., 1975) is updated by D.R. Heise in *Surveying Cultures* (2010) with attention in measurement in cases where graphic scales are used, and more recently by Verhagen et al. (2014) with attention for semantic bipolarity testing and manifesting semantic differential dimensionality. The respondents were asked to evaluate the features of the object with seven-point scale within 32 adjective pairs. Adjectives were formulated to be applicable to both musical and visual objects. The paired adjectives are not strictly opposite to each other. Instead, they were selected to capture different aspects of the object's particular feature.

In addition to these three question sets, the survey contained questions about the self-perceived importance of musical and visual environments as the sources of pleasure in the respondent's daily life. This was answered with a 7-point scale ranging from *not at all important* to *highly important*. In addition, open questions concerning the contradictory feelings and personal meanings of the object were asked.

IV. RESULTS

In this chapter some general features concerning the respondents' emotional relation to the object (musical piece, visual object or visual environment) are presented.

G. Object selection

The distribution of the object selection showed small emphasis towards visual rather than musical objects: Visual object was selected by 13% (N=14), and visual environment by 42% (N=46) of respondents, while musical piece was selected by 45% (N=49) of respondents.

The selected visual object was typically an image, utensil or art object. Particular home environment (N=12) was most commonly selected as the singular visual environment. However, different nature environments were selected by 20% of the participants (N=22). Within the music genre options, rock (N=9), alternative/indie (N=9), and pop (N=7) genres were most often selected singular genres, while 13% (N=14) of the respondents had chosen the option 'something else'.

H. Emotions (general)

Respondents were asked to evaluate the strength of the 53 particular emotions induced by the object they selected. Table 1 shows the mean values and standard deviations of each emotion. Emotion terms are listed in the same order as they were in the questionnaire.

Table 1. Mean values and Std. deviation for emotions related to the object.

Emotion	Mean	Std. Deviation
2.1 Cheerfulness	**5.51**	1.32
2.2 Positivity	**5.63**	1.39
2.3 Joy	**5.53**	1.44
2.4 Enthusiasm	**5.22**	1.43
2.5 Easygoingness	**5.57**	1.46
2.6 Enjoyment	**5.93**	1.26
2.7 Warmth	**5.13**	1.47
2.8 Acceptability	4.80	1.83
2.9 Rebelliousness	2.88	**2.17**

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2.10 Nostalgia	4.25	**2.16**
2.11 Yearning	3.49	**2.02**
2.12 Feeling blue	4.05	**2.06**
2.13 Tenderness	3.89	1.82
2.14 Security	4.66	1.59
2.15 Anxiety	1.76	1.26
2.16 Carefreeness	4.43	1.73
2.17 Freedom	**5.40**	1.53
2.18 Melancholy	3.08	**2.00**
2.19 Relaxation	**5.34**	1.55
2.20 Communality	3.43	**2.02**
2.21 Privacy	4.26	1.97
2.22 Emotionally moving	4.33	1.96
2.23 Sexiness	2.18	1.50
2.24 Sublime	3.47	**2.11**
2.25 Strength	4.97	1.82
2.26 Elation	4.62	1.66
2.27 Hilarity	3.51	1.83
2.28 Aggression	1.74	1.46
2.29 Rage	1.55	1.21
2.30 Agony	1.87	1.50
2.31 Sensitivity	4.64	1.83
2.32 Hatred	1.48	1.09
2.33 Calmness	**5.06**	1.67
2.34 Curiosity	3.94	1.85
2.25 Energetic	4.62	1.68
2.36 Happiness	**5.73**	1.25
2.37 Anger	1.45	1.11
2.38 Gloominess	2.01	1.40
2.39 Tranquility	**5.13**	1.63
2.40 Sorrow	2.14	1.51
2.41 Empathy	3.79	1.81
2.42 Exuberance	4.12	1.57
2.43 Suffering	1.85	1.45
2.44 Unconstrained	**5.43**	1.44
2.45 Cynicism	1.64	1.18
2.46 Agreeableness	**5.24**	1.52
2.47 Empowerment	**5.77**	1.35
2.48 Love	**5.10**	1.74
2.49 Toughness	2.38	1.68
2.50 Sensuality	4.75	1.75
2.51 Dejection	2.38	1.75
2.52 Amazement	3.40	**2.03**
2.53 Spirituality	3.93	**2.08**
Valid N	109	109

The results show that the most intensively experienced emotions induced by the everyday objects were enjoyment (M=5.9), empowerment (M=5.8), happiness (M=5.7), positivity (M=5.6), easygoingness (M=5.6), relaxation (M=5.6), joy (M=5.5), and cheerfulness (M=5.5). Also the terms unconstrained (M=5.4), freedom (M=5.4), relaxation (M=5.3), enthusiasm (M=5.2), agreeableness (M=5.2), warmth (M=5.1), love (M=5.1), tranquility (M=5.1), and calmness (M=5) were rated high.

Strongly negative or aggressive emotions, like rage, agony, anger, and gloominess gained low scores, which was expected as the study focused on objects that the participants found pleasurable in their daily life. However, there was a minor group of participants who actually did give high ratings also for the abovementioned negative emotions, indicating that, in some cases, these emotions relate to something that makes these objects meaningful for these participants.

The standard deviation values indicate that the ratings were most dispersed for rebelliousness, nostalgia, yearning, feeling blue, melancholy, communality, amazement, and spirituality (S.D > 2).

One interesting feature of the emotions induced by an everyday object is the experience of privacy. According to results, the respondents' relation to the object is clearly more private than communal in its nature. Though, for both terms, the S.D. values were high, the ratings were high for privacy in all cases, while they were placed low and in the middle of the scale for communality.

Another interesting distinction was found for emotions that could be conceived sexual or somewhat sexually charged. These were studied through the terms of sexiness and sensual. Distinctively, sexiness was rated low (M=2.2), while sensuality was evaluated relatively high (M=4.8) for the chosen everyday object. This may be explained by the fact that the concept *sensuality* can hold a variety of different meanings and interpretations including both sexual and non-sexual contents.

I. Object-Specific Features

As regards the abovementioned list of different emotions, the five highest-rated emotions related to musical piece were enjoyment (M=5.8), empowerment (M=5.7), strength (M=5.4), happiness (M=5.4), and love (M=5.4). For visual object, they were positivity (M=6.3), joy (M=6), cheerfulness (6.1), enjoyment (M=6), and empowerment (M=5.7). When visual

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environment was selected as the object, the five most highly rated emotions were easygoingness (M=6.1), enjoyment (M=6.1), happiness (M=6.1), positivity (M=6.1), and relaxation (M=6).

Strongly negative emotion concepts, anger, hatred, rage, cynicism, aggression, and suffering were rated the lowest within all object types. Lowest mean ratings for the negative emotions appeared when a visual object was selected. The mean ratings were also relatively low (and similar to each other) in musical pieces and visual environments.

Respondents were also asked to evaluate the general level of strength of the emotions attached to the object. Within the sample the self-evaluations varied from 4 to 7 mainly falling between 6-7 in the scale of 1-7 (M=5.9, (S.D. .85), indicating a generally high strength of emotional experience.

Table 2. Strength of emotions by object type

Case summaries	Mean	S.D
Musical piece	**5.98**	.78
Visual object	**5.64**	1.08
Visual environment	**5.80**	.86
Total	**5.86**	.85

Table 2 shows the mean values of the strength of emotions ratings for the chosen object by the different object types. The mean value of the strength of emotions was slightly higher for the musical piece than for the other groups, but the difference between the specific object types was not statistically significant (F (2,106) = 1.06; ns). Generally the strength of emotions was evaluated strong or very strong for all object types.

Table 3. Ambivalent emotions by object type

Case summaries	Mean	S.D
Musical piece	**3.71**	2.16
Visual environment	**2.91**	1.76
Visual object	**1.71**	.99
Total	**3.12**	1.98

Respondents were also asked if the object induced ambivalent emotions in them. These ratings were generally relatively low. However, a clear distinction between the object types was found (Table 3). Ambivalent emotions were most commonly experienced in relation to musical piece (M=3.7), much less commonly in relation to visual environment (M=2.9), and even less commonly in relation to the visual objects. The difference between the object types was found to be statistically significant (F (2,106) = 6.61; $p \leq .01$). Post-hoc comparisons showed that the means of each of the object type differed significantly from each other (musical piece and visual object: mean difference 2.00; $p \leq .001$; musical piece and visual environment: mean difference .80; $p \leq .05$; visual object and visual environment: mean difference 1.20; $p \leq .05$).

J. Role of Musical and Visual Environments

Finally, the respondents were asked to evaluate the role of musical and visual environments as the sources of pleasure in their daily life by using a 7-point scale (1=*not at all important* to 7=*highly important*). Both questions were obligatory for all respondents regardless of their object choice.

Table 4. Importance of musical and visual environments

Case summaries	Mean	S.D
Musical environment	**6.02**	1.21
Visual environment	**6.26**	.91

Overall, the role of both types of environments was evaluated to be very important as a source of daily pleasure (Table 4). The mean score was actually higher for the visual environment than for the musical environment. However, the difference between the visual and musical environments did not quite reach significance (t (108) = 1.70; $p = .09$).

V. CONCLUSION

The current study investigated two things. Firstly, we explored the variety and strength of emotions that were characteristically induced by everyday objects. Secondly, we conduct a preliminary comparison of the emotion-related characteristics by object types. The study specifically focused on objects that people personally considered pleasure inducing and meaningful in their daily life.

In many ways, the sample appeared somewhat alike across the object types. Not depending on the object type, the strength of the experienced emotions was generally considered strong, with no significant difference between the object types. The importance of both musical and visual environments was also evaluated to hold high significance as a source of daily pleasure. As regards the highest ratings given to the particular emotion terms among the whole sample, *enjoyment* was the most strongly experienced emotion. It was also among the five most highly rated emotion terms in each of the object type. The lists of the particular (negative) emotion terms that received the lowest ratings were also similar among the object types.

Some domain-specific characteristics were, however, also observed. Emotional terms conveying connotations of power, like empowerment and strength, were typically attached to music, whereas conceptions of relaxation and easygoingness were more typically experienced in relation to visual environments. In addition, the ambivalent emotions appeared significantly more typical for music than for visual objects and visual environments. It may be that people hold higher tolerance for experiencing ambivalent emotions concerning music. Also, music as an object type may itself partly explain the phenomenon, as it holds great potential for denoting ambivalent emotions explicitly. It's also possible that people (consciously or not) tend to seek different types of emotions from different object types.

Overall, the result indicate respondents' tendency to consciously orientate, select, or construct their daily visual and musical environments that sets up distinctly positive emotions. According to the results, the emotional experiences induced by everyday objects are also characteristically more private than communal in nature.

The current study was able to identify some interesting characteristics, even from the comparative perspective between the musical and visual domains. However, it also pointed towards a need for a more extensive data set for achieving more reliable results, particularly regarding the subtle differences. We also wish to point out the need for comparative data from contrasting cultures in order to examine the culture specific features of the emotions induced by everyday objects. A full-fledged theoretical elaboration of the results can't be presented, as the main purpose of the study was only to pilot questions and measures for the further steps to be taken during the *Affect from Art* –project. However, already as such, the findings provide grounds for interesting new perspectives for interdisciplinary dialogue.

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The cognitive representation of recursive processes in music

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ABSTRACT

Background

The human ability to process hierarchical structures has been a longstanding research topic. However, the nature of the cognitive machinery underlying this faculty remains controversial. Recursion, the ability to embed structures within structures of the same kind, has been proposed as a key component of our ability to parse and generate complex hierarchies (Hauser, Chomsky, & Fitch, 2002). Recently, we devised an empirical paradigm, based on the properties of fractal geometry, which can be used to test for the ability to represent visual recursion (Martins & Fitch, 2012), and to contrast it with simple iterative processes.

Aims

Here, we extended the visual recursion paradigm to the musical domain, with the aim of investigating the cognitive representation of both recursive and iterative auditory structures.

Method

The experiment used a two-alternative forced-choice (2AFC) paradigm: participants were exposed to four-step processes in which pure-tone auditory sequences were built either through recursive or iterative processes, and had to choose the correct completion. Foils were constructed according to generative processes that did not match the previous steps.

Results

A significant proportion of participants (20 out of 30, binomial test: 67%, $p < 0.05$) without musical training scored above chance ($M = 71\%$, $SD = 18\%$). Musicians ($n = 18$) scored significantly higher than non-musicians ($M = 85\%$, $SD = 20\%$, t-test: $t = 2.5$, $p = 0.017$), suggesting that musical training facilitates the representation of auditory recursive processes. Crucially, participants' performance followed a typical learning curve and was consistent across different foil categories, suggesting that they acquired an abstract rule to solve the task instead of using simple heuristics. Further experiments showed significant correlations between accuracy rates on recursive structures and performance on the Tower of Hanoi, a recursion-based game.

Conclusions

As with visual recursive structures, humans are able to represent auditory recursive structures, although only musically-trained participants achieved accuracy rates comparable to those observed in the general population with visual recursion processes.

Keywords

Hierarchy, recursion, fractals

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Promoting health in music education: Better practice

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ABSTRACT

The physical and psychological demands of the training and practice that musicians must achieve to perform to a high standard on their instruments can produce deleterious effects on health and wellbeing, arising mostly from musculoskeletal and neurological causes. The available evidence on promoting musicians' health has been reviewed. Musical Impact, an AHRC-funded research project involving all nine UK conservatoires (2013-2017) seeks to enhance the health and wellbeing of musicians in Britain. Better Practice, one of three sub-projects, asks 1) What can be learned from existing approaches to promoting musicians' health? 2) How can such approaches be adapted, applied and evaluated across educational and professional contexts in the UK and internationally? Given the complexity and context specificity of the interventions and programmes, a realist synthesis approach was applied. Published full-text quantitative and qualitative studies in English were included. Databases were searched for interventions and health programmes targeting musculoskeletal and music performance anxiety issues among musicians. Quality and validity are enhanced by continuous discussion among the reviewers. Few taught courses on health and wellbeing have been evaluated systematically. Zander et al. (2010), using pre-post, longitudinal testing of one programme in Germany, reported a stabilising effect on psychological health, but no effect on physical symptoms. Purpose-designed interventions based on endurance exercises reduced levels of perceived exertion, pain and fatigue (Kava et al., 2010). Current approaches vary widely and present substantial methodological flaws. This project is intended to inform the development and implementation of a new evidence-based programme for promoting health, behaviour change and managing ill-health in musicians.

I. INTRODUCTION

According to the ICSOM survey conducted among more than 2,000 respondents, 76% of American orchestral players reported at least one medical condition that affected their performances while 36% mentioned they suffered from up to four independent problems. Problems of the lower back, neck, shoulder and upper back were the most prevalent. In addition, a quarter suffered from stage fright (Fishbein, Middlestadt, Ottati, Straus, & Ellis, 1988). Prevalence and incidence of playing-related musculoskeletal disorders of musicians range widely between 26% and 93% (Bragge, Bialocerkowski, & McMeeken, 2006; Zaza, 1997; de Souza Moraes & Antunes, 2012; Ackermann, Kenny, O'Brien & Driscoll, 2014; Leaver Harris & Palmer, 2011). Up to 87% of college music students reported having experienced playing-related injuries at some point in their lives (Guptill, Zaza & Paul, 2000) while 25% of music students in Freiburg said they already had playing-related symptoms in their first academic semester (Spahn, Strukely & Lehmann, 2004). Risk factors include excessive repetition, awkward postures and heavy lifting (da Costa & Vieira, 2010). Moreover, younger musicians (<30 years) tend to be significantly more anxious than older musicians (51+) (Kenny, Driscoll & Ackermann, 2012). Students of music performance from two major UK conservatoires seemed to neglect health responsibility and showed lower scores for physical activity and stress management compared to interpersonal relations and spiritual growth (measured using subscales of the Health-Promoting Lifestyle Profile (HPLPII) as well as the Positive-and-Negative Affect-Schedule (PANAS) scales) (Kreutz, Ginsborg & Williamon, 2008). Considering some performance injuries are preventable, performing arts medicine specialists and musicians have been encouraged to make inter-disciplinary efforts to facilitate the development of conservatoire-based health programs (Manchester, 2006). Health education aimed at teachers has also been proposed since music students are inclined to approach their instrumental teachers for health related advice before consulting relevant medical professionals (Williamon & Thompson, 2006). An array of complex health courses have been implemented in a few music institutions (Manchester, 2007a, 2007b, 2007c) and some specific preventative interventions have been conducted among music students and professionals. Such endeavours are certainly in line with the consensus-based recommendations suggested by the authors of a report on the Health Promotion in Schools of Music (HPSM) project. These are that the promotion of health and prevention among music students should incorporate: a holistic approach supporting wellness and encouraging personal responsibility; the assimilation of the idea of prevention within the values and beliefs of music schools; and preparing teachers and educators to be more health-conscious (Chesky, Dawson & Manchester, 2006). We reviewed the current approaches and concluded that most conservatoire-based courses have not been evaluated systematically while other intervention studies reveal considerable methodological flaws.

Musical Impact, an AHRC-funded research project involving all nine UK conservatoires (2013-2017) seeks to enhance the health and wellbeing of musicians in Britain and has emerged as a proposed solution to musicians' current needs. Better Practice, one of three sub-projects, asks 1) What can be learned from existing educational and professional approaches to promoting musicians' health? 2) How can such approaches be adapted, applied and evaluated across educational and professional contexts in the UK and internationally, from the earliest years of study into the profession? While the present project is in its infancy, this paper attempts to describe the main findings and limitations of the available evidence, based on the specific interventions and more general health promotion courses among music students and professionals that have been evaluated to date. In addition, it suggests some pathways with the potential to be considered for further work.

The present review was based on a realist synthesis approach. Unlike traditional systematic review methods, which are very specific and focus mainly on whether interventions work or not, the realist synthesis approach starts from the premise that an intervention does not work *per se,* and thus aims to unpack the mechanisms by which it works and its facilitating context; it offers an explanation and not necessarily a judgement (Durham & Bains, 2015). The approach can be summarized as an attempt to answer 'what is it about this kind of intervention that works, for whom, in what circumstances, in what respects and why?' (Pawson, Greenhalgh, Harvey & Walshe, 2004). Realist synthesis is an interpretive approach that can be applied to qualitative, quantitative and mixed-methods research. It is particularly relevant for assessing complex health implementation interventions and the context specificity in which these occur (Rycroft-Malone et al., 2012). The research question was formulated according to the four elements that make up PICO (population, patient groups studied; intervention, treatment, test, or exposure for the population; comparison, alternative intervention or control; and outcome, intervention results (Wright, Brand, Dunn & Spindler, 2007). The objectives of the current review were to examine 1) health promotion courses among music students/musicians/music teachers and 2) specific, non-pharmacological interventions on music performance anxiety (MPA) and performance-related musculoskeletal disorders (PRMDs) among music students/musicians. The first stage of concept mining was conducted via 'digging through' the literature and identifying keywords, relevant concepts and explanatory theories. It was modelled after a series of questions developed by Rycroft-Malone et al. (2012): 1) What is the impact of the various characteristics of the intervention? 2) What is the overall impact of the intervention? 3) What is the impact of the interaction between the intervention and the specific context in which it is employed? Next, a preliminary computerized search was conducted on MEDLINE, Embase, and PsychINFO using a purposive list of keywords and their truncations such as: musician ('musician*', 'music student*', 'music major*', 'orchestral play*'), MPA ('music-related performance anxiety'), PRMDs ('musculoskeletal disorder*', 'injury prevention', 'pain', 'exert*', 'fatigue'), 'health promotion', 'prevent*' and 'intervention or study or trial or program or course'. The search was limited for studies published in the last 20 years (1995-2015). Full-text papers were retrieved and evaluated for related terms. Relevant search terms were also drawn from similar reviews. Terms were searched in titles, abstracts and keywords, they were combined using the Boolean operators 'OR' and 'NOT' and search strings were linked using 'AND'. A manual search of the reference lists of the papers included was also conducted. The screening was intentionally inclusive so that all relevant articles could be captured. Studies were considered eligible if: written in English to ensure that they could be adequately evaluated and reviewed; they included samples made up of music students, music teachers and/or professionals as well as both females and males; samples were from non-disordered populations and apparently healthy; they were quantitative and/or qualitative; the full text was available; they included any intervention designs (pre-post, quasi-experimental, controlled or randomized); they looked at objective and/or self-reported measurements as primary and/or secondary outcomes. Studies were excluded if: they could not be accessed through the London University Research Libraries Services, or the libraries of Manchester Metropolitan University or the Royal Northern College of Music; they were not published in peer-reviewed journals. In terms of MPA assessment, papers were excluded if they used psychological tests such as the Spielberger State/Trait Anxiety Inventory (STAI) on their own, without specifically measuring MPA, considering the two measurements might be quantifying different phenomena (Kenny, 2004). Consistent with Pawson's suggestions, quality appraisal was conducted based on the following question (Rycroft-Malone et al., 2012): 'is the evidence good and relevant enough?'

Retrieved papers included six health courses conducted in the USA (Indianapolis), Spain, Taiwan, Switzerland and Germany (Barton & Feinberg, 2008; Lopez & Martinez, 2013; Su et al., 2012; Hildebrandt & Nubling, 2004; Spahn, Hildebrandt & Seidenglanz, 2001; Zander, Voltmer & Spahn, 2010); seven interventions aimed at reducing PRMDs, fatigue, pain or exertion and conducted in Australia, the USA (Florida), Australia and the Netherlands (Ackermann, Adams & Marshall, 2012; Lee, Carey, Dubey, & Matz, 2012; Kava, Larson, Stiller & Maher, 2010; Brandfonbrener, 1997; Chan, Driscoll & Ackermann, 2012, 2014; de Greef, van Wijck, Reynders, Toussaint & Hesseling, 2003); eight interventions aimed at reducing MPA and run in the USA (Boston, New York), Canada and Australia (Chang, Midlarski & Lin, 2003; Kim, 2008; Esplen & Hodnett, 1999; Osborne, Greene & Immel, 2014; Braden, Osborne & Wilson, 2015; Stern, Khalsa & Hofmann, 2012; Lin, Chang, Zemon & Midlarsky, 2008; Wells, Outhred, Heathers, Quintana & Kemp, 2012); and three studies conducted in the USA (Massachusetts) that looked at both PRMDs and MPA (Khalsa, Shorter, Cope, Wyshak & Sklar, 2009; Khalsa & Cope, 2006; Khalsa, Butzer, Shorter, Reinhardt & Cope, 2013). Participant characteristics included wide ranges across the above-mentioned studies in terms of age (from 13 to 67 years), type of musician (professionals, music teachers, orchestral players, conservatoire students as well as teenage musicians; all instruments and singers included). Sample sizes ranged from 15 to 167 in all interventions and from 15 to 247 in the course-based studies. In terms of length, interventions ranged from a one-off session to one year (the majority ranging between six and 12 weeks) while courses varied between eight weeks to one semester and one year respectively. One of them was a longitudinal study (Zander et al., 2010). Most studies used a pre-post and repeated measurement designs respectively.

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Only four studies incorporated objective measurements (i.e. endurance via a Cybex dynamometer and time measurement; heart rate variability via the Polar RS800CX watch and chest-strap; finger temperature as an MPA measurement) that added to the reliability of their findings. Self-report measures for MPA included the Performance Anxiety Inventory (PAI), the Performance Anxiety Questionnaire (PAQ), the Music Performance Anxiety Inventory for Adolescents (MPAI-A) and the Music Performance Anxiety Questionnaire (MPAQ). Self-report measures for PRMD included the Performance-Related Musculoskeletal Disorders (PRMD) Questionnaire, the Health-Pain-Injury Inventory (HPI), the Performance Skills Inventory (PSI), Physical Competence Scale (PCS) and the Giessen Symptom Questionnaire (GBB). All interventions were focused on measuring PRMDs or MPA as primary or secondary outcomes, while courses looked at a variety of outcomes including psychological and physical health, overall knowledge of prevention and health, health and lifestyle issues, practice and performance issues, confidence on stage, total symptom severity and frequency and the ability to cope with work.

II. CURRENT EVIDENCE

1) Interventions aimed at music performance anxiety (MPA)

A pre-post study involving 19 music students suggested that meditation training over eight weeks led to decreased performance anxiety and less mind-wandering in contrast to a control group that received no intervention (Chang et al., 2003). Stern et al. (2012) found that a nine-week hatha yoga intervention consisting of fourteen 60-minute classes twice a week and daily home practice led to large decreases in MPA among 17 students. The positive effects were maintained at 7- to 14-month follow-up. Also, Zen meditation training across eight weeks including group discussions, instruction for daily practice and performance visualization showed significant reductions in performance anxiety post-intervention, but no differences in musical performance quality as evaluated by two independent jurors. In fact, a positive correlation between performance quality and performance anxiety was found in the meditation group. This could have been due to increased awareness of autonomic effects of anxiety without the adverse psychological reactions, although it remains unclear (Lin et al., 2008). A very recent psychological intervention aimed at reducing performance anxiety among high school students and based on cognitive behavioural elements (such as cognitive restructuring and relaxation techniques) and elements of positive psychology (such as identification of strengths, goal-setting, imagery and visualization techniques) showed significant reductions in MPA which were maintained at two months post-intervention (Braden et al., 2015). An eight-week group training programme in performance psychology including channelling performance energy, developing confidence, mental rehearsal and dealing with adversity showed significant reductions in MPA (maintained at 2-months follow-up), as well as improvements in confidence and in the ability to focus on music preparation and performance tasks among 30 adolescent female students who had studied their instrument for an average of four years (Osborne et al., 2014). Consistent with other similar previous findings, no significant improvements in judge-rated performance quality was found. Kim (2008) looked at two six-week music therapy approaches among a group of 30 college pianists and found reduced MPA scores for both the improvised music-assisted desensitization group and the one which combined imagery with music-assisted progressive muscle relaxation. Measurements included finger temperature and were taken following lab performances pre- and post-intervention. A randomized controlled trial among 46 trained adult musicians compared the effects of a session of slow breathing with a session of slow breathing with biofeedback and found that slow breathing, regardless of biofeedback, was sufficient for controlling physiological arousal when anticipating music performing related stress (Wells et al., 2012).

2) Interventions aimed at playing-related musculoskeletal disorders (PRMDs)

A randomized controlled trial conducted among 45 orchestral musicians found reduced PRMD incidence and severity in the experimental group after a 15-week programme based on warming-up, general and specialized exercising and cooling down (de Greef et al., 2003). Two other studies looked at the effects of exercise programmes among 18 and 14 university students respectively. They included generic strength, postural and aerobic exercises and showed improvements in playing posture as well as reductions in frequency and intensity of PRMDs (Ackermann et al., 2002; Kava et al., 2010). When compared with a strength training programme, endurance training significantly reduced perceived exertion of playing. The endurance training might have been perceived as more relevant due to its similarity with the highly repetitious action with light load of playing a musical instrument. However, neither the six-week endurance training nor the six-week strength training reduced the frequency or intensity of PRMDs significantly (although there was a decreasing pattern) (Ackermann et al., 2002). Nevertheless, both Pilates and a series of conventional trunk and upper extremity endurance exercises across six weeks each proved equally effective in decreasing pain, fatigue and perceived level of exertion while playing an instrument (Kava et al., 2010). One specific programme for orchestral players including neck, shoulder, spinal, abdominal and hip series as well as warm up and cool down exercises, demonstrated and supervised by a physical therapist and accompanied by booklets with detailed instruction and pictures showed significant reductions in frequency and severity of PRMDs as well as improvements in perceived exertion (Chan et al., 2014). The study found that a DVD-based exercise programme run among 50 orchestral players also showed significant reductions in PRMD frequency and severity as well as moderate increases in strengthening muscles that support playing. Approximately 55% reported that they

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preferred the DVD version of the exercise programme as compared to a previously tried face-to-face equivalent of the same intervention.

3) *Mixed interventions (both MPA and PRMDs)*

Khalsa et al. (2013) investigated the effects of a controlled, six-week yoga intervention among 135 adolescent musicians and found significant reductions in MPA post-intervention in the experimental group while the results for PRMDs were inconclusive. Another yoga intervention incorporating a considerable amount of group interaction and socialization found greater improvements in performance anxiety relative to PRMDs. While pre-post reductions in performance anxiety scores (for practice, group and solo performance) were significant within the intervention group, the significance was maintained only for the solo condition when compared to the controls. This is consistent with the findings of Khalsa and Cope (2006) suggesting that anxiety is higher in solo than group and practice conditions, although the authors reported that those recruited to the intervention group were highly motivated to take part in the intervention, which could have influenced the results. Similarly, a three-arm, non-randomized study comparing a yoga plus meditation and a yoga lifestyle intervention with a control group over the course of two months found that both experimental groups showed a trend towards less music performance anxiety relative to the control group, but no changes in PRMDs. However, group differences did not last according to a one-year follow-up assessment (Khalsa et al., 2009). Qualitative data suggested that breath control techniques were perceived as helpful in managing pre-performance anxiety among the lifestyle participants while a number of participants reported better self-confidence.

4) *Institution-based health promotion courses*

A Spanish conservatoire-based one-year programme consisting of ergonomics and the prevention of musculoskeletal injuries, warm-up practical sessions and private lessons with personalized instruction showed improved body awareness by 91% and decreased injury frequency by 78% across all three time-points among 90 students relative to controls, although no validated questionnaires were used (Lopez & Martinez, 2013). A pre-post, non-randomized evaluation of a one-semester prophylactic course on ‘Physiology of Music and Performing Arts Medicine’ offered to 22 students at the Zurich Conservatoire suggested greater positive effects on playing-related symptom frequency, emotional disturbances and anxiety levels as well as coping with work and confidence on stage in the intervention group (Spahn et al., 2001). However, significantly more non-controls reported suffering from music-related symptoms and coping less well with their music-related work at baseline relative to controls. The course included weekly two-hour sessions combining practical physical exercises with lectures on preventative topics relevant for musicians. Another educational programme including modules on nutrition, fitness, sleep, performance anxiety, relaxation, deep breathing, injury prevention through improved postural awareness and stretching showed improvements in knowledge of covered topics, but not in occurrence or intensity of PRMDs (Barton & Feinberg, 2008). The longest and largest longitudinal, observational study in music students that has been conducted to date showed that a combination of physical, psychological and behavioural elements delivered during participants’ first two semesters at the Freiburg Music University led to elevated ratings in psychological and physical health, but no reductions in physical symptoms (Zander et al., 2010). The sample involved 247 (non-randomized) students who were assessed during their first two years of training. Su et al. (2012) looked at the effectiveness of an e-learning curriculum on occupational health among 15 graduate-level students using a pre-post and one month follow-up design. Implemented over 14 weeks, weekly classes comprised a 60-minute prerecorded lecture followed by a 40-minute real-time interactive discussion. Student awareness of practice and performance issues increased significantly between pre-test and follow-up while awareness of health and lifestyle issues did not show significant increases. Only one intervention looked at a training programme aimed at instrumental teachers and their students. It combined elements of prevention and standard music psychology focusing mainly on the psycho- and sensorimotor problems of musicians and an appropriate instructional style. The intervention was run across 17 weeks and suggested that, compared to a control group, teachers from the test group had become more responsible for instructions while the students from the test group reported a change in their teachers’ teaching style with respect to guidance on posture and playing-related movements (Hildebrandt & Nubling, 2004).

III. LIMITATIONS

The above-mentioned studies reveal an array of methodological weaknesses such as: small sample sizes, over-representation of female participants, short duration of interventions, and often, the lack of a control group to evaluate a potential placebo effect. Moreover, health promotion courses encompass a range of potentially active ingredients that cannot precisely be separated from each other. This is particularly relevant in yoga-based interventions, where factors such as the social environment and community interactions could have made it hard to isolate the components specific to yoga (Khalsa et al., 2009). Also, it is particularly important, in the context of such complex interventions, to amass sufficient data from diaries to determine the extent to which participants followed instructions and practised specific techniques, as well as differentiating the effects of participation from those arising from mere exposure to the intervention itself (Osborne et al., 2014). In addition, it has been suggested that training programmes should be specific and adapted to each instrument (Wilke, Priebus, Biallas & Frobose, 2011). The self-report method provides responses potentially affected by social desirability (i.e. over-reporting of physical activity and under-reporting of anxiety) and recall bias, although it remains the quickest, easiest and least expensive method of

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measurement. However, the use of objective data such as psychophysiological measures including respiratory rate, measures of performance quality and checklists of anxious behaviours relevant to musicians (i.e. hand tremble) are recommended (Stern et al., 2012). One important issue associated with intervention studies is attrition bias (Stern et al., 2012; Lee et al., 2012); the main reason students report for dropping out of such studies is lack of time. To address this, Stem et al. (2012) recommend increasing the pool of participants by recruiting students from more than one conservatoire, offering a wide range of options regarding the day and time of the intervention sessions, keeping the intervention sessions as brief as possible, and providing immediate and reasonable incentive/remuneration. Also, a flexible delivery approach such as using a DVD-exercise which participants could use at home might be effective. Increasing adherence and reducing drop-out rates could also be addressed through extrinsic motivators in the form of management involvement and encouragement particularly in the case of orchestral players (Chan et al., 2014). Not blinding participants to the intervention could be problematic as they might feel encouraged to report more positive experiences in order to please the researcher. Most intervention studies reported to date do not involve long-term follow-up measures, which raises the question of whether any positive changes are sustainable after the intervention ceases. This is especially relevant considering behavioural changes take longer than cognitive adjustments to be implemented and that periodic reinforcement throughout an educational curriculum might be important for maintaining behavioural changes (Barton & Feinberg, 2008). The importance of a control group is emphasized by Brandfonbrener (1997), who noticed a significant improvement in musculoskeletal symptoms in the intervention-free group. She suggested that simply drawing the musicians' attention on such issues might in itself have a positive effect. This is supported by the mere measurement effect whereby simply asking questions could trigger behaviour change by increasing the availability of the behaviour in the momentary focus of the respondent and could, thus, in itself, be used as an effective way of promoting adherence to the desired behaviour (Fitzsimons & Williams, 2000; Morwitz & Fitzsimons, 2004). Also, a comparison group could reduce the likelihood of producing a Hawthorne effect (adjusting one's behaviour in response to the awareness of being observed) (Chan et al., 2014). In addition, most of the intervention studies reported to date use a waiting list approach or simply a no-intervention comparison group. A better, more relevant comparison would be a different therapy/technique which has demonstrated some positive effect in the past. Thus, there might be more scope in comparing two active treatments/interventions rather than treatment vs. waiting list, non-treatment or placebo groups, as this could help identify active ingredients in each group and then compare them under the same methods/experimental conditions (Brodsky, 1996). Cross-over designs have also been recommended. Also, the use of heterogenous participants who were not selected according to a specific level of MPA, and who did not report problematic levels thereof, might influence intervention outcomes due to floor effects (Kenny, 2006). Another limitation in some studies could be the low ecological validity of incorporating public performance tasks that are not officially assessed as part of the curriculum when looking at the effects of an intervention on MPA, as performances given only for research purposes might not evoke such high levels of MPA (Braden et al., 2015). Lack of randomization could impair the results of an intervention through selection bias. For example, Chan et al. (2014) found that at baseline, their intervention group had higher PRMDs frequency and severity compared to the control group while the control group was more physically active. Given the significant decrease in PRMDs frequency and severity among the intervention participants and the lack of randomization, it is therefore hard to tease out 'regression to the mean' or the effect of generic physical activity on the lower baseline PRMDs symptoms. However, it is likely that exercises specifically tailored to the individual and his or her instrument are required for injury prevention, considering that the benefit reported by participants most often was strengthening the muscles that support playing (Chan et al., 2014, Chan et al., 2012).

IV. CONCLUSIONS AND FUTURE DIRECTIONS

Despite all their limitations, the intervention studies reviewed above are important attempts to increase insight into issues of importance for future research. Moreover, they focus on a population somewhat under-represented in research on health, namely musicians. Small studies designed to help establish whether an intervention deserves further testing involve relatively low costs. They facilitate the estimation of parameters such as adherence and response to questionnaire rates (Arain, Campbell, Cooper & Lancaster, 2010) and could be a precursor in addressing some barriers to participation in subsequent studies, such as musicians' busy schedules. The importance of physical activity could hardly be overestimated. Physically active musicians have significantly lower levels of MPA than inactive ones, independent of gender (Rocha, Marocolo, Correa, Morato & da Mota, 2014) and show less anxiety after giving a musical performance (Wasley, Taylor, Backx, & Williamon, 2012). Similarly, a recent correlational study among 225 young Polish music students suggested that not meeting the criteria for minimal physical activity levels was associated with increased pain frequency and intensity in the neck, shoulders and back (Nawrocka, 2014). Moreover, it has been suggested that in helping improve executive function, physical activity could indirectly improve other health related behaviours, making it a 'best buy in medicine' (Loprinzi, 2015). Despite the work of Baumeister, Bratslavsky, Muraven and Tice (1998) on ego-depletion, which states that self-control is an expensive and finite resource and that its glucose-dependent use would impair performance on subsequent occasions, emerging studies show the 'mindset' might play a key role. Thus, when people believe willpower is an abundant resource (rather than finite), they present better self-regulation after demanding tasks (Job, Walton, Bernecker & Dweck, 2015). On the other hand, other

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novel, theory-based models provide an alternative to the long-term use of willpower. The habit formation theory (Lally & Gardner, 2012) is based on the notion that forming habits (through the repetition of a behaviour in the same situation in which it occurs) could free some of the mental energy required by effortful deliberation, since the subject can instead rely on automatic responses (Gardner, Lally & Wardle, 2012). This has potential for the maintenance of desired behaviours over time (Gardner, 2012). Health psychology theories and behaviour change techniques conducive to habit formation, such as action planning and self-monitoring (Lally & Gardner, 2013; Michie, Fixsen, Grimshaw & Eccles, 2009; Michie et al., 2013), could come into play and establish an innovative approach to musicians' health. Future research could perhaps also aim to incorporate elements into performance and practice such as 'flow', described by Csikszentmihalyi (1990) as being experienced when one or more of the following conditions is met: challenge matching current skill level, being totally absorbed in the task, clarity of goals, the presence of immediate feedback, sense of control, loss of self-consciousness and altered sense of time. Performance anxiety has been shown to correlate negatively with proneness to flow (Kirchner, Bloom & Skutnick-Henley, 2008). Some 'active ingredients' of proneness to flow might, thus, be worth encouraging: self-confidence while performing, desire to experience and express feelings through music, having goals related to experience, maintaining focus on the music and playing without self-criticism (Bloom & Skutnick-Henley, 2005). Cognitive reappraisal strategies have been shown to be more effective in moderating the subjective feeling of anxiety than the suppression or acceptance of anxiety (Hofmann, Heering, Sawyer & Asnaani, 2009). These have not yet been investigated with the participation of musicians, although an early study of cognitive restructuring techniques conducted with musicians produced large effect sizes in reduced anxiety and MPA, and improvements in performance quality and heart rate compared to controls (Sweeney & Horan, 1982). Unlike other components of cognitive behavioural therapy (CBT), such as mindfulness meditation, reappraisal is aimed at reshaping the perception of arousal rather than diminishing it. This is in line with the recommendation already made that future interventions should take into consideration the specificity of MPA by encouraging sufficient relaxation to counteract excessive activity of the sympathetic nervous system while maintaining the levels of arousal necessary for optimal performance (Kenny, 2004). Jamieson, Nock and Mendes (2012) found that reappraisal is associated with more adaptive cardiovascular stress response and decreased attentional bias although they warn that there might have been other variables confounding their results. Nevertheless, it has the potential to be explored further, especially considering that a simple reappraisal instruction might be sufficient to trigger both physiological and cognitive responses (Jamieson et al., 2012). For example, students improved their performance on a maths exam when they interpreted stress as 'challenging' rather than 'threatening' (Jamieson, Mendes, Blackstock & Schmader, 2010), and Brooks (2014) similarly showed that individuals who reappraise anxious arousal as excitement perform better than those who attempt to calm down. The 'challenge' and 'threat' responses are linked to different physiological responses and are based on the biopsychosocial (BPS) model, a theoretical framework connecting cognitive (i.e. stress appraisals), physiological (i.e. autonomic nervous system (ANS) reactivity) and behavioural (i.e. performance) responses to stress (Rith-Najarian, McLaughlin, Sheridan & Nock, 2014). A challenge response elicits the activation of the sympathetic-adrenal-medullary (SAM) axis, an increased cardiac efficiency and vasodilation. A threat response also activates the SAM axis, but, unlike the challenge response, is associated with reduced cardiac efficiency and vasoconstriction, which could lead to poor decision-making in the short term, as well as cardiovascular disease and cognitive decline in the long term (Jamieson et al., 2012). Although CBT might be more effective than some beta-adrenergic-blocking agents in treating MPA (Clark & Agras, 1991; Kenny, 2004) and more supportive of a self-management approach, it seems that 40% of musicians who experienced MPA as a severe problem had used a 'prescribed medication' while only 25% had sought 'psychological counseling' (Fishbein et al., 1988). Similarly, counseling and psychotherapy were not even mentioned among the coping strategies employed to reduce anxiety among Canadian musicians (Bartel & Thompson, 1995). A more recent Australian study suggests that among 377 orchestral musicians, 6% had consulted a psychologist while 31% had taken beta-blockers to control their anxiety (Kenny et al., 2012). Among other reasons, this could be because taking medication requires less effort and is more accessible financially compared to psychotherapy. Thus, it has been suggested that more effort should be put into adapting current effective interventions for musicians (e.g. enhancing traditional forms of psychotherapy with music) (Brodsky, 1996). A systematic review of MPA treatments (Kenny, 2006) suggested a 12-week music therapy intervention including musical improvisation, performing in front of an audience, awareness techniques and verbal processing of anxiety responses led to less anxiety (as measured by the Spielberger State/Trait Anxiety scale) and increased confidence among ten freelance musicians suffering from MPA compared to a control group (Montello, Coons & Kantor, 1990). Moreover, interventions leading to better performance quality might boost self-confidence on their own, thus diminishing the need for further treatment. Effective techniques that showed positive effects on performance quality include behaviour rehearsal and cognitive restructuring (Kenny, 2006).

No intervention to date has attempted to decrease the prevalence of PRMDs by reducing sedentary behaviours. Prolonged sitting has been associated with all-cause mortality, cardiovascular disease, cancer and type 2 diabetes, however, independently of physical activity (Biswas et al. 2015). Public health guidelines recommend minimization of sitting time and constant interruption of sedentary behaviours by standing or taking light intensity activity breaks (Department of Health [DOH], 2011). Interrupted sitting has been shown to reduce the risk of unhealthy metabolic profiles (Healy et al., 2008), physical complaints (Roelofs & Straker, 2002) and fatigue

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(Hasegawa, Inoue, Tsutsue & Kumashiro, 2001). Breaking up sitting time every 30 minutes was also associated with lower-back discomfort in overweight/obese adults (Thorp et al., 2014). Objectively assessed sitting time also seems to be positively correlated with lower-back pain intensity (Gupta et al., 2015), stiffness of the lumbar spine after only one hour of sitting and reduced strength of the back muscles (Beach et al., 2005). Reducing sitting correlates with improved outcomes for upper back, lower back and neck pain (Pronk, Katz, Lowry & Payfer, 2012), which correspond to the body regions most affected in instrumental musicians (Silva, Filipa & La, 2015). Interrupting sitting is in line with the importance of rest and recommendations such as interspersing practice sessions with breaks of 5-15 minutes every hour (Lopez & Martinez, 2013). This is highly relevant to musicians considering they might spend a considerable amount of time sitting during orchestral and chamber music rehearsals. One innovative study suggested right arm movements are more restricted and weight distribution more unbalanced while sitting in front of a stand compared to standing among violinists (Spahn, Wasmer, Eickhoff & Nusseck, 2014). Considering musicians' training is still largely based on tradition rather than empirical evidence (Clark & Lisboa, 2013), approaches such as the Alexander Technique and the Feldenkrais method, and the benefits of stretching, might need to be better defined and/or revisited. A systematic review of treatments for music performance anxiety found only very weak evidence that the Alexander Technique could improve performance quality and the mental state of the performer, because of methodological weaknesses in the studies reported (Kenny, 2006). The findings of a recent systematic review of controlled trials of Alexander Technique among musicians indicated that it may improve performance anxiety but its effects on music performance and respiratory function remain inconclusive. However, studies reviewed included a wide range of musical levels (amateur players, music students and professionals). When compared to physical activity, the latter also showed some reduction in performance anxiety. Again, the authors draw attention to the need for larger sample sizes as well as the use of objective outcomes (Klein, Bayard & Wolf, 2014). Further, a systematic review of randomized controlled trials of the Feldenkrais method concluded that the evidence for this method is encouraging but not compelling, again because of the methodological limitations evident in reports of the studies undertaken (Ernst & Canter, 2005). The evidence on stretching is not particularly clear either, due to conflicting research reports (Shrier & Gossal, 2000). In fact, it seems to vary widely depending on the type of sport, whether it is combined with warming-up (Taylor et al., 2009) and if it is static or dynamic (Behm & Chaouachi, 2011). In addition, the great majority of articles on stretching report studies that were conducted among sports players, rather than musicians. One study looked at four sets of stretches/exercises such as wrist, shoulder and neck rotations and rolls, oppositional finger-wrist presses and fist clenches, hand wringing and arm-bicep curls as well as handshakes, arm-triceps extension and fingers clenches among American teenage string players. Results suggested stretching exercises lowered students' perception of discomfort, regardless of whether they played lower (cello and bass) or upper string instruments (violin and viola), as compared to a control group. There was, however, also, an effect of instrument, regardless of whether the participant was in the intervention or control group, such that upper string students' perception of discomfort was slightly lower before rehearsals than after, whereas lower string players reported an increase in discomfort from before- to after-rehearsal (Cooper, Hamann & Frost, 2012). Further research on stretching is important, given that 75% of students in a sample of 45 respondents reported that they stretch prior to playing (Hagglund & Jacobs, 1996). The concept of 'warm-up' is also often poorly defined. Many music students might also refer to playing scales and technical exercises as 'warm-up' (Lopez & Martinez, 2013). In terms of conceptual clarity, Brodsky (1996) draws attention to the importance of having operational definitions of PRMDs in order to ensure the measurement of comparable severity levels (Bragge, Bialocerkowski & McMeeken, 2006) as well as to distinguish PRMDs from related terms such as 'stage fright' and 'performance anxiety', which have been used interchangeably in the past. He proposes the use of a conceptual framework which would help distinguish between a 'necessary' amount of anxiety that is inherent to the profession and a debilitating level thereof.

Finally, while the present paper is exploratory, by no means attempting to provide an exhaustive account of the available evidence and its limitations, it nevertheless captures the main issues of interventions aimed at health promotion. We believe that the limited, yet growing existing literature, indicates that further investigation may be fruitful; there is also potential in pursuing inter-disciplinary collaborations between performing arts medicine, sports medicine, physiotherapy, health psychology and behaviour change research. In addition, our present work is in line with the idea of implementation research aimed at improving health through the translation of 'proven' clinical treatments, practices, organizational and management interventions into routine practice (Clark & Lisboa, 2013). The actual practice of implementation research should guide the development and evaluation of future improved, better tailored, more sustainable interventions through a seven-step process: identifying gaps and need for change, identifying barriers, reviewing evidence and interventions, tailoring interventions to improve performance, implementing interventions, evaluating the process of implementation and evaluating outcomes (Bhattacharyya, Reeves & Zwarenstein, 2009). Although the present review is still preliminary, we think that evidence thus far could inspire two different approaches: 1) a health course aimed at raising awareness of the prevalence of music performance related health issues and the strategies currently known to be available to reduce and prevent them among musicians. We currently believe that the most urgent needs are to address both MPA and PRMDs since these seem to be most prevalent among musicians. We currently envisage aiming to enhance musicians' knowledge, building on their own stated concerns and requirements, by promoting less familiar or very new information/techniques, and undertaking a limited number of intervention studies designed to reduce MPA (e.g. based on cognitive reappraisal) and PRMDs (e.g. reducing prolonged sitting and exercises targeting relevant muscle groups) through the use of behaviour change tools.

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Music education and music therapy in schools for children with special educational needs: Similarities, crossovers and distinctions

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ABSTRACT

Music education and music therapy have long been shown to be beneficial to the education and wider development of children with special educational needs and disabilities (SEND). However, it has been acknowledged that there are many similarities between the two practices when both are provided in schools for children with SEND. As such, it is difficult to ascertain what constitutes music education and what constitutes music therapy in SEND school settings. This research paper explores the similarities, crossovers and distinctions between music therapy and music education in SEND schools by considering qualitative research data gathered from two recent case studies. The research explores practitioners' views of what constitutes music education and what constitutes music therapy within the schools in which they work. Semi-structured interviews were carried out with three key practitioners at each school. Observations of music lessons and music therapy sessions were also conducted. Analysis of interview data was carried out using the principles of Interpretative Phenomenological Analysis. Results show that, despite some key differences in approach, several similarities exist between the practices of music education and music therapy in each SEND school. This is in-keeping with findings from previous research. However, it can also be seen that crossovers between each practice vary widely between the two schools depending on the way in which therapy is integrated into the curriculum. Whilst generalisations cannot be made from such a small sample, the wider implications and potential impact of these findings are considered and ideas for further research are presented.

I. INTRODUCTION

Music education and music therapy have long been shown to have benefits for children and young people with special educational needs and disabilities ([SEND] e.g. Alvin; 1965; Dickinson, 1976; Dobbs, 1966; Nordoff & Robbins, 1971). However, it has been acknowledged that there are several similarities between the two practices when both are used in schools for children with SEND (Bruhn, 2000; Bruscia, 1998; Bunt, 2003; Kemmelmeyer & Probst, 1981; Patterson, 2003; Schalkwijk, 1994).

For example, Ockelford (2000) argued that there are two strands of music education for pupils with SEND: "activities that are undertaken primarily for their intrinsic musical value and those which are intended principally to promote wider learning and development" (p.197). Reflecting on these strands, he proposed a model of music education for pupils with complex needs. The model depicts Ockelford's belief that, although the musical activities undertaken with pupils with SEND may be similar, the underlying aims and approaches to such activities will vary depending on whether they are used in therapy or education. He proposed that therapy has a stronger focus on wellbeing with largely internally determined goals (i.e. those determined by the child), whereas music education places more emphasis on the development of skills, knowledge and understanding with largely externally determined goals (i.e. those determined by a teacher). Ockelford also included 'Training' as part of his model of music education. This branch of music teaching includes peripatetic vocal and instrumental tuition and highlights the fact that, although some pupils with SEND may struggle with academic learning, their practical musical ability may have the potential to be developed to a high level (Lense & Dykens, 2013; Ockelford, 2007).

In a similar vein to Ockelford, Robertson (2000) acknowledged that "the therapeutic potential of music is not exclusive to the profession after which it is named" (p.41) and suggested that, particularly in mainstream settings, music teachers will be required to meet the therapeutic as well as educational needs of pupils with SEND. As such, he developed a continuum model which redefines the practices of music therapy and music education into four key strands: clinical music therapy, educational music therapy, music education and the music profession. Robertson outlined that the continuum is not meant to be seen as progressive. Rather, the boundaries between each practice are flexible and represent "the overlap between clinical music therapy and what might be considered as conventional music teaching" (p.45). As such, he calls into question who would be best suited to carry out the role of an educational music therapist and advocates the inclusion of additional modules of training in initial teacher training courses to help practitioners prepare for this role.

Whilst Ockelford and Robertson make some interesting observations about the similarities, crossovers and distinctions between music education and music therapy, at the time of writing, very little empirical evidence existed to support their claims. As such, suggestions for a change in approach to the SEND music education system were somewhat premature. It is thought that the wider views of practicing music teachers and therapists must first be sought in order to effectively gauge how each practice is viewed and approached in SEND schools. Such research will help to clarify the various similarities, crossovers and distinctions between music therapy and music education. In addition, it will help to ensure that ideas for potential changes to the SEND music education system are rooted in the needs of practitioners who work within this field.

More recently, it has been argued that empirical research exploring the use of music therapy in schools is essential if we are to fully establish its efficacy in such settings (Stephenson, 2006). The Provision of Music in Special Education (PROMISE) research (Welch et al., 2001) and the Sounds of Intent framework of musical development for children with complex needs (Ockelford et al, 2005) are examples of

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empirical work that have contributed significantly to the field. However, to date, it would seem that much of the empirical work exploring practitioners' views on the similarities and differences between music education and music therapy in the UK has largely been instigated by student researchers (Markou, 2010; Mawby 2011, 2014). These studies remain unpublished and are not widely accessible therefore limiting the contribution they are able to make to the field.

This research paper aims to address this lack of dissemination by considering qualitative research data from two recent case studies (Mawby, 2011, 2014). Each case study shared the same research design and analytical techniques. This choice was deliberate in order to facilitate comparison between cases.

II. METHOD

A. Research Design

Both research studies (Mawby, 2011, 2014) were single case studies which aimed to explore practitioners' views of what constitutes music education and what constitutes music therapy within the schools in which they work. Semi-structured interviews were carried out with three practitioners at each school. In School 1 this included the deputy head teacher, the school's music coordinator and the music therapist. In School 2 this included the head teacher, the school's specialist music teacher and the music therapist. Observations of music lessons and music therapy sessions were also conducted at each school (in School 1 only group music therapy sessions were observed as this was the only therapeutic provision the school provided. In School 2 both individual and group music therapy sessions were observed). Both participating schools were state-run special schools operating in the east of England.

B. Data Collection

Each interview lasted no longer than thirty minutes. All interviews were audio recorded and transcribed. Individual transcripts were then returned to participants for verification. Each participant was asked to read their transcript and confirm that it provided an accurate representation of their experiences. Participants were informed that they could amend their transcripts if they wished. Only the music therapist in School 2 returned her transcript with amendments. When asked about her reasons for altering the transcript, she revealed that this was simply to clarify her responses and to make her viewpoint more succinct. As the amendments did not contradict anything she originally mentioned during her interview, she gave permission for both the original transcript and the revised text to be used during data analysis. The other participants returned their transcripts without amendments.

All observations, aside from those of music therapy sessions in School 2, employed a marginal participant design. This involved the researcher sitting on the periphery of each lesson/music therapy session observing and taking notes about musical activities without taking an active role within them. Conversely, music therapy sessions at School 2 were observed by way of pre-recorded video footage. The music therapist at School 2 felt that having the researcher present during therapy sessions could infringe clinical boundaries. The therapist therefore suggested that observations of pre-recorded video footage would be feasible as she kept recordings of her music therapy sessions as standard practice. To ensure that the confidential nature of an entire music therapy session was not compromised, the music therapist compiled short videos clips of sessions for the researcher to view. Whilst this meant that therapy sessions could not be viewed in their entirety, potentially limiting the researcher's ability to analyse the footage with sufficient context, it was felt that this was an appropriate compromise.

During the observations, descriptive observation notes were taken by the researcher which provided a record of events. Fieldnotes were written up on the same day as each observation. To further ensure validity, the typed notes were sent to the relevant teacher/therapist to verify. These were all returned without alterations.

C. Data Analysis

Analysis of interview data was carried out in accordance with the principles of Interpretative Phenomenological Analysis (IPA), as presented by Smith, Flowers and Larkin (2009). IPA was chosen because it provided a detailed exploration of the participants' lived experiences of music education and music therapy at their respective schools. Each transcript was read many times. Transcripts were subsequently annotated with exploratory comments which were divided into three main categories: descriptive comments, linguistic comments, and conceptual comments. Once a detailed annotation of each transcript had been completed, each was read again several times along with its annotations and a list of initial themes was compiled. These themes were then compared and consolidated into four key themes for each school (School 1: music therapy and music education; control; behaviour; and collaboration. School 2: distinctions; crossovers; collaboration; and the children's views).

Observational coding was carried out in accordance with the methods of Charmaz (2006). Observation notes were first subjected to 'Initial Coding'. The fieldnotes were first read and re-read in order to engage fully with the data. Notes were then coded using 'Open Coding'. This involved writing a succinct description of each action which was carried out on an incident to incident basis. After this, the initial codes were grouped and refined during a period of 'Focused Coding'. Several themes were developed across which similarities and differences between music therapy sessions and music lessons could be identified. These themes were then compared with the themes established during the IPA analysis of participants' interview transcripts. The observation notes were used as a means of contextualising the experiences described by practitioners during their interviews. As such, themes stemming from the observation data were combined with those which arose during interview analysis. This provided a focused account of what constituted music therapy and what constituted music education in the opinions of the practitioners at each school.

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III. FINDINGS

Data gathered from each school were analysed as part of two separate research studies (Mawby 2011, 2014). As such, the themes arising from each case study are not identical. In order to remain true to the original research, findings are presented below for each school under their relevant themes. A comparison between cases will then be provided in the discussion.

A. School 1

1) Music Therapy and Music Education. Distinctions between music education and music therapy were generally agreed upon by all three participants, showing a grounded understanding of what the terms music education and music therapy meant to practitioners at the school:

> "The focus is different. So, music education: teaching, performance, achievement, skills. Music therapy: the individual, communication, emotional self-expression" (Music Therapist)

It was also acknowledged by all three participants that music education is predominantly teacher-led and music therapy is predominantly pupil-led.

It is interesting to note that only the music therapist formally mentioned there being any crossovers between the two practices. Crossovers were occasionally acknowledged by the music coordinator but these were always discussed in a contradictory manner:

> "I think with the music therapist, um, I think she's very much about letting the boys and the youngsters express themselves. Um, which of course we are in music, but…" (Music Coordinator)

This could perhaps indicate a more subconscious recognition of the crossovers between the two practices.

It was not clear why music therapy was used at the school. This could be attributed to the fact that the researcher failed to ask any questions regarding why music therapy was important to the school. The music therapist mentioned that it satisfied the school's "inclusion policy" and that music therapy was on a rota with other activities such as horse riding and swimming. It could be seen from this that music therapy was viewed as an extra-curricular activity at the school.

The idea that music therapy was viewed as an extra-curricular activity was further supported by the amount of time each practitioner had to achieve various goals and objectives. The music coordinator mentioned that the school's music curriculum utilised a long-term plan which was spread over a period of four years. In contrast to this, the music therapist had just a term to work with each class in the school. The music therapist expressed that this short time-frame compromised some of her aims for the children's therapeutic development, particularly with regards to behaviour and self-esteem. She further mentioned that she had spoken with the head teacher in order to try and increase the amount of time she spent with each group of pupils. This request was met with concerns that if she worked for a longer period of time with each class it would take too long for her to work with every pupil in the school. As such, the therapist concluded that the therapy sessions she conducted with the children were "more like a taster than long-term".

2) Control. A further point of distinction expressed by teachers was that relinquishing control of their students during music therapy sessions was a difficult task:

> "We found it [adjusting to the music therapist's approaches] hard at first because we're so used to having the control of the students" (Music Coordinator)

A difference in approach between music education and music therapy with regards to control was also acknowledged by the music therapist:

> "It's so much about keeping communication open between the usual classroom methods and my methods, which are letting go of control. Um, now, I wouldn't say their approach is wrong and they wouldn't say, well they might say my approach is wrong, but there is a way of respecting both and it's finding how to make that work" (Music Therapist)

She went on to argue that giving pupils the freedom to engage in "spontaneous activity" has considerable benefits, helping them to increase self-esteem, build confidence and communicate in their own way. However, the teachers believed that, because of the general aims and objectives required by the school system (e.g. meeting targets and working towards the children's individual education plans), allowing pupils this sort of freedom in music lessons was a near-impossible task.

3) Behaviour. All three participants described how approaches to addressing pupils' behavioural difficulties differed between teachers and the music therapist. It was acknowledged that relinquishing control over the pupils' behaviour posed a great deal of difficulty for the teachers:

> "The music therapist's approach is different from the music lessons, but…behaviours sometimes perhaps can get in the way. Whereas the music therapist would be more laid-back about that and would not be too worried, we as teachers are thinking about them in other set-ups and other lessons…I think that's something we've found quite difficult" (Music Coordinator)

The music coordinator also mentioned that the way in which behaviours are dealt with by teachers during a music therapy session might contradict the music therapist's overall therapeutic aims. During her interview she described an incident in which a child became agitated during a therapy session and explained how staff had to "step in with him" and remove him from the session for a short while to calm down. She continued:

> "I think the music therapist…found that quite difficult because I think it obviously seemed to sort of not go, it probably went against, in a sense, her, her ideas for what she wanted to do but [the removal of the child] was necessary because he would have caused chaos and we couldn't have allowed that" (Music Coordinator)

Indeed, the therapist confirmed that her approach to dealing with behaviour did differ greatly from that of the teachers.

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Rather than discourage undesired behaviour, the therapist mentioned that music therapy is a time in which a child is allowed to freely express how they're feeling at any given moment. The therapist then provides musical support for this:

> "Enjoy is a, not always the right word in music therapy because sometimes a student might be in a state of agitation or upset, for whatever reason, and the music therapist will try and support that mood" (Music Therapist)

Despite these initial behavioural concerns, when asked to describe a typical music therapy session and its effect upon pupils, both the deputy head teacher and the music coordinator mentioned experiencing a calm atmosphere:

> "A lot of [the pupils] were calmer afterwards. It does have a calming effect" (Deputy Head)

This contradiction of potential chaos and experienced calm may stem from an issue of group size. For example, the music therapist mentioned that there was a definite difference in the children's behaviour and the way in which the teachers responded when music therapy was experienced in a large group (around eight or more pupils):

> "I've had feedback that often [the teachers] have said "oh it's so chilling" and "oh I can relax"…that's the smaller groups. Um, [pause] with the larger groups, where there's more intensive behaviour management needed, I don't think it's relaxing for them" (Music Therapist)

4) Collaboration. The theme of collaboration was mostly discussed by the music therapist who stated that open communication between her and the teachers was "totally crucial and essential". The music coordinator mentioned a "balancing act" between the two practices and that it was important to agree upon how a therapy session would be carried out prior to its implementation in the school timetable.

The music therapist placed a great deal of importance upon collaborating with the staff and finding suitable compromises with the teachers on issues of behaviour management and control. However, there were times when she seemed concerned that the teachers may not feel the same way:

> "It's interesting you know, you don't always know everyone's perspectives so, and also people might not always tell me" (Music Therapist)

This feeling was later confirmed when the therapist spoke about her work at a nursery outside of the school:

> "[At the school] I recognise the limits set by time and place really…I've got more time at the nursery um, and more liaison with a greater number of people and I find…there are more outcomes, more personal long-term outcomes such as improved behaviour….Here [at the school], what I do is confidential but also a lot is confidential from me, whereas at the nursery, I'm part of the team that is keeping [and] protecting confidentiality" (Music Therapist)

The music therapist felt that the way in which the school viewed music therapy and incorporated it into their overall curriculum prevented her from collaborating with teachers, thus minimising the potential outcomes for the pupils taking part.

B. School 2

1) Distinctions. In a similar vein to School 1, each practitioner at School 2 had a similarly established idea of what constituted music education and music therapy within their school. It was agreed among all practitioners that music education was primarily concerned with building musical knowledge and skills, whereas music therapy was described and being more concerned with supporting the overall wellbeing of the child, helping them to develop primarily un-musical skills such as speech and communication.

Participants in School 2 also acknowledged that music education is predominantly teacher-led, whereas music therapy is predominantly child-led. Having said this, during observations there was an exception to the practitioners' views as it was clear that the observed group music therapy sessions were led predominantly by the music therapist. This finding is discussed in more detail under the theme 'Crossovers'.

Another distinction between the two practices discussed during participant interviews was that music therapy has clinical boundaries. For example, the music therapist explained that therapy sessions are a "safe space" where each child is able to express themselves freely without any pressure to conform or play conventionally. The importance of keeping music therapy sessions confidential was also mentioned when discussing clinical boundaries. Furthermore, the understanding that music therapy sessions should not be interrupted was also deemed to be important:

> "I know how important it is that the clinical boundaries are kept in place for the session, so, for my part it's about not interrupting them [and] hoping that nobody else interrupts them" (Music Teacher)

Again, whilst this view was held in theory, in practice it appeared that issues of confidentiality in a school setting were much more difficult to maintain. For example, the therapist videoed each of her therapy sessions and shared the footage with teachers and parents. This raises the question of whether it is necessary to adapt the clinical boundaries of music therapy in order to effectively integrate the practice into an SEND school's wider curriculum.

2) Crossovers. Despite practitioners' acknowledgment that there were some key distinctions between music education and music therapy, it was evident that in this particular school there were considerable crossovers between the two practices. All three practitioners acknowledged this in their interviews. These crossovers appeared to stem from the fact that, in this school, music education and music therapy shared a number of similar aims. Shared aims discussed by participants during their interviews were primarily non-musical. They included improving pupils' communication, concentration, engagement,

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verbal development, self confidence, self esteem and turn-taking. The head teacher explained that sometimes children struggled to achieve these goals in a whole class setting and that music therapy facilitated this:

> "That's kind-of where the therapeutic role comes in. So smaller groups or one-to-one versus the whole class; because…essentially it's so much about communication and interaction in every single curriculum area, not just music. By and large [these aims] can be met within a whole class setting but there are individuals where it needs to be one-to-one sessions really" (Head Teacher)

In this sense, music therapy was viewed as an integrated part of the school's wider curriculum, helping pupils to meet a variety of developmental aims outside of the traditional classroom environment.

During his interview the head teacher acknowledged that there are "very similar aims but different ways of approaching them" within music therapy sessions and music lessons. This viewpoint, again, works well in theory. However, it was apparent from the experiences of the music teacher and the music therapist, as well as information gathered during class/therapy session observations, that there were in fact some crossovers between practitioners' approaches to each practice. This can be demonstrated by way of a continuum model, as shown in Figure 1.

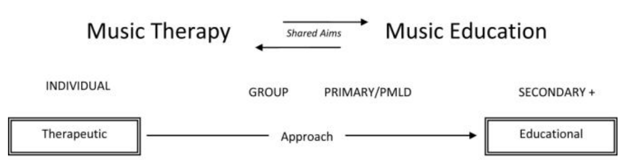

Figure 1. Crossovers between approaches to music therapy and music education within School 2

The model demonstrates that, whilst each practice had shared aims, the practitioners' approaches varied from being mostly therapeutic to mostly educational. Group music therapy, primary-school music lessons, and music lessons for pupils with Profound and Multiple Learning Difficulties (PMLD) sit in the middle of the continuum, as they shared both therapeutic and educational approaches. Individual music therapy sessions took a predominantly therapeutic approach and secondary school music lessons and sixth-form music lessons took a more educational approach.

Finally, perhaps one of the most interesting crossovers between music education and music therapy at the school was the fact that the music teacher was a qualified music therapist and not, at the time of interviewing, a qualified music teacher. The head teacher discussed the reasons for this in his interview, explaining that it was "really difficult" to recruit a suitable specialist music teacher who could not only teach one subject to every pupil in the school across all age-ranges, but who also had "the teaching skills to reach our difficult to reach students". After several failed recruitment attempts the head teacher offered the position to the music teacher "on an unqualified teacher basis". The head teacher makes an important point here with regards to the specialist skills and competencies required by a specialist SEND music teacher. In addition, the difficulties experienced in recruiting the right person for the role raise an interesting question as to who is best placed to teach music to pupils with SEND.

3) Collaboration. A further area of both distinction and crossover between the two practices was the importance of collaboration. There was a diverse range of music provision at the school. As such, collaboration between practitioners was an important means of ensuring that this varied provision served to meet the needs of pupils. This occasionally meant that the school veered away from normal conventions. For example the head teacher explained that:

> "Unlike other schools, we, actually, the therapists are part of our staff team. Other special schools, as you'll be aware, kind-of approach groups like [music hubs] for their music therapists. We wanted to do it a different way [by employing them directly]" (Head Teacher)

The care taken to ensure that music therapy was an integrated part of the school's curriculum served to make the music therapist feel more connected as a member of the staff team:

> "There's so many different people working with the children and I see my role as a kind-of integrated part of that holistic care that they're given" (Music Therapist)

The head teacher was a prominent means of support for both the music teacher and the music therapist. It was also expressed that the music therapist worked closely with class teachers, holding regular meetings in order to discuss pupils' progress. In contrast to this, the music teacher did not suggest that collaboration with other class teachers was an important part of her role at the school. The reasons for this diminished collaboration between the music teacher and class teachers was not particularly clear and further information is needed in order to sufficiently contextualise this finding.

An additional area of collaboration that participants felt to be of importance was collaboration between practitioners and parents. The head teacher explained that the school regularly notified parents regarding their child's progress in music education by way of assessment feedback. He also mentioned that the music therapist organised "parents' sessions at the end of the term so that parents can see for themselves what the child is doing".

Although collaboration featured strongly in participant interviews, it is perhaps interesting to note that collaboration between the music teacher and the music therapist was not mentioned in much detail by any of the participants. It was acknowledged that logistical collaboration among music practitioners was imperative because they used the same space for both teaching and therapy. However, active collaboration surrounding aims and approaches to music therapy and music education were not evident.

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4) The Children's Views. The practitioners shared the belief that, although they had established ideas as to what constituted music education and music therapy, the children may not be able to differentiate between the two practices so easily. There was a sense that the diverse range of musical experiences on offer at the school and the shared location of these experiences could serve to confuse pupils as to what each practice was for. The music teacher in particular gave several examples of the ways in which conceptual confusion among pupils may occur. For example:

> "The instrumental teacher has been coming in for about four weeks now and I heard some pupils sort-of-say "oh we're going for music therapy with [name omitted]" and I sort-of had – this was some of the senior classes – I said "right we've got lots of people coming into this school doing music, let's talk about what they do because [name omitted] does not provide music therapy he provides instrumental lessons" (Music Teacher)

The idea that some pupils with SEND may not be able to differentiate between music therapy and music education raises an important issue. In order to fully understand the similarities and differences between the two practices, it is thought that seeking the views of the pupils themselves is a matter of great importance.

IV. DISCUSSION

The findings presented above show that there are distinctions between music education and music therapy in each school. For example, all practitioners agreed that music education is teacher-led and predominantly focuses on musical goals, whereas music therapy is more child-led and predominantly focuses on non-musical goals. This supports Ockelford's (2000) educational framework as well as discussion in previous research literature (e.g. Bunt, 2003; Kemmelmeyer & Probst, 1981; Markou, 2010; McFerran & Elefant, 2012; Welch et al., 2001).

However, the degree of similarity between each practice and the crossovers that exist between them vary widely for each school. It is reasonable to hypothesise that this may stem from the way in which each school approaches the inclusion of music therapy as part of their overall curriculum.

For example, School 1's approach to the inclusion of music therapy in the school time table resembled that of an extra-curricular activity. More emphasis was placed upon the short-term inclusion of all pupils rather than the benefits that long-term more individualised therapy sessions may provide. This approach to music therapy inclusion meant that the therapist had to substantially alter her overall aims and objectives, significantly adapting the ways in which she would normally approach her sessions in order to meet the needs of the school. This was further exacerbated by the teachers' reluctance to relinquish control over pupils and their behaviour during therapy sessions. This had a considerable impact upon collaboration among practitioners, ultimately causing the therapist to feel isolated from her colleagues at the school. As such, the practice of music therapy and the practice of music education had far more distinctions at this school than they did crossovers and similarities.

In contrast, Schools 2's approach to the inclusion of music within their overall school time-table was much more holistic. Music therapy was viewed as a comprehensive component of the school's overall curriculum. The therapist was employed directly by the school and felt as though she was an appreciated and integrated member of the school's staff team. Although practitioners felt that there were key distinctions between music therapy and music education at the school, there were many crossovers between each practice. Interestingly, despite these crossovers, and despite collaboration being important to both the music therapist and the music teacher in this case, collaboration between them was not evident from the researcher's observations.

Robertson's (2000) concerns over who is best placed to teach music in SEND settings was also placed into context from data gathered during the case study at School 2. The school struggled to recruit a specialist music teacher and eventually employed a trained music therapist to teach music on an unqualified teacher basis. This echoes Robertson's thoughts and supports his idea for a specialist branch of SEND music education: educational music therapy.

However, further research is required in order to verify these findings, as conclusions cannot be drawn about the wider population (both national and international) on the findings of two case studies. Furthermore, the research presented above is not without its limitations. Many of the interview responses would have benefited from follow-up questions to help clarify the researcher's interpretation of the findings. Information pertaining to each participant's musical backgrounds would also have helped to further contextualise their interview responses. Finally, the research deals with a select number of participants and does not account for the fact that many SEND schools do not provide music therapy as part of their curriculum (Welch et al., 2001). Research which explores the role of music is SEND schools without music therapy provision would be beneficial.

There is still a great deal of research ground left to cover before enough empirical evidence has been gathered to start making claims for potential changes to the SEND music education system. However, the above case studies highlight that rooting research in the experiences of practitioners working in the field can be a powerful means of ensuring that any catalysts for change are embedded in the needs of those that such changes will affect the most. That said, SEND music education research has yet to explore the views of pupils. As identified by the practitioners at School 2, research which explores the children's views is paramount if practitioners and researchers are to begin to understand pupils' perceptions of music education and music therapy in their respective schools. Finally, cross cultural studies would be welcome to further contextualise current research findings.

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The effect of fear on human motor performance

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ABSTRACT

Background

The extent to which fast motor performance can be altered by fear and anxiety is currently debated (Carpenter, Horslen, Dakin, Inglis, & Blouin, In press; Reynolds, Osler, Tersteeg, & Loram, In press). Human and animal studies support the theory that anxiety increases sensitivity to self-motion to allow for faster motor performance to avoid possible harmful events (Balaban, 2002). To test fast motor performance, vestibular-evoked whole body balancing responses were induced using galvanic vestibular stimulation (GVS). GVS is delivered by percutaneously attaching electrodes behind the ears on the mastoid processes. Electrical stimulation stimulates the vestibular nerves and causes a perceived rotation in the frontal plane. During upright standing an increased whole body sway is induced towards the cathode electrode side, which is the opposite direction of perceived rotation. These motor responses were measured while standing on a narrow walkway at height to induce fear.

This motor performance is closely related to musical performance on stage. In both tasks a high motivation and fear of failure of accurate motor control within narrow constraints is present.

Aims

To investigate if fear influences fast balancing motor performance.

Method

For 16 young healthy adults GVS-evoked involuntary balance responses were studied while standing on a narrow walkway at ground level and at a height of 3.85 m to evoke fear of falling. Full-body 3d kinematics was collected, skin conductance was recorded as a measure of physiological arousal and questionnaires were filled out as a self-evaluation of fear (State Trait Anxiety Index and anxiety thermometer). Subjects' stood with feet together and eyes closed. In each condition 30 GVS impulses of 1 mA during 2 seconds (15 anode-left, 15 anode-right, randomly ordered) were applied at intervals of 20 seconds.

To investigate if fear modifies fast motor performance we analysed frontal plane joint angle acceleration throughout the whole body. Additionally, mediolateral linear acceleration of 12 nodes throughout the body was analysed: Head centre of mass (COM), upper thorax, shoulders, elbows, wrists, pelvis COM, knees and ankles. Instead of traditional statistical analysis of scalar data, we used statistical parametric mapping (SPM) to compare acceleration time series of the ground and height conditions. All SPM analyses were implemented using the open-source spm1d code (v.M0.1, www.spm1d.org)

Results

Acceleration peaks in joint angles and mediolateral displacement of body segments within 250 ms after GVS onset were found. The GVS response was fastest and largest in the neck joint and Head COM node, and relatively small in appendicular joints. These reflex acceleration peaks were increased at height compared to ground condition for appendicular joints and body nodes, whereas no height effect was found in axial joints or body nodes.

Conclusions

These results illustrate how appendicular fast motor performance (upper and lower extremities) can be modified through fear and anxiety, whereas early axial fast motor performance (neck and lower back) seems to be governed by different mechanisms and neural pathways that are more task invariant. As fear increased the gain of appendicular responses these effects may become detrimental in a vicious cycle of anxiety where a positive feedback loop induces stiffening and ultimately inability to move.

Keywords

Fear, anxiety, 3d kinematics, motor performance, vestibular reflexes.

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"Limits are relative" - Hearing-impaired children improve their musical potential

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ABSTRACT

Background

Hearing impairment (HI) is not normally associated with musical potential. It is defined as a physical hearing loss and/or a malfunction of perceptual processing in the auditory pathway, which seems to be an important predictor of reduced perception and performance of music.

Physical hearing loss is described as a conductive loss or a sensi-neural loss. Conductive losses concerning the loudness factor can be compensated by the use of hearing aids. Sensi-neural losses arise from disorders concerning the cochlea and affect the perception of sound quality or sound clarity.

Many hearing-impaired children suffer from conductive and sensi-neural losses. However, advanced technology in the last twenty years (digital hearing aids, cochlear-implants) enable hearing-impaired children to perceive sounds much better than before. It is conjecturable that these children can now discriminate musical patterns with all senses, including vibrotactile and visual stimuli and that they will be even able to generate auditory skills and voice capacities by musical practise.

HI in children most commonly leads to delayed speech and language acquisition, but is often accompanied by a range of multi-functional disorders ranging from somato-sensory to mental dysfunctions. Therefore, the developmental implications of HI may vary to a great degree from child to child. However only a small percentage of hearing-impaired individuals do not hear at all. Most of them have some residual hearing which can be fostered with musical programs. Musical capacities of hearing-impaired children might be limited by their hearing loss, but this does not vitiate musical responsiveness.

Both developmental and neuropsychological studies suggest close interactions between language and music domains in infancy and childhood as well as in adulthood. To date, there is paucity of research on musical competence and learning in children with hearing impairments (HI), and the relationships of musical competence to language acquisition.

Aims

The rationale of this study is to respond to the individual musical potential in hearing-impaired children in relation to general music skills and voice capacities. Moreover music and language perception can be modeled by a similar hierarchical structure. At the bottom we find the so called 'Low-Level competences'. These competences are responsible for the solution of time and frequency information. The ability to judge pitch, duration and time of sounds leads to more complex abilities in the recognition of sentences and melodies. Thus, the recognition of non-verbal stimuli is important to guarantee a phonological consciousness concerning the language acquisition process. In that way, musical practice leads to benefits in both domains

Method

A group of 31 children participated in this study. Each child was audio- and videotaped during spontaneous singing, dancing and movements and during their performances with music instruments (keyboards, guitar). The test battery is comprised of first a music attitude test for young children including time and pitch performances, second measures of intelligence (K-ABC) and measures of emotional aspects in spoken language. The control group had traditional rhythm lessons, whereas the model-group had active musical training with instruments (keyboard/guitar) – combined with embodied voicework.

Results

All participants showed an improvement concerning both metric-rhythmical and tonal competences. Cognitive skills, especially complex capacities, can be highly improved by instrumental learning (MG: M=8.43; SD=9.95; KG: M=-2.6; SD=7; p=.01). The subjects of the model group were able to enhance the difference frequencies of their voices mediated by instrumental learning and voice-work. That leads to a better modulation in speech; especially among those who have cochlear implants. This group profits significantly from voice development (MG/CI: p=.04; d=1.2).

Conclusions

Musical training supports hearing-impaired children to develop musical capacities. Instrumental practise leads to improved competences for the recognition of complex structures. The aural-oral-loop mediated by instrumental lessons and singing supports an enhancement of voice frequencies. Musical experiences can be saved as "Hearing vocabulary" in the auditory cortex. This kind of learning process creates the base to develop a musical self-concept for those children and offers the opportunity to discover their own musical culture. Hearing-impaired children have musical abilities above their language level. They are able to produce or reproduce melodies and perform on several instruments. The musicality of hearing impaired children is obvious and should no longer be neglected in music education programs.

Keywords

Hearing Impairment, Cochlear Implant, instrumental practice, voice development, musical self-concept

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Cross-cultural comparisons of absolute pitch and relative pitch in music students in different countries

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ABSTRACT

Background

Absolute pitch (AP) is commonly known to be an extremely rare and highly valuable musical ability. However, there are a few reports indicating that AP is relatively prevalent among musicians in East Asia (China and Japan) compared to the West (Deutsch et al., 2006, 2013; Miyazaki et al., 2012). More evidence is needed to shed more light on the prevalence of AP among different countries.

On the other hand, the musical significance of AP is called into question by the evidence indicating that some music students having AP performed poorer in identifying or recognizing transposed musical intervals and melodies than those having no AP (Miyazaki, 1995; Miyazaki & Rakowski, 2002). AP is no more than an ability to identify isolated pitches without any context. When we consider the fact that essential elements of music (e.g., melody and harmony) are constructed on the basis of pitch relations independently of AP, far more important is the ability to perceive relative pitch (RP), and AP is almost irrelevant to every aspects of music activities.

Aims

The present study aims at comparing the accuracy of AP and RP in music students among music conservatories and departments in different countries. To our knowledge, there has been so far no systematic research that has examined both AP and RP performances. With the AP and RP scores obtained from a large number of music students of different musical, cultural, and social backgrounds, we could evaluate the relationship between AP and RP across different music institutions and discuss their significance to music.

Method

We conducted AP and RP tests on music students attending conservatories and departments of music in different countries (Japan, China, Germany, Poland, and USA). The participants were grouped as follows:

- Music Program of Faculty of Education, Niigata University (NGTU), Japan, *n* = 143
- Department of Music, Kyoto City University of Arts (KCUA), Japan, *n* = 175
- Central Conservatory of Music, Beijing (CCOM), China, *n* = 63
- Shanghai Conservatory of Music (SCOM), China, *n* = 103
- Fryderyk Chopin University of Music (UMFC), Warsaw, Poland, *n* = 127
- Institute of Music, Martin-Luther University (MLU) Halle-Wittenberg, Germany, *n* = 61
- School of Music, University of Minnesota (UMN), USA, *n* = 100

The participants took the test in group setting with exactly the same instruction and procedure used. In the first AP test part, sixty recorded piano tones over a 5-octave range were presented in a nearly random order with an inter-tone interval of 3 s, during which the participants were required to write down their musical pitch labels. The latter part of the test was the RP test, in each trial of which an authentic cadece (V^7–I) was followed by a pair of successive tones; the first tone was always the tonic of the key established by the preceding cadence and the second tone was the test tone whose pitch was 1- to 11-semitone higher than the first tonic tone. The key of the chords-tones sequence changed in every trial. There were 4 different key conditions (C major, A flat major, F sharp major, and a major with a half-tone lower E as its tonic). The time interval between the onset of the test tone and the onset of the first chord of the next trial was 3.5 s, during which the participants answered a musical interval name or a movable *sol-fa* name of the test tone relative to the tonic. Before or after the test, the participants filled out a simple questionnaire about their music background.

Results

We summarized performance of the AP test results for each group as the median proportion correct responses and the percentage of participants who made 90% or more correct responses.

NGTU:	.750	35.0%
KCUA:	.950	60.0%
CCOM:	.667	25.4%
SCOM:	.533	27.7%
UMFC:	.150	11.0%
MLU:	.075	0%
UMN:	.083	0%

The Japanese participants stood out in their accuracy of AP. Remarkably, in KCUA, most students had accurate AP and those having no AP were in a tiny minority. Performance of the Chinese students was close to that of the Japanese students. To the contrary, only small minority had AP in UMFC and no in MLU and UMN.

According to the non-parametric Kruskal-Wallis test, the difference in the AP test score among groups was statistically significant ($\chi^2 = 373.86$, $df = 6$, $p < .0001$). Post-hoc pairwise comparisons revealed significant differences between the pairs, KCUA > all others, NGTU > SCOM, SCOM > UMFC, and UMFC > UMN ($p < .05$). Differences of percentage of the participants having accurate AP among groups were also statistically significant ($\chi^2 = 84.43$, $df = 4$, $p < .0001$). Tukey's multiple comparisons revealed significant differences between the pairs, KCUA > all others, and NGTU, SCOM, and CCOM > UMFC ($p < .05$).

For the RP test results, the median values of the proportion correct responses and the percentage of participants who made 90% or more correct responses were as follows:

NGTU:	.485	3.5%
KCUA:	.606	9.1%
CCOM:	.818	31.8%
SCOM:	.818	22.9%
UMFC:	.939	69.3%
MLU:	.848	36.1%
UMN:	.848	38.0%

The pattern of the RP performance exhibited remarkable differences, and its pattern was almost opposite to the pattern of the AP performance. The Japanese music students, most of whom had accurate AP, showed extremely poor scores in the RP test. On the contrary, the students in the Western countries showed much higher scores; remarkably, most of the UMFC students achieved the excellent level of RP. Performance of the Chinese groups was similar to the Western groups.

The difference in the RP test score among groups was statistically significant ($\chi^2 = 298.62$, $df = 6$, $p < .0001$). Post-hoc pairwise comparisons revealed significant differences between such pairs as UMFC > all others, NGTU < all others, KCUA < CCOM. Percentage of the participants who surpassed the level of 90% correct was also significantly different among groups ($\chi^2 = 190.69$, $df = 6$, $p < .0001$). Tukey's multiple comparisons yielded significant differences between such pairs as UMFC > all others, and KCUA and NGTU < all others ($p < .05$).

Some caveats should be noted regarding the differences among groups we compared. First, the NGTU group consisted of students of Faculty of Education and the MLU group consisted of students majoring musicology and music education. Therefore, participants of these groups should be different to some extent in the amount and degree of musical training they had received from those of other conservatory-level groups who might have had more extensive and professional music training. The lower AP and RP scores of NGTU than KCUA and no AP in MLU may be partially due to this difference. However, the higher AP score of the NGTU group and the higher RP score of the MLU group require other explanations.

Another caveat is regarding the difference in specialties of the conservatory-level students. For example, in the KCUA group, percentage of the accurate AP amounted to 90% of the participants majoring in piano, but it was about 30-40% of those majoring wind instruments or singing. On the other hand, percentage of the accurate RP participants was no more than 23% for the piano majors, less than 10% for string and wind instrument majors, and, oddly enough, 0% for the singing majors. In the SCOM group, the AP percentage was 74% for the composition and piano majors, as opposed to the string instruments (11%) and singing majors (0%). Percentage of the accurate RP was 45% for the singing majors, 35% for the Chinese traditional instruments majors, 19% for the composition and piano majors, and only 4% for the string instrument majors. In the UMFC group, the AP percentage was 29% for the students of sound engineering, and around 10% for the instrument majors. In contrast, the accurate RP participants was 91% for the sound engineering majors, and about 70% for the instrument majors. In spite of these considerable differences in the AP and RP performance among subgroups of different specialties in each group, there were greater contrasts in the overall AP and RP performance among the Japanese, Chinese and Western groups.

Conclusions

We found remarkable differences of the AP and RP performance among music students of different countries. Most salient features of the results requiring explanation are the high AP scores and the extremely low RP scores of the Japanese music students. We speculate that one of the most important factors that produce the high prevalence of AP in Japan is widespread early music education that facilitates acquiring AP as well as a favorable view of AP accepted in Japan, and that, once acquired, AP may have negative effects on the development of an ability required to perform the present RP task. Furthermore, it could be speculated that, in a class where most of the students have AP, usual ear-training may not be effective. It is likely that those who had acquired AP in early childhood may lose an opportunity to fully develop RP. The present results point out the problem of the current practice of music education, particularly of ear-training in Japan.

It is, however, important to note that this study is a correlational type and therefore it is not justified to discuss possible factors that produced the differences observed here. Speculations above mentioned should be taken as suggestions for future research.

Keywords

absolute pitch, relative pitch, pitch naming, ear training, cross-cultural comparisons

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Strategies for synchronization in music performance: The sniff

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ABSTRACT

Background

Synchronization is an essential part of ensemble performance. Musicians use different strategies to be able to start playing together and keep the same tempo. The cues for synchronization can be given either by the musicians themselves, or by adding an extra element such as a conductor or an automated time-keeper like a metronome or a click-track. Common methods used by the musicians themselves include counting, giving explicit gestural cues and sniffing. The latter method is often used when musicians are not able to mutually see each other and relies on a common knowledge of the musical content. Intriguingly, the sound of a single sniff does not contain explicit intervallic information. Nevertheless it is commonly used and appears to be a successful method to synchronize onsets in music performance. We hypothesize that the sniff functions as a sonification of a visual cue, translating the gesture of, for example, a conductor in an auditory trace.

Aims

We want to gain insight in the practice of synchronizing by sniffing. Is the method efficient, even when the performers can’t see each other and gestural cues are thus completely absent? How does the shape and timing of the sniff relate to aspects of musical structure such as tempo and meter? And can we actually relate the shape of the sniff to the shape of a gestural cue?

Method

Twenty couples of experienced musicians participated in the experiment. They were not able to see each other during the whole experiment, sitting back to back at about 2 m distance. A 4-channel sound recording was made, consisting of a stereo recording of the ambient sound and two mono recordings using small head worn microphones located close to the nose. The experiment started with a training phase in which both participants alternately had to give sniffing cues initiating single, synchronized claps. In the second phase of the experiment, participants were asked to clap series of simple rhythmic patterns of 5 or 9 elements, in three different meters (2/4, 3/4, 6/8) and three different tempi (fast, medium, slow). Instructions were shown on screens in front of each of the participants. The rhythms were displayed in standard music notation and the subject who had to give the cue saw a visual sign on the screen 5 to 8 seconds after the rhythm had been shown. Subjects were instructed to clap the rhythm following the sniffing cue, synchronizing with each other as well as possible.

Results

Indicating a single onset with a single sniff seems fairly successful, asynchronies staying below 200 ms, with an average of 70 ms. The average length of the sniff is 473 ms with a standard deviation of 110 ms.

When we look at the rhythmic patterns, we see that the duration of the sniff is clearly related to the tempo category, with an average of 640 (sd = 166) ms for the slow, 512 (sd = 139) ms for the medium, and 400 (sd = 121) ms for the fast rhythms. Meter does not seem to have a significant influence on the sniff duration. Despite this variation in duration, the time interval between the end of the sniff and the first clap stays relatively constant around 200 ms, with the person who gave the cue usually (63.5%) clapping first. For the rhythmic patterns involving tempo and meter, the synchronization at the first clap is more difficult, with an average of almost 100 ms. However, over the whole pattern, the mean asynchrony lies around 60 ms and for the last event in the pattern it goes down to about 30 ms. This asynchrony is similar across tempo and meter.

Conclusions

We explored the intriguing phenomenon of cueing using single sniffs in musical ensemble performance. A typical sniff used by musicians has a duration between 300 and 800 ms, but this is influenced by the implied tempo, making them longer to indicate slower tempi. As a method to synchronize single claps it is relatively efficient, asynchronies being usually in the range of asynchronies found in regular music performance. Different ideas about tempo lead to larger asynchronies in the longer rhythmic patterns. However, the participants usually succeed in synchronizing their claps towards the final event of the rhythmic pattern.

This experiment gives us a prototypical timing pattern of a sniff as used for synchronization between musicians and shows us how it changes in relation to the tempo and meter. This material can now be used to search for analogies in gestural cues, comparing the intensity pattern within the sniffing cue to, for example, the speed of a conducting movement.

Keywords

synchronization, ensemble performance, cueing

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Melody recall and recognition: The effect of musical features on memory

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ABSTRACT

Background

Much of the current literature on melodic memory investigates recognition ability (e.g. Dowling & Fujitani, 1971; Dowling, 1978; Halpern & Müllensiefen, 2008). Recently Müllensiefen & Halpern (2014) used a computational feature analysis of a large corpus of melodies to discover which features were related to implicit and explicit memorability in a standard recognition paradigm; currently no study has used this exploratory work to predict the memorability of melodies a priori.

Comparatively, there have been far fewer studies into recall memory of melodies. Since Sloboda and Parker's (1985) seminal work, only a few studies (e.g. Oura & Hatano, 1988) have used a singing recall paradigm, perhaps due to complex data generated by the experimental procedure that commonly requires a large amount of manual preprocessing. Consequently there is no strong evidence base from which to predict the recall memorability of melodies and no comparisons between recall and recognition memory of melodies. Computational methods to asses one melody's similarity to another (Müllensiefen & Frieler, 2004; Müllensiefen & Wiggins, 2011) offer a potential way to asses a performance's similarity to its target melody without large amount of manual processing.

Aims

Firstly, we aimed to test the predictive power of a feature-based model for melodic explicit and implicit memory developed in Müllensiefen & Halpern's (2014) exploratory study.

Secondly, we aimed to develop and validate a computational procedure to analyse audio data from melody recall experiments and to test predictions that tunes in major modes and duple meter are more easily memorised than those in minor modes and triple meter. Thirdly, we aimed to compare results from a recognition and a recall experiment on the same sample of participants.

Method

Sixty-four participants were tested, each taking part in a melody recall experiment and a melody recognition experiment.

In the melody recall experiment, participants were exposed to eight novel melodies (six times each) in turn, after each exposure participants were asked to recall the melody to the best of their ability. Stimuli for the recall experiment were selected to equally represent major and minor modality and duple and triple meter; two stimuli in each cell. These recalls were recorded, transcribed semi-automatically using the Tony transcription algorithm (Mauch et al., 2015) and converted into MIDI files.They were then computationally analysed for similarity to their target melodies using a similarity algorithm optimised for the comparison of melodies as described in Müllensiefen & Frieler (2004).

Stimuli for the recognition experiment were selected from a large database of commercial pop tunes in MIDI format as being either "low implicit/high explicit memorability" or "high implicit/low explicit memorability" as predicted by the feature-based statistical model idenified by Müllensiefen & Halpern (2014). In the test phase, participants were asked to identify which of the melodies they recognised from the exposure phase to obtain explicit memorability. They were also asked to give pleasantness ratings; exploiting the mere exposure effect to obtain implicit memorability measures (Zajonc, 1968; Halpern & Mullensiefen 2008).

Results

Analysis of the data from the recognition experiment confirms the predictive validity of the feature-based model from Müllensiefen & Halpern (2014) for stimuli associated with high explicit memorability. However, no effects were found for the tunes predicted to have high implicit memorability.

Results from the recall experiment showed a learning effect over six exposures to a novel melody and considerable individual differences among participants in their ability to learn and recall novel tunes.

However, there was no significant correlation between participants' performance in the recall and the recognition task.

Figure 1. Mean similarity scores by trial number: Illustrating the main effect of number of exposures to stimuli.

Conclusions

The results of the recognition experiment demonstrate the utility of the feature-based computational model for analysing the data from melody recognition experiments and predicting the explicit memorability of novel melodies.

Results of the recall experiment do not support the hypothesis that difficulty to memorise novel melodies is related to simple global features such as mode or meter. However, a feature analysis of individual stimuli of the recall experiment using the computational model that was employed for selecting the stimuli of the recognition experiment is planned as a next step and might reveal more insights into which features make novel melodies easier to memorise.

The lack of a significant correlation between the performance on the recall and the recognition experiment might be explained by singing ability as a confounding variable which is not related to memory processes.

Keywords

Memory, melodic memory, recall memory, recognition memory.

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The effectiveness of TV ads and the impact of music on ad perception: An electrodermal activity study

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ABSTRACT

Background

Music can be a highly arousing stimulus influencing the emotional experience of visual media. The measurement of electrodermal activity (EDA, aka galvanic skin response or skin conductance response) is a non-invasive way of quantifying the emotional arousal generated by an aesthetic experience. Previous research has suggested that music can influence the reactivity to TV ads. But the direct relationship between emotional arousal, music and commercial effectiveness of ads in the market remains unclear.

Aims

The first aim of this study was to validate the suitability of a new EDA measurement system that had not been used for music and emotions research so far by using a validated reference set of emotional stimuli. The second aim was to compare arousal responses to a set of commercially effective vs ineffective ads. Finally the effect of music on emotional arousal was assessed on a subset of ads that was presented with music to one group of participants and with the musical sound track removed for a second group of participants.

Method

Experiment 1 presented high- and low-arousal visual and auditory stimuli taken from International Affective Picture System (IAPS; Lang et al., 2008) and the International Affective Digital Sounds inventory (IADS; Bradley & Lang, 1999) provided by the University of Florida and a set of musical stimuli taken from Mas-Herrero et al. (2014) while recoding the EDA of 20 participants. In experiment 2, 20 ads (10 commercially effective ads and 10 ineffective ads, classified in terms of whether they had generated large business effects or not as taken from an industry effectiveness database) were presented to 33 participants while EDA was recorded. A subset of 10 ads was presented once with their original musical sound track and once with the musical sound track removed to the participants of both groups in a between-groups design. The data was analysed using Continuous Decomposition Analysis (CDA) and the traditional Trough-to-Peak (TTP) analysis. Event-related EDA as well as spontaneous EDA activity was analysed using linear mixed effects models.

Results

Experiment 1: Both CDA as well as TTP responses were significantly stronger for high arousal sounds and images compared to low arousal stimuli. Spontaneous EDA responses to musical stimuli were significantly greater than the responses to high arousal auditory (non-musical) stimuli.

Experiment 2: Effective ads generated significantly more spontaneous EDA responses than ineffective ads and the music versions of the ads produced more spontaneous EDA responses than the non-music versions.

Conclusions

The results of Exp. 1 indicate the validity of the new EDA system as a measurement tool for research on musical emotion induction. The results from Exp. 2 show the commercial effectiveness of ads can be directly linked to their potential to arouse emotions and that music is a significant driver of the emotional experience when watching TV ads.

Keywords

Electrodermal activity (EDA), Galvanic skin response (GSR), musical emotions, emotional arousal, TV advertisements

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Can correlations imply causation? Causal modeling and music psychology research

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ABSTRACT

Background

The gold standard for the assessment of causal effects are randomized controlled trials (RCTs). However, in many areas of music psychology (e.g. social psychology of music, research on musical expertise research) RCTs can be very difficult to implement because they can be expensive or unethical or the phenomenon of interest can't be replicated under controlled conditions. In these situations, it is common to publish tables of correlations even though the interesting questions concern the causal relationships between the measured variables. This practice is in line with the common view is that it is impossible to infer causal relationships from correlational, non-experimental data.

Aims

The aim of this presentation is to introduce modern causal analysis techniques to the music psychology community and to demonstrate how these techniques can help to identify causal relationships between variables from non-experimental datasets.

Method

We will describe two general causal analysis approaches – Rubin's causal model (Rubin, 2006) and graphical causal models (Pearl, 2009a, 2009b; Spirtes et al., 2000) - that have found widespread use in economics, the social sciences (Morgan & Winship, 2007; Morgan, 2013), and psychology (Foster, 2010; Stuart & Green, 2008). We demonstrate how causal models can be used a) to identify causal effects by controlling for confounding variables, b) to identify distinct clusters variables in highly multivariate datasets, and c) to potentially identify the direction of causal effects. In addition, we will describe different application scenarios for causal models and explain where they can be employed most effectively.

Results

We re-analyze published data (i.e. correlation tables) from previous music psychology studies and show how causal modeling can provide additional insights into the information contained in non-experimental datasets. Specifically, we show
- how accounting for confounding variables can greatly simplify the pattern of significant results,
- how structural relationships between variables in large correlational datasets can be identified and used to derive hypotheses for subsequent experimental research and
- how the causal effects size is often different from the magnitude of the reported correlation coefficients.

Conclusions

We advocate the use of causal models in music psychology for non-experimental data and demonstrate the potential to identify causal relationships from correlational data that might be tested in subsequent RCTs. We also show how causal modeling differs from more commonly used techniques (e.g. covariate adjustment in multiple regression). Finally, we discuss the limitations of this analytic approach and explain why and how it needs to be complemented by experimental research.

Keywords

Causal models, empirical methods, survey research, data reanalysis, mutli-variate analysis.

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The psychosocial profile of young musicians on the example of Polish music school students

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ABSTRACT

Background

This topic was inspired by numerous researches realized by music psychologists, which showed that there are significant differences between musicians and non-musicians, not only in the level of their musical abilities but also in the range of their psychosocial functioning.

Aims

The main aim of the research is to understand the psychosocial profiles of musically talented youth studying in professional music schools in Poland. Understanding their particular functioning style will be possible by comparing their results with the results of several control groups. The first control group are art schools students. The second control group are students attending general education schools, who do not have experience with artistic education. The specific objectives of the research will help to find answers to the questions of **whether** and **to what extent** musically gifted youth is different from their artistically gifted peers or peers without artistic talents, in the field of (1) temperament traits, (2) locus of control, (3) strategies for coping with stress (4) emotional intelligence level and (5) social competence.

Method

The research has a theoretical and practical character and was conducted on a group of more than 350 students (aged from 16 to 20 years). To accomplish this project selected psychological tests available in Poland such as the Temperament Questionnaire (FCZ-KT), the Locus of Control Questionnaire (KBPK), the Questionnaire for Coping with Stressful Situations (CISS), the Popular Emotional Intelligence Questionnaire (PKIE), and the Social Competence Questionnaire (KKS) were used. The results obtained allow for the use of statistical analysis to show the differences between groups (such as discriminant analysis), and to use correlation analysis to find the strength of the association between the selected variables.

Results

Research is in progress. However, the results of some tests allow the observation that they are statistically significant differences among music schools students and art school students or general education school students. For example, music school students have a higher level of (1) emotional intelligence, (2) internal locus of control, (3) sensory sensitivity and (4) in stressful situations they use more often a strategy of coping with stress focused on the task, and (5) they cope better with public exposure situations.

Conclusions

The results confirmed the hypothesis that youth learners in Polish music schools differ from their art talented and non-art talented peers in the level of prevalence of the psychosocial selected characteristics. They made it possible to observe that students with different profiles of abilities also differ in the specifics of their psychosocial functioning, which causes that they require different interactions in difficult situations. The results are also important to the formation of modern profiles of youth learning in art schools, for whom the musical activity is the first step to becoming professional musicians in the future. Dissemination of the results should contribute to a better understanding of psychosocial functioning of the artistically talented young graduates.

Keywords

Music school student, temperament, locus of control, strategies for coping with stress, emotional intelligence, social competences

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Social entrainment in the synchronous reproduction of musical pulse: Developments in childhood

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ABSTRACT

Background

Van Noorden and Moelants (1999) postulated a resonance around 2 Hz in our perceptual system to explain the range of tempi in which one can perceive a pulse or beat in music. In recent years this perceptual resonance has been linked to a resonance in human motor activity, as it has been observed that a normal adult-walking gait and the tempo of spontaneous repetitive movements of young children are also close to 2 Hz. (e.g. Drake et al. 2000).

Aims

The link between perception and motor activity can be studied in the synchronisation of tapping to the pulse of musical pieces. In order to perform an experiment with very young children it is necessary to give the experiment an ecological and familiar setting. As a consequence the experiment was run in little groups of 4 class mates together. While the basic results have been presented in a previous ESCOM conference, the focus of this talk is to present the results on mutual entrainment between the children, i.e. how they synchronise to each other while deviating from the exact beat of the music. See Figure 1.

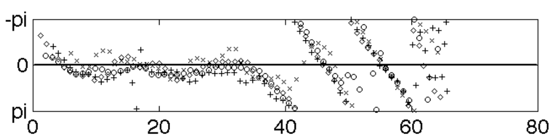

Figure 1. Example of mutual entrainment: during the first 33 beats of the music (horizontal axis) the four subjects in the group entrain together very closely to the 0 phase line of the beat (vertical axis, below the zero phase line is before the beat. Each marker is a tap. Its vertical position is the phase with respect to the beat). Suddenly all four begin tapping much faster and lose track of the beat of the music. It is rare that all participants do the same thing at the same moment, but serves here as a clear example.

Method

Children between the ages of 3 and 11 years old (N=392) were asked to tap to the beat of 50-second pieces of five common children's songs with a tempo between 80 and 160 beats per minute. To make the task clear to even the youngest children an avatar tapping along with the beat of the music was projected during the first half of each song. The seating had two conditions: peers visible and peers hidden. This varied the coupling between the children, which could influence their mutual entrainment. The children tapped with a little drum stick on a toy drum which was connected via a contact sensor to one of the channels of a multichannel ADC for sound registration. The music went to the 5th channel.

Results

Seeing their peers helped the children of 5 to 6 years old to synchronise better to the music. Children of 8 to 9 performed worse, especially the boys. See Figure 2.

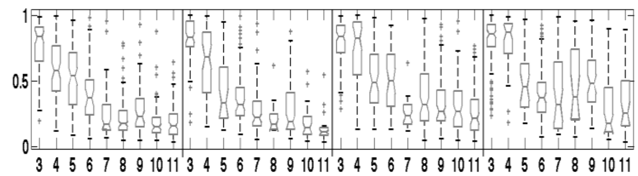

Figure 2. Circular variance of tapping as a function of the grade. Conditions left to right panes: girls, peers hidden; girls, peers visible; boys, peers hidden; boys, peers visible.

In many cases the children entrained to each other. Sometimes they lose the synchronisation with the beat completely while staying together in time. The entrainment is stronger (i.e. the time interval between the taps of peers are smaller) in the peers visible than in the peers hidden condition. The older children do this more than the younger ones. See Figure 3.

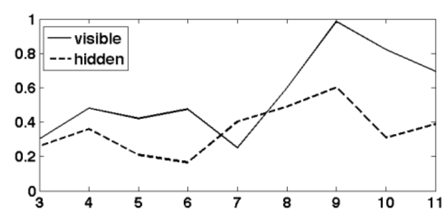

Figure 3. Mean best entrainment over the grades.

Conclusions

When people perform the same piece of music together they tend to stay together in time even if this means to lose the synchronisation with the accompanying music. Children do this already from a very young age onwards. But they have still to learn to be precise in their movement and to pay attention to signals of synchronisation.

Keywords

timing in children, resonance for musical pulse, period adaptation, phase synchronisation, mutual entrainment.

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Instrumental and vocal music teachers' views on a multi-disciplinary team approach to health promotion for musicians

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ABSTRACT

Performing Arts Medicine (PAM) has developed considerably since the 1980s; however, initiatives for preventing performance-related problems (PRPs) are still rare. Instrumental and vocal teachers have been identified as potential health promotion advocates who could work with representatives of a multi-disciplinary team (MDT) to support students' well-being. There is a lack of research investigating teachers' health-related experiences, beliefs and practices; the present study investigates these in relation to teachers' current and potential activities as health promotion advocates and members of MDTs. Thirteen teachers (selected on the basis of their willingness to participate, location, instrument, genre, and teaching environment) took part in semi-structured interviews. Transcripts were analysed thematically. Preliminary analysis indicates that teachers feel at least partially responsible for their pupils' well-being and assume the role of health promoters even though they do not generally believe that their training prepared them to do so. Interviewees reported learning about health-related topics during the course of their musical education from a wide range of sources, including those nominated in the PAM literature as appropriate members of MDTs. Most interviewees were unfamiliar with the concept of an MDT before the researcher introduced it towards the end of the interview. They were all receptive to the concept and agreed that it is appropriate for teachers to be considered health promotion advocates although they raised potential difficulties associated with developing an MDT approach to health promotion for musicians. Results will be of interest to musicians, providers of teacher training, PAM specialists, music colleges and universities.

I. INTRODUCTION

Performing Arts Medicine (PAM) has been developing since the 1980s and our understanding of the aetiology, epidemiology and treatment of performance-related problems (PRPs) has advanced considerably. PRPs are common amongst musicians and can have a serious impact on their professional and personal lives. Treatment may return musicians to near or fully functional capacity, but PRPs can cause physical and psychological distress, loss of income, and – in severe cases – cessation of musical activities. Most PRPs are preventable with appropriate education and support (Chan & Ackermann, 2014; Chesky, Devroop & Ford, 2002; Winspur & Warrington, 2010) and many researchers (e.g., Brugues, 2011b; Butler, 2005; Potter, 2012) agree with Ralph Manchester that "a sixteenth note of prevention is worth a whole note of cure"(2006b, p.1).

Da Costa and Vieira (2010) conclude from their review of risk factors for work-related musculoskeletal disorders that health promotion initiatives should call on the expertise of qualified professionals and the educated opinion of stakeholders in the target environment (see also Butler, 2005; Chan & Ackermann, 2014; Dehar, Casswell & Duignan, 1993). Potter (2012) identifies two forms of prevention:

1) Primary prevention, i.e. avoiding the onset of preventable impairments that result from overuse, poor ergonomics or incorrect technique
2) Secondary prevention, which involves promoting a better understanding of performance impairments in order for them to be addressed earlier in their presentation.

In music education, stakeholders include carers, classroom teachers, schools, tertiary-level institutions, musicians and above all the instrumental and vocal teachers who so often provide the gateway through which people learn to make music. These teachers have influential relationships with students and are involved in aspects of music education that relate to primary and secondary prevention of PRPs. Early experiences establish habits that can help or hinder musicians throughout their careers; it is therefore not surprising that researchers have argued that health promotion should be included in musical education from the very first lessons (Blackie, Stone, & Tiernan, 1999; Chesky, Dawson, & Manchester, 2006; Rosset i Llobet, 2004; Spaulding, 1988). There have been many calls for instrumental and vocal teachers to be trained in health promotion (e.g. Barton & Feinberg, 2008; Brandfonbrener, 2002; Britsch, 2005; Chesky et al., 2002; Guptill & Zaza, 2010; Hildebrandt & Nübling, 2004; Petty, 2012; Ranelli et al., 2011; Redmond & Tiernan, 2001); however, the opinions of teachers and other stakeholders are rarely sought or reported

Elite level athletes are surrounded by MDTs of experts that work together with a lead coach to support the athlete's performance (Taylor & McEwan, 2012). Although musicians have access to advice from a range of professionals – e.g. academic tutors, physiotherapists and doctors – these individuals rarely work as a team. Researchers have called for more interaction between stakeholders in musical environments to improve the quality and coherency of available information (Gaunt, 2011; Nagel, 2009; Williamon & Thompson, 2006). Palac (2008) recommends that health professionals should work with music teachers to ensure they base their teaching not only on musical but also psychological and biomechanical principles. Health professionals in the UK already diagnose and treat PRPs and are often involved with health promotion

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initiatives; however, they are unlikely to play a formative role in the development of musicians' beliefs, attitudes and behaviours. As the concept of health promotion gains momentum in musical communities instrumental and vocal teachers are regularly nominated as health promotion advocates. Research is needed to investigate teachers' perspectives on the appropriateness of this role and the practicalities of introducing an MDT approach into a musical environment. Accordingly, an interview study was undertaken with four main aims: to 1) explore teachers' demographic characteristics, identities, education and qualifications; 2) explore their personal experiences of PRPs and how they may affect their teaching; 3) investigate teachers' perceptions of health promotion and PRPs and current inclusion of health promotion in lessons; 4) introduce, if necessary, and consider an MDT approach to health promotion and the teacher's role in this approach. For reasons of space, this paper reports and discusses findings pertaining only to 4.

II. METHOD

A. Participants

Prior to the interview study an online survey was conducted. Respondents were recruited using a purposive, snowball sampling method via professional organisations, institutions, publications, professional contacts and social media. A total of 496 (30% male, 69% female; age range 18-90 years; mean age=46.24, SD=14.14) participated in the survey, which ended with an invitation to take part in further research. Those who accepted the invitation were contacted and 13 (9 female, 4 male, aged 21-70; mean age=47.77, SD=17.67; median age=54; see Table 1 for further information) were selected on the basis of their availability, location, instrument, teaching environment, and level of experience. Ethical approval having been granted by the researcher's institutional Research Ethics Committee, participants gave their informed consent and were subsequently debriefed.

B. Materials and Procedure

The researcher constructed a semi-structured interview schedule based on published literature, insights from previous research (Norton, 2012) and professional knowledge. It was designed to explore participants' experiences and views *prior to* the introduction of concepts from PAM literature and was divided into four sections: Musician and Teacher, Musical Performance and PRPs, PRPs in Pupils, and Teachers as Health Promotion Advocates. Interviews took place at the researcher's institution and in participants' homes and lasted 35-130 minutes (mean=76.15, SD=22.90). Interviews were recorded using a portable Dictaphone and transcribed by the researcher. Having checked transcripts against the recording she invited participants to remove or alter information that identified them or that they did not wish to be included.

C. Reflexivity

The researcher is a postgraduate student and professional instrumental teacher in the North of England. She works with the British Association for Performing Arts Medicine (BAPAM) as the Manager of their Student Advocate Scheme. These roles, together with personal experience of PRPs, enhance her understanding of the interview topics, and she shared her experiences with participants when appropriate. The researcher anticipated that participants' personal health would be discussed during interviews and where appropriate listened sensitively, made participants aware that she is not medically qualified and gave details of resources that may be of interest.

D. Analysis

Thematic analysis was undertaken following the guidelines outlined by Braun and Clarke (2006). It was primarily researcher-driven as there was an existing coding frame (including identification of potential MDT members in the PAM literature, nomination of the teacher as a health promotion advocate, and questions about preparation for this role), and the researcher introduced the concept of the MDT approach to participants.

Table 1. Participants

Pseudonym	Interview length	Age (years)	Sex (M/F)	Primary Teaching Instrument Family	Teaching experience	Genre of musical activities	Self-reported professional identity
Henry	70 mins	70	M	Keyboard Instruments	11-20 years	Classical, Jazz, Baroque & Early Music	Musician who performs and teaches
Mary	55 mins	68	F	Keyboard Instruments	31-40 years	Classical	Instrumental teacher
Felicity	86 mins	62	F	Keyboard Instruments	>40 years	Classical	Instrumental teacher
Diane*	130 mins	60	F	Solo Voice	21-30 years	Classical	Vocal teacher
Harriet	75 mins	57	F	Keyboard Instruments	31-40 years	Classical, Jazz Contemporary	Instrumental teacher
Gemma	90 mins	55	F	Choral Voice	5-10 years	Classical, World Contemporary	Vocal teacher
Sophie	75 mins	54	F	Plucked Strings	31-40 years	Jazz	Performing musician who also teaches
Kate	75 mins	50	F	Percussion	21-30 years	Classical, Contemporary	Instrumental teacher
Amelia	56 mins	49	F	Woodwind	5-10 years	Classical	Performing musician who also teaches

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George	75 mins	30	M	Plucked Strings	11-20 years	Jazz, Contemporary	Musician who performs and teaches
Scott	98 mins	23	M	Brass	3-4 years	Classical	Postgraduate researcher
Ben	35 mins	22	M	Bowed Strings	1-2 years	Classical	Performing musician who also teaches
Lauren	70 mins	21	F	Woodwind	1-2 years	Classical	Classroom music teacher

*Data provided by Diane is not included in this report as her transcript has not yet been anonymized and approved.

III. FINDINGS

To the researcher's knowledge this study is the first to focus on UK instrumental and vocal teachers' experiences and beliefs about health promotion. Given the lack of previous research, findings will be presented in three sections (personal experiences of health-related learning, beliefs about responsibility for pupils' health, and responses to the concept of an MDT approach to health promotion and the teacher's role within the team) and followed by a conclusion relating the findings to the literature outlined in the introduction.

E. Personal Experiences of Health-related Learning

Interviewees described learning formally and/or informally about health-related topics from a range of sources including individuals (e.g. their teachers, colleagues, doctors, and Alexander Technique teachers), organisations (e.g. their educational institutions, or professional bodies), and resources. In addition, four interviewees reported gaining knowledge and understanding through their personal experiences.

Other than Mary, all interviewees reported receiving health-related information from their teachers; Scott, Sophie, Amelia, Harriet and George all specified particular instances of their teachers telling them how to protect their health and Gemma commented, "every singing teacher has their own favourite remedies for dealing with sore throats, coughs and colds." Four interviewees reported learning from students (sometimes their own children), for example: one of Amelia's students had soft palate problems and Harriet said that "having my children has broadened my attitude to how I teach." With the exception of Mary, who teaches in relative isolation, all interviewees recounted anecdotes about colleagues' PRPs, which added to their own understanding of PRPs and their potential impact. George and Henry's colleagues also shared recommendations for the management of PRPs. Interviewees' experiences of support and/or training provided by educational institutions and professional companies were mixed; examples of learning opportunities were provided by George, Amelia, Gemma and Lauren but Ben said he couldn't remember if health education was available at college as, if it was, he "probably didn't listen". Kate's music service offered support and training but in the two cases reported she believed that the outcome was unsatisfactory.

Amelia, Kate, Lauren and Henry reported consulting health professionals about PRPs, without complete success. George observed that "it's a bit of a lottery whether you get a GP who will be sympathetic, and will believe that you're injured." He, Ben and Gemma have health professionals in their families and Amelia has a background in nursing; all four said they would seek advice from these sources. BAPAM is a national charity that provides specialised support for performing artists. Three interviewees did not know about BAPAM, five were aware of it but not in detail while Sophie, George, Felicity and Lauren had accessed their services and/or resources. Eight interviewees referred to the Alexander Technique. Henry, Gemma and George have received lessons and George believes he is now "a lot more aware of my body… and what it's doing." Sophie finds books about the technique useful and Harriet, having encountered it on a CPD course, reported that she now does "a tiny bit of Alexander Technique with the slouchers." Lauren and Kate did not comment on the one-off sessions they had participated in but Scott described his first experience as having been delivered by a "completely disconnected woman [who] came in and said to a group of slightly hungover, slightly disinterested, first years in a class of 80 in a hall 'lie on the floor for ten minutes.'" Kate sees an osteopath approximately every six months but otherwise interviewees reported consulting no other health professionals.

Interviewees have consulted a range of resources including books, internet and print articles, research reports, and continuing professional development (CPD) events. Most interviewees enjoyed learning from CPD courses; according to Amelia, "the thing I prefer above all else is to go and have a day and you can talk about it with the experts." However, they suggested that it can be difficult to find the time to go and sometimes the content is irrelevant or unhelpful. The majority of interviewees use the internet and read books, but Henry (70 years old) is "not terribly happy using the computer" and George (30 years old) believes he is "not very good at reading books." Henry advocated considering topics "from many points of view" because, as Scott pointed out, "the more lenses you see something through the better it is understood."

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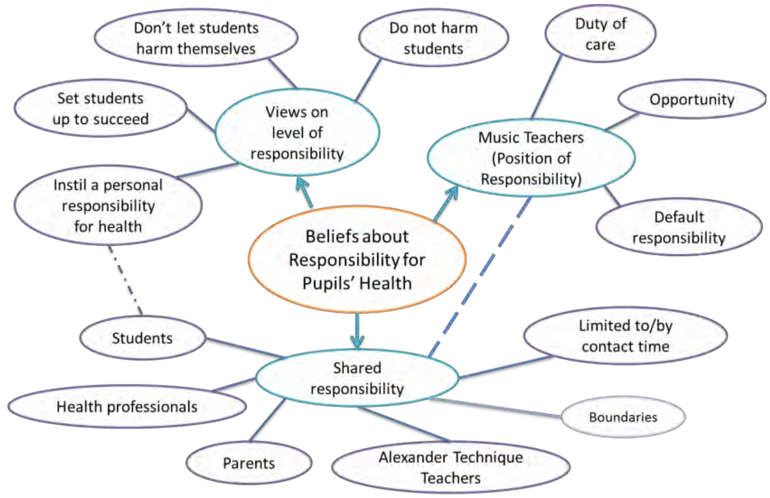

Figure 1. Thematic map of interviewees' beliefs about responsibility for pupils' health.

F. Beliefs about Responsibility for Pupils' Health

Survey study respondents rated the extent to which they believe they are responsible for their pupils' health from 1 (not at all) to 7 (wholly responsible). The mean response for the full sample (N = 426) was 4.63 (SD = 1.40) with a range of 1 to 7 and a median and mode of 5; when the 13 interview participants responses' were extracted it was found that they ranged from 1 to 6 with a mean of 3.92 (SD = 1.19) and a median and mode of 4. Survey respondents had been invited to expand on their ratings by writing free text in the comment boxes provided. The data thus obtained were categorised as follows: Responsibility for Certain Aspects, Shared Responsibility, Position of Responsibility, Limited Responsibility and Miscellaneous. During their interviews participants spoke most about topics relating to Shared Responsibility and Position of Responsibility and offered suggestions regarding different levels of responsibility in terms of protecting pupils' health (see Figure 1).

Interviewees identified teachers, parents, students and health professionals as those who share responsibility for music students' health. While some survey respondents mentioned professional boundaries, George was the only interview participant to comment that "there's nothing worse than someone who is not medically qualified giving medical advice". Some interviewees felt that teachers have a "duty of care" (Gemma and Kate) or an "ethical prerogative" (Scott) to protect pupils under their supervision. For example, George would let someone know if a pupil was upset and Harriet said that "if you see something that you know isn't quite right…you do something about it." Four interviewees believe that teachers are responsible by default because "your main point of contact is your teacher" (Lauren), "[pupils] don't get any other time with their instrument and someone else" (George) and, as Kate concluded "as a teacher you're responsible for putting that knowledge out there…otherwise where will they get it from?" However, Gemma and Kate believe that students are responsible for taking the advice provided:

> …all of the best teachers in the world are not going to prevent somebody who wants to throw themselves at the cliff from throwing themselves at the cliff. But your responsibility as a teacher is to make sure that they know what they're doing. (Gemma)

Scott, Sophie and Lauren raised the issue of limited contact time and suggested that teachers are responsible for pupils in lessons, but that "once they're out of your sight it's really difficult" (Sophie) and "you can't always be there when they're practising" (Lauren).

Interviewees offered suggestions regarding different levels of responsibility in terms of protecting pupils' health: i) not intentionally harming pupils, ii) not allowing pupils to harm themselves, iii) setting pupils up to succeed and iv) teaching pupils to take responsibility for their own health. Scott and Amelia believe that the adage 'do no harm' applies to pupils' psychological and physical health. Aside from harming a pupil, interviewees suggested that teachers should convey "good practice" (George) to ensure pupils "are not harming themselves" (Henry, also Mary) thereby preventing them developing health problems "40 years down the line" (Amelia, also Felicity). Sophie works for a large UK music organisation and stressed the importance of prevention initiatives because musculoskeletal damage "takes ages to mend" and with hearing damage "you don't get it back". Some interviewees believe that being a teacher is "all about setting your students to up succeed" (Lauren). This appears to be based on the belief that health and technique are "bound together to some degree" (Lauren) and therefore it is essential to "set [pupils] up with the right technique to help them through" (Scott). Amelia said that this needs to happen throughout the learning process and Felicity believes that her ultimate goal is to "give them the tools so that they can do it without me". Sophie and Gemma also referred to the need for musicians to take responsibility for their own health: "preparation for any kind of performance health-wise is a responsibility that has got to be taken seriously" (Gemma). Finally, three interviewees commented that the appropriate level of intervention depends on pupils'

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age – "input is going to be different form a 7 year old to a 60 or 60 year old" (Henry) – and ambitions. Scott and Ben moderate their actions according to what stage a pupil is at and whether they are planning to become a musician. In comparison, Sophie believes that "it's not fair that you only get access to [Alexander Technique] if you do a music degree…the more information there is out there the better".

G. Interviewees' responses to the concept of an MDT approach to health promotion for musicians and the teacher's role within this team.

In the final interview section the researcher introduced participants to the field of PAM, the MDT approach recommended in PAM literature and the proposal that music teachers could be health promotion advocates; their familiarity with these concepts varied and the introduction was tailored accordingly. Interviewees considered who might be involved in an MDT, discussed the extent to which an MDT approach currently exists and commented on the practicality of supporting an MDT.

Various types of doctors, counsellors, Alexander Technique teachers, physiotherapists, massage therapists, psychologists, music organisations, teachers and students were nominated by interviewees' as members of musicians' MDTs. Two interviewees reported that they already have access to MDT representatives: Gemma commented that "they've never formed a team, but there are lots of people out there to whom I would go for advice" and Henry has personal experience with various professionals and would "certainly volunteer the names of these people" to pupils. Conversely, eight interviewees do not believe that a consistent MDT approach currently exists. Scott feels that access to support from an MDT is "a complete lottery based on the mentalities of the people you're studying with." Mary, Sophie, Amelia, and Harriet commented that it is difficult to know what is going on elsewhere: "there might be some enlightened place in the UK, I haven't heard of it…it's a lack of integrated, co-ordinated strategy about how to go about it" (Sophie). Felicity recounted an incident where a teacher had attempted to seek help for a student but had been blocked by their educational institution. Lauren felt it would be "fruitful…to have those discussions going on" and Harriet believes that the MDT approach used in mental health care could work for musicians.

None of the interviewees disagreed with the suggestion that instrumental and vocal teachers are ideally placed to act as health promotion advocates. Most interviewees were, in fact, very supportive and commented that it was "entirely appropriate" (Amelia), "totally reasonable…it would probably have to work that way" (George). Harriet suggested that as "music is cross-curricular" then "why shouldn't you be doing health education as well?" Likewise, Mary believes that teachers have "an ideal opportunity to teach all kinds of things beyond what appears to be their job". Kate agreed but suggested that it is only reasonable if appropriate training is available. Gemma expressed the reservation that care must be taken not to "suffocate the beast", i.e. introduce too many requirements so that teachers have "no time to do what it is people are wanting." In Gemma's experience, singing teachers are "very aware" of their students' health because it is "inescapable"; compared to other instruments the voice is "more vulnerable to being knocked off its perch and losing pitch and tone". With the exception of Gemma, interviewees were unsure whether UK teachers currently engage in health promoting-behaviours but the general feeling is that "it would completely depend on the tutor…it's not institutionalized at all. It's not the norm" (George).

Almost universally, interviewees said that their musical training had not prepared them for a health promotion role. Gemma and Lauren's tertiary-level courses did not include formal health education. Amelia attended an institution that runs a pedagogy module (which she believes covered performance anxiety and physiological topics) but commented that "linking that to teaching is not always done overtly, so it depends on the individual and how 'up' they are on putting things together". Felicity stated that none of the music teacher training courses address health education. Only Ben felt his training would provide him with the information he needs, or as he said: "I reckon I could deal with most things". Ben's closest counterparts in terms of age and experience believe that the training available does not adequately equip a teacher to act as an advocate (Lauren) and is "a complete lottery based on where you work and who you work with" (Scott). Gemma said she has had "access to good training" and Sophie commented that many teachers have been "taught very well". However, Felicity suggested that if teachers did not learn about health-related topics during their time as learners then they cannot teach them; she also believes that many teachers do not know how to deal with their own PRPs and are therefore unable to help their pupils. Seven interviewees discussed the need for teachers to develop a "more formalized awareness" (Gemma) of health promotion. Amelia feels that she is "more clued up than most" because of her background in nursing; when thinking about young teachers she said "there must be things on university courses, is there?" Mary commented that "it is to my pupils' detriment that I'm a better teacher now" and suggested that young teachers should be "more aware of the possible problems". Sophie believes that the lack of an integrated national policy has resulted in "pockets where there is absolutely nothing…and pockets where it is sort of ok". Felicity suggested that teachers must be involved early on in their careers to contribute to the prevention of PRPs and "put the word out" to other musicians. Lauren would like to learn more about physical problems so that she can "help in a meaningful way" and would like to gain this knowledge through membership of an MDT. Reading a book or doing an e-training course is inadequate for Kate as she thinks teachers need practical experience and the opportunity to ask questions. Henry queried whether teachers would need to do "extra qualifications in a little bit of psychiatry…or the Alexander Technique" to appropriately aid their pupils. Felicity suggested that a CPD course of one-off days delivered over the course of a year by medics ("because I want to know that they really know what they're talking about") coupled with "a teacher who I can respect" would be ideal. Gemma warned against putting people off teaching, or undermining teachers' confidence "because they didn't have all of these things".

Despite their positive – and sometimes wistful ("in my dreams" [Harriet]; "in an ideal world" [Kate]; "Ooo, that would be nice wouldn't it!" [Felicity]) – reactions to the idea of introducing an MDT approach for musicians interviewees voiced concerns regarding practicalities such as "cost…time…availability" (Harriet), communication, dissemination of information, and who an MDT approach would be appropriate for. Scott referred to pupils ending up "between a rock and a hard place" if they received contrasting advice from MDT members. Amelia believed "there could be some merit in working together" but found it difficult to imagine how that would work in practice. Amelia questioned how you reach "the myriad of private teachers who are not affiliated to any kind of official bodies" and Felicity wondered whether teachers who are doing it for "pin money" would be motivated to engage with training. Sophie believes teachers are "doing great stuff" but because they are "scattered to the four winds" it is hard to get hold of them. Harriet suggested that using "cyber space" would be helpful. Two interviewees raised the issue that the MDT approach would cost money and that "there's less money in music than there is in sport" (Ben); this led Kate to suggest that teachers are better placed to help younger students. Sophie offered practical advice on accessing funding to run a pilot study and test whether the MDT approach is feasible and effective. When considering who the MDT approach would be most appropriate for interviewees generally believed that it would apply to "the ones who are serious about [music]" (Harriet):

> I think [at] the low end of the pyramid…the benefits of musicking are great. The more concentrated you get, the more hazards there are, and the more careful you've got to become, the more specialised knowledge, and the more of a team of back-up that you're going to need….I think that if you're down here – teaching the bottom of the pyramid – you're dealing with common sense (Gemma).

Scott could imagine how the MDT approach might work in the "rarefied environment" of a conservatoire, but could not see it working in a "broader sense". Henry believes that those who are aiming to be professional musicians should have access to an MDT as "the demands of creating a career in music are fairly horrendous" but if pupils are not aiming to be professional he suggested that "less is probably advisable". However, Kate commented that the MDT approach might be practical if a teacher was working in a school with a lot of pupils and Sophie firmly believes that these opportunities should be available to all musicians.

IV. CONCLUSION

The results reported here are based on a preliminary analysis of interview study data. It is clear that interviewees have experienced elements of an MDT approach to health promotion during their training, however informal. The individuals and resources they consult are included in the MDT advocated by PAM specialists. From their descriptions it appears that interviewees' most positive and influential interactions are with other relevant stakeholders rather than qualified professionals. The value of relevant stakeholders as information sources should not be underestimated or undermined. However, future research should investigate why musicians favour stakeholders over qualified professionals, and whether it is possible to redress this imbalance. The teachers in this study support the suggestion made in PAM literature that instrumental and vocal teachers are ideally placed to act as advocates and should be included in the MDT. Interviewees believe they are responsible for their pupils' health and are already engaging in health-promoting behaviours; from their accounts it is clear that they regard themselves as key stakeholders in their pupils' musical environments. Palac (2008) suggests that health professionals should provide the knowledge upon which teaching principles are based. Although based on a small sample, the results of this research suggest that UK teachers are not consistently gaining access to knowledge that is appropriate and up-to-date and therefore do not feel confident that their teaching is founded upon sound principles. Interviewees are generally in favour of an MDT approach to health promotion, but raised concerns regarding the practicality of implementing this approach within musical environments. These concerns must be explored in more detail in order to develop health promotion initiatives that are suited to their target environment and which will be well received by teachers and other relevant stakeholders.

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Health and wellness education for musicians: Investigating music teachers' perspectives

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ABSTRACT

Background

Musicians are vulnerable to the development of performance-related problems (PRPs) such as noise-induced hearing loss (NIHL), music performance anxiety (MPA), and musculoskeletal disorders. Research suggests that PRPs are prevalent amongst a range of musical communities including young, pre-professional and professional musicians (Ginsborg, Spahn & Williamon, 2012; James, 2000; Kreutz, Ginsborg & Williamon, 2008; Leaver, Harris & Palmer, 2011; Ranelli, Straker & Smith, 2011; Williamon & Thompson, 2006). Researchers have begun to investigate the effect of PRPs on musicians' lives empirically, using mixed and qualitative methodologies. Results suggest that PRPs affect physical, emotional, social and financial aspects of musicians' lives; that disruption of the ability to make music can be devastating and career-threatening; and that PRPs interfere with musicians' enjoyment of playing, relationship with their instrument and artistic expression. (Guptill, 2011; Schoeb & Zosso, 2012).

Most PRPs are preventable provided appropriate education and support are available throughout a musician's training and career (Chan & Ackermann, 2014; Winspur & Warrington, 2010; Wynn Parry, 2003). Instrumental and vocal music teachers provide training and support and therefore may be ideally placed to act as health promotion advocates. Researchers have called for music education to include information about prevention of PRPs from the first lessons (Blackie et al., 1999; Chesky, Dawson & Manchester, 2006; Rosset i Llobet, 2004) and therefore for instrumental and vocal teachers to be trained in appropriate health promotion strategies (Barton & Feinberg, 2008; Guptill, 2012; Guptill & Zaza, 2010; Palac, 2008; Petty, 2012; Ranelli et al., 2011).

Despite these calls, research investigating teachers' experiences, beliefs and current practices regarding health and wellness for musicians is very limited. Only six papers have been published regarding music teachers' knowledge and awareness of PRPs (Barrowcliffe, 1995; Brandfonbrener 1989/1990; McKechnie & Jacobs, 2011; Quarrier, 1995; Redmond & Tiernan, 2001; Rogers, 1999) all of which report studies undertaken in the USA using primarily survey methods with predominantly instrumental teacher respondents. The findings of these studies suggest that music teachers and students would benefit from, and would like to receive, structured health education. Hildebrandt and Nübling (2004) provided teachers with health education in order to assess the effect of such training on teaching practices; results indicated a positive influence and the investigators called for further research. A PhD research project in the UK (see Atkins, 2013) explored occupational health and wellbeing provision in the conservatoire sector using semi-structured interviews with a range of staff, including primary study teachers; participants expressed a desire for health education to be incorporated into everyday conservatoire life. To date, no research has explored UK music teachers' personal experiences with PRPs, beliefs and current practices regarding health promotion, or interest in this subject for their own – or their pupils' – benefit.

Aims

The present study aimed to: provide preliminary data regarding UK music teachers' experiences with PRPs; understand where, how and why teachers access information and health; and investigate teachers' current beliefs, practices and interest in this subject.

Method

A survey based on existing literature and a pilot study was designed using the online software 'eSurveysPro'and administered online via purposive and snowball sampling from August 2013 to February 2014. A mixture of 50 single choice and open-ended questions were presented in four sections: teacher profiling, performance-related problems, beliefs and practices relating to health, and interest in further education. Results were analysed using descriptive statistics and thematic analysis.

Results

Respondents were 502 teachers from a variety of musical genres and instrumental groups (female 69%, male 30%, age range 18-90, mean age = 46.24). Physical symptoms such as pain, weakness, lack of control, numbness and tingling had been experienced by 69% of the sample with 30% currently experiencing such symptoms. Respondents were asked whether they had experienced a "marked and persistent anxious apprehension relating to music performance": 55% had at some point and 28% were currently experiencing these symptoms. A small percentage of respondents (6%) had been diagnosed with NIHL and a further 19% had hearing difficulties but did not know what caused them.

Most participants reported feeling responsible for pupil well-being and shared their beliefs regarding why they feel

responsible in an open-ended text box. Thematic analysis of their responses suggests that teachers believe that being a teacher is a position of responsibility, but that this responsibility is shared with others (including the student) and can relate to performance and/or general health. The level of responsibility can be limited by a variety of factors. Other responses related to the similarities of music and other performance disciplines, the importance of training for teachers and the positive effects of music on health. Respondents report already discussing PRPs with their pupils and spending time adjusting posture, technique, instrument size, positioning and adaptations, and environmental factors such as lighting and temperature. The primary source of respondents' knowledge of PRPs is personal experience. Seventy-four percent of respondents offer basic advice regarding how to manage PRPs but refer pupils to specialists (primarily doctors or physiotherapists but also body awareness technique teachers and other musicians) if symptoms persist. Most respondents said they would like to know more about health and wellness and would prefer to learn via the internet, books, and face-to-face lectures.

Conclusions

Instrumental and vocal teachers are ideally placed to act as health promotion advocates and to a large extent are already fulfilling this role because they feel at least partially responsible for their pupils' health and wellness. In order to protect the health of pupils and teachers it is imperative that further research is conducted to facilitate the development of resources that are accurate, practical and appropriate to the context. The design of such resources should include input from all relevant stakeholders and must respect the beliefs, experiences and expectations of instrumental and vocal teachers.

Keywords

Music, health, well-being, teacher, education, advocate

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Exploring the relationship between motor execution and motor imagery in expert pianists using chronometry and pupillometry

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ABSTRACT

Background

Kinaesthetic motor imagery (MI) is an extraordinary human cognitive capacity which allows individuals to simulate and experience actions without engaging in the physical movements involved (Moran, Guillot, MacIntyre, & Collet, 2012). Research has demonstrated that the systematic use of MI enhances skilled-performance in sport, medicine and music, and that actual and imagined actions share similar neural substrates (Hetu et al., 2013). So, what accounts for such effects?

According to Jeannerod's simulation theory (2001), the 'functional equivalence' between actual and imagined actions offers a plausible explanation for the positive effects of MI. Briefly, this theory suggests that imagery and physical execution of actions share representations of movement at neural and cognitive levels. Support for such functional equivalence comes from studies comparing the neuroanatomical substrates, and movement durations (as measured by chronometry; see Guillot, Hoyek, Louis, & Collet, 2012), of actual and imagined actions. Mental chronometry paradigms operate on the assumption that cognitive processes are susceptible to measurement using temporal indices. Therefore, an examination of the durations of actual and imagined actions provides an opportunity to explore how both movement types are represented in the mind and whether they rely on similar motor representations. Indeed, temporal congruence between actual and imagined actions has been demonstrated in numerous contexts (for review, see Guillot et al., 2012). However, studies have also demonstrated that temporal congruence is affected by variables such as the level of individual expertise (experts are most accurate; Reed, 2002) and the level of movement complexity (complex actions typically result in longer imagery durations than simpler ones; Calmels, Holmes, Lopez, & Naman, 2006). Unfortunately, few studies to date have investigated these effects and no research has explored the temporal equivalence between the actual and imagined *complex* movements of *expert* pianists.

Aims

The aim of Study 1 was to investigate temporal aspects of the relationship between the actual and imagined complex piano performances of expert pianists. Study 2 aimed to explore for the first time certain attentional aspects of actual and imagined piano playing using pupillometry (the measurement of pupil size is an index of mental effort; Laeng, Sirois, & Gredebäck, 2012).

Method

In Study 1, nine expert pianists (6 Men; 3 women) (M = 40.7 years, SD = 13.68 years, range = 24 - 61 years) participated. In study 2, seven expert pianists participated (6 men; 1 woman) (M = 36.43 years, SD = 15.29 years, range = 20 - 61 years). All participants satisfied the conventional criteria of expertise (see Moran et al., 2012). The Movement Imagery Questionnaire-2 established participants' MI abilities. Both studies used the same bespoke musical composition which used extracts from Brahms' 51 Exercises for piano. The composition had four stages - two complex and two less complex. Complexity was operationally defined by the texture of the music and the hand-movement patterns involved. Participants learned the music prior to the experimental session.

During the experimental session, participants firstly actually performed the music on a piano while following the music notation. A metronome speed of 76 crotchet beats per minute was given for 5 seconds immediately prior to the performance. Following this, and maintaining the same seating position, participants performed the music using MI. Their hands were placed palms down on corresponding thighs and were kept still throughout (observed by the experimenter). During the actual/imagined performances, participants pressed a button (Cedrus Response Pad) with their foot at the start of each stage of the composition and at the overall conclusion. The Pad was connected to a laptop to record, using SuperLab Software, the duration of each stage of the composition.

Study 2 followed the same procedure, only prior to the performances a mobile eye-tracking system (Tobii glasses) was fitted to capture pupil-size measurements. Consistent room luminance was maintained throughout. In Study 1, the mean numbers of milliseconds required by participants to execute/imagine performing the entire musical composition and each of its component stages were analysed. In Study 2, the mean percentages of the average values of the right pupil size measured during calibration for actual and imagined performances of the entire musical composition and each of its stages were analysed.

Results

In Study 1, a one-tailed paired sample t-test revealed that on average participants executed the entire piano performance (M = 71185, SD = 3051) *quicker* than they played it in their imagination (M = 81099, SD = 7350), t (8) = -3.783, p < .05.

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To investigate the effects of complexity on timing mean durations were examined using a 2 (mode: executed and imagined) x 2 (stage: complex and less complex) repeated measures analysis of variance (ANOVA). This revealed a main effect of mode, $F(1,8) = 14.313$, $p = .005$, and a main effect of stage, $F(1,8) = 7.481$, $p = .026$, on the number of milliseconds for movement. There was no significant interaction. A series of post-hoc paired samples *t*-tests (where the alpha value was set at $p < 0.008$ using Bonferroni correction) revealed that on average, executed playing of the complex movements ($M = 17583$, $SD = 826$) was significantly *quicker* than was their imagined playing of them ($M = 20044$, $SD = 1934$;), $t\ (8) = -3.596$, $p < .008$. No significant difference was found between the mean duration required for execution of complex movements ($M = 17583$, $SD = 826$) and that required for execution of less complex movements ($M = 18010$, $SD = 848$). Similarly, no differences were evident between the times required for imagined playing of complex ($M = 20044$, $SD = 1934$) and less complex ($M = 20505$, $SD = 1777$) movements. The results of Study 1 showed that the durations for expert pianists' to imagine performing the entire musical composition and the complex and less complex stages were *longer* than those for actually performing them.

In Study 2, chronometric measurement results were consistent with Study 1. A two-tailed paired sample *t*-test revealed that on average there was no significant difference between pupil size during executed performance ($M = 95.57$, $SD = 35.39$) and imagined performance ($M = 83.79$, $SD = 25.06$) of the entire composition, $t\ (6) = 2.405$, $p = .053$, $d = 0.384$.

To investigate the effect of complexity on expert pianists' pupil size during executed and imagined movements, mean pupil-size measurements were analysed using a 2 (mode: executed and imagined) x 2 (stage: complex and less complex) repeated measures ANOVA. This revealed no significant main effect of mode or stage and no significant interaction. Overall, the results showed that participants' mean pupil-size measurements during executed and imagined performances of a composition with complex and less complex stages were similar.

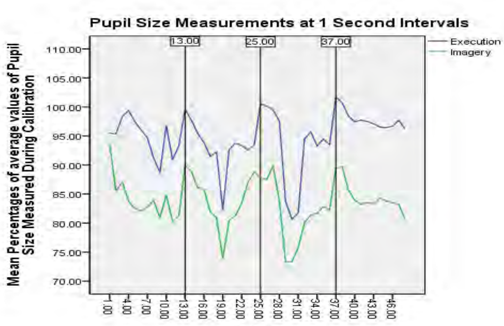

Figure 1. Pupil-size measurements for actual/imagined performances. Stage 1(less complex) = 1-12s, Stage 2 (complex) = 13-24s, Stage 3(less complex) = 25-36s and Stage 4 (complex) = 37-48s.

Conclusions

Overall, the findings show that the relationship between actual and imagined piano playing is not straightforward. On the one hand, the results of Study 1 demonstrated that expert pianists' imagined durations for performances of the entire musical composition were *longer* than those for their actual performances. Further, in contrast to previous studies the level of movement complexity did *not* alter this relationship. On the other hand, despite such apparent temporal incongruence, analysis of component stage durations revealed that there was a close correspondence between the executed stage-duration variations and the imagined stage-duration variations. Consequently, it is possible that the longer imagery times observed may have been caused by the extra cognitive demands that MI requires – imagined movements typically activate greater conscious processing relative to action execution (Munzert, Lorey, & Zentgraf, 2009). If MI involves greater cognitive effort, then it would be expected that pupil-size measurements during imagery of piano playing would be larger than those during actual piano playing (Laeng et al., 2012). The results of Study 2 did not support this hypothesis as they revealed that pianists' pupil-size measurements during executed and imagined piano performances were similar. It was notable however, that pupil-size measurements during imagery were on average 12% *smaller* than those during execution (see Figure 1). Consequently, the question arises as to why average pupil-size measurements during MI were smaller if durations were longer? A possible explanation may be that the amount of attentional processing required during MI of the complex actions exceeded the participants' available processing resources (thereby inducing pupil constriction; see Granholm, Asarnow, Sarkin, & Dykes, 1996). This idea needs to be tested more systematically, however, as the findings reported above may have been an artefact of a small sample size (n=7). It is also possible that participants simply did not 'work' as hard or allocate sufficient mental effort, during MI – the result being longer imagery times and smaller pupil size.

Keywords

Motor imagery, chronometry, expertise, pupillometry, functional equivalence, music.

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Expectations evoked on hearing a piece of music for the first time: Evidence from a musical savant

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ABSTRACT

Background

The purpose of the study described here is to investigate a hitherto unresearched feature of the 'zygonic' model of implication and expectation in music (Ockelford, 2006) – in particular the assertion that implications arising from the projection of zygonic relationships *between* veridically encoded groups of musical events offer a more or less specific indication of what is to come, based on previously heard material that is the same or similar.

Aims

To discover whether in principle it may be possible to model and therefore predict the specificity and strength of an implication arising from a group of notes through zygonic analysis?

Method

An innovative approach is taken to tackling this issue, by having a prodigious musical savant, highly skilled in playing by ear, attempt to play along with a novel piece on a MIDI keyboard as he hears it for the first time. The piece is designed so that differing numbers of structural relationships exist between clearly identifiable groups of notes, enabling varying strengths of implication to be modeled. These predictions are compared with the savant's efforts at replication. The assumption is that the more strongly a group of notes is implied, the greater the likelihood that the savant will be able to play that group in time with the stimulus. Possibly confounding effects of within-group and tonal implication (also predicted in the zygonic model), as well as potentially familiar patterns of fingering, are avoided in the design of the piece.

Results

The savant's responses and the zygonic model are highly correlated ($R^2 = 0.91$). There is a ceiling effect where $\#Z \geq 8$, which happens to be the point at which the limitations of working memory are assumed to kick in. That is to say, seven sources of prediction are sufficient to ensure successful anticipation of musical events, and, in terms of accurate prognostication, values of $\#Z > 7$ are likely to be redundant in terms of the cognition of structure, since it is probable that the capacity of working memory will in any case be exceeded.

Conclusions

The results support the theory that, the more often a motif appears, the stronger the expectations are that future material will be patterned in the same way. That is, it seems to be the case that implications from groups of notes, whose representations are stored in working memory, function cumulatively, up to a maximum of about seven or eight chunks, in accordance with George Miller's famous dictum (Grundy and Ockelford, 2014).

Keywords

musical expectation, first time hearing, savant syndrome, zygonic theory

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Spectral distribution and dynamic range in best-selling popular music recordings

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ABSTRACT

Background

Loudness and dynamic range of popular music recordings, especially the decrease of dynamic range over the years, is a often mentioned phenomenon in many studies. Several aspects had been in the focus of interest, as the audibility of hypercompression, the perceived quality of music, the used loudness models, the correlation of reduced dynamic range and commercial success of the recordings or the effect of auditory fatigue and hearing damage. Most studies are based on a selection of Music Week or Billboard charts, only a very few songs, artificial stimuli or the corpus is based on mixed sources that compile lists of best-selling albums.

Aims

As there is no specific operationalization of popular music in most studies and/or the sample is not balanced, the aim of our study is to analyze the evolution of loudness and dynamic range in popular music in an exactly specified music market over a long period of time. A second objective is to analyze the role of spectral distribution in the context of decreasing dynamic range, as another important finding in this field of research is the increase of energy in low frequency bands over time, especially since the 1980s. This phenomenon is often mentioned but there are only few studies that analyze this phenomenon in detail.

Method

The top 40 recordings of each year of the German year end-charts from 1965 to 2013 were used as sample. Besides the RMS as a global descriptor of the signal, a modification of the crest factor was used as loudness measure. At the end all results were compared to the determined loudness LKFS as specified in ITU-R BS.1770. Finally the ratio of low and high frequencies with a cutoff frequency of 182 Hz (approximately the upper limit of the ERB band with a centre frequency at 161 Hz) was analyzed. All calculations were done using Matlab.

Results

Especially since 1990 there is a significant increase of loudness until today. While the increase is rather moderate in the period from 2006 until 2011, the years from 1990 to 2005 and the most recent two years, 2012 and 2013, show a steeper slope. From 1965 until 2013 the ratio of frequencies below 182 Hz is continuously increasing from about 8% to 13% of the energy. The year of recording significantly correlates with the different loudness parameters LKFS ($r = .378$, $p = .0001$), dBFS RMS ($r = .459$, $p = .0001$) and the calculated dynamic range ($r = -.496$, $p = .0001$). The ratio of high and low frequencies at a cutoff frequency of 183 Hz also correlates with the year of recording ($r = -.291$, $p = .0001$).

Conclusions

Our main results are in concordance with previous research in this area. The analysis of the German top 40 year-end charts showed a significant increase in loudness, a decrease in dynamic range and an increasing importance of the low frequency bands over time. The years 1989 and 1990 seem to be important, as the increase of loudness and the decrease of dynamic range accelerate at that time. However our data does not fully support the often mentioned viewpoint that the loudness war appears to peak in 2004 and a modest movement toward the opposite direction can be observed, as from 2011 to 2013 again a notable increase in loudness and a decrease of the dynamic range can be observed.

Keywords

Dynamic Range, Loudness, Popular Music.

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Children's perception of emotion in music (A cross-cultural study)

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ABSTRACT

Background

From the lullabies that our parents sing to us, to nursery rhymes we are taught in school, our lives begin surrounded by music. Research suggests that infants' lives begin with a number of important skills, such as frequency coding mechanisms and multisensory connections, which facilitate a range of musical behaviours (Thompson, 2009). Studies have shown that human infants have the ability to understand and appreciate the music in their environment, which is known as enculturation (Thompson, 2009). Many reports also affirm that infants even have the physical capacity to distinguish pitch differences as small as the half step that separates major and minor tonalities (Bridger, 1961; Dowling 1982). For older children, Eugenia (1996) explored "young children's ability to perceive mode changes in music and to identify major and minor stimuli." Cunningham and Sterling (1988) have shown that four years-olds can identify appropriate negative emotions in music by pointing to schematic faces. It seems that many researchers note that the major/minor connotations are intrinsic while others claim that they are learned. Moreover, many researchers (Kastner and Crowder, 1990; Nawrot, 2003; Egermann and et al, 2012) have mentioned that by listening to the major mode, a listener can feel positive whereby the feeling may be negative for the minor mode.

Aims

Two American researchers, Kastner and Crowder (1990), studied the effects of listening to twelve excerpts on 3-12 year old children, and concluded that for major-mode stimuli, participants experienced positive emotions while for minor-mode they experienced negative emotions. There were four emotion options presented to the children in the form of four schematic faces representing happy, sad, angry and contented. This raised the question of whether the results might be the same for children from different countries and cultures. Can these conclusions be applied to countries throughout the world, or does this mostly characterise Western perceptions and tastes in music, especially if compared to cultures that are very different?

On the other hand, Nawrot (2003) claims that lullabies, which are in major keys, bring positive valence to a child's mind – a phenomena observed in Western countries. This appears to be opposite to what has been observed in Eastern countries with mostly minor lullabies. For instance, in Iran and even in Finland (where the culture is closer to Western countries) most lullabies seem to be in the minor mode. So, do the modes of lullabies in one culture affect children's perception of emotion in music?

The primary focus of this paper is the perception of emotion in music. The present study builds upon and improves previous work by examining the role of culture, lullaby and family music preferences on children's perception of emotion in music. Moreover, mothers' perceptions of emotion in music and music preference have been taken into account as the adult sample group in Eastern and Western cultures. Participants and stimuli were drawn from two culturally disparate countries, Iran and Finland. The overarching question concerns the effects of culture on emotional responses of children to music characterised by different modes.

Method

Children comprised the primary population in this research and were chosen randomly through advertisements in many educational institutions and mailing lists in two cities - Isfahan (Iran) and Jyväskylä (Finland). Because of the importance of the role of culture and parental influence in this study, we included both children and their mothers.

Participants were presented with twelve musical excerpts which were played randomly and grouped into three categories according to their style (folk/traditional, lullaby, classical), mode (major and minor), and country (Finland and Iran). Efforts were made to control for characteristics such as timbre, rhythm, instrument and so on.

Children and their mothers were tested separately and in a comfortable setting. To avoid any interference by the interviewers, participants were asked to listen to the music using high-quality headsets. There were two questionnaires for each participant: one sought to consider their respective musical backgrounds, while in the other (main) questionnaire participants were asked to answer after listening to each excerpt from the music collection. As part of this, they were asked to choose a schematic face that best represented the excerpt valence. These faces were described to participants as happy and calm for a positive valence, and boring and upset regarding a negative emotion.

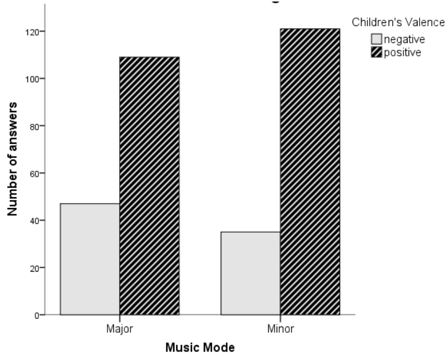
Results

1) *Children's perception of emotion in different music modes*

The results demonstrate that overall children tend to feel positive when listening to music regardless of whether it is in a major or minor key. That being said, the results show that this positivity a in minor mode (81%) is a little higher than a major mode (77%) for them, which is not a large gap and is consistent with the expectations of this experiment, given that children in

both countries have been known to be more interested in listening to minor music rather than major (ρ > 0.05).

However, when considering the countries separately, results illustrate that the effect of mode on Iranian children valences is significant (ρ < 0.05) which is not significantly different for Finnish ones (ρ < 0.05). Therefore, we can conclude that children in Iran experience positive feelings when they listen to a minor mode to a greater extent than when they listen to a major mode, although it is not particularly different for the young audiences in Finland.



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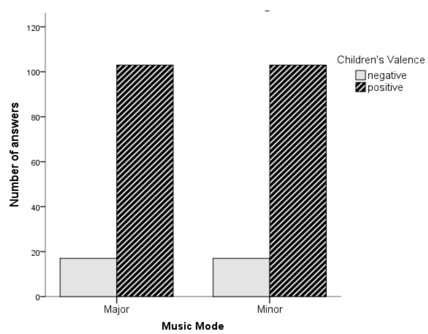

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FIGURE 1: Iranian (a1) children's music feeling and Finnish (a2) in two different modes include major and minor.

2) *Mothers' perception of emotion in different music modes*

Overall, mothers tend to feel more positive when they listen to music whether it is in a major or minor key, but they feel particularly positive when listening to minor music (ρ < 0.05).

According to the results of the mothers' survey, (ρ < 0.05), which is significant, we can conclude that the relationship between minor music and positive emotion is stronger for Iranian mothers than Finnish mothers (ρ < 0.05). Overall, results show in two different countries their positive valence by listening to a minor mode is significantly meaningful, however in Iran, it is stronger than Finland.

Conclusions

This study has demonstrated differences in Eastern and Western perceptions of emotion in music mode. Unlike Western music listeners (both children and adults), Eastern listeners in both groups feel positive by listening to minor music and they tend to favour this mode to the major mode to a considerable degree. In a country like Iran, where collaboration and communication with other countries, especially the West is less common, the results were clearer and more meaningful. In Finland, on the other hand, the results were less so, most likely because of this country's stronger relationship with the rest of the Western world and the exposure of its citizens to a variety of cultures and musical traditions. The experiment has also demonstrated that even though in Finland the adult group clearly feels more positive about minor modes, they are now using lullabies mostly in major modes, so Finnish children do not feel the same as their mother, but they tend to listen to major modes more than minor.

Notwithstanding the small number of participants in this particular study, it is clear that cultural and musical backgrounds can have a significant influence on the perception of music. More studies will likely be necessary in the future, so that the results can be more robust in their facility to deepen our understanding of the role music plays in our society. This promise lies far beyond explaining the potential of strengthening the intergenerational connections and expanding our understanding of our legacy in the context of various world cultures.

Keywords

Cross-Culture, Lullaby, Minor/Major Mode, Negative/Positive Emotion, Music Preference.

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Intracranial evidence of the modulation of the emotion network by musical structure

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ABSTRACT

Background

Psychological research has demonstrated that, in the general public, music is widely exploited as a powerful tool with which to evoke emotions as well as manage mood and arousal (Juslin and Sloboda, 2010). However, while a growing body of neuroscience research has provided insights into the neural correlates of musical emotions, in terms of valence, arousal and basic emotions (Koelsch, 2014), still unclear is the nature of the dynamics of communication that exists between implicated brain areas. Furthermore, the extent to which musical structure alone, in the absence of perceivable or explicit emotion, can be shown to modulate the emotional brain network remains an important topic for new research.

Aim

The current study aimed to examine the extent to which musical structure modulates brain areas that are typically associated with processing musical emotions (Koelsch et al., 2014). Specifically, it aimed to *1)* characterise the sensitivity to musical pitch structure of medial temporal and medial frontal lobe structures like the parahippocampal gyrus and cingulate gyrus, and *2)* to examine how such areas' connectivity changes with the predictability of musical structure.

Method

Advantage was taken of the excellent spatial and temporal resolution offered by intracranial electroencephalography (iEEG) recordings, which can be collected from epileptic patients implanted with depth electrodes for presurgical evaluation. 5 such participants gave informed consent to participate in the current study. They were presented with 58 short melodies of varying length (range: 32 to 64 notes) and, to keep their attention constantly high, were required to indicate at the end of each melody whether they had heard a note played in a deviant instrument (where such deviant notes existed in 10 % of melodies). In order to focus on pitch structure in particular, the rhythmic structure of the melodies was removed in a musically sensitive manner so that each note had the same duration, an equivalent inter-onset interval, and a constant amplitude. Each note in each melody was characterized in terms of Information Content (IC) - a measure of the structural predictability of each note, given its preceding context- using a method (Pearce, 2005) that has received behavioural and electrophysiological validation (Omigie et al. 2012 Omigie et al., 2013). iEEG responses to these notes were examined with event-related-potential, time frequency and functional connectivity (Granger causality) analysis to determine the extent to which IC predicted activity in and between the different brain structures that were recorded from in the temporal, parietal and frontal lobe.

Results

Modulation of neural activity by the IC of notes was found in the parahippocampal gyrus and cingulate cortex, confirming the role of these structures not just in the processing of valence and basic emotions (Koeslch, 2014), but also in the processing of musical pitch structure. Further, granger causality analysis demonstrated that low and high IC notes differed in the degree of causal flow they induced within and between the medial and lateral areas of the temporal and frontal lobes. Differences were also observed between the frontal, parietal and temporal lobe, whereby the lattermost exhibited the greatest changes in network functional connectivity as a function of changes in IC (music structural predictability).

Conclusions

Medial temporal and medial frontal lobe structures, typically involved in emotion processing, are also involved in the processing of musical pitch structure. Modulation of brain activity by musical structure, as seen here, may provide a basis of the subjective feelings experienced when listening to music.

Keywords

Intracranial EEG, Pitch structure, Information content, Emotion.

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The design, development and evaluation of a personalised music-listening intervention for people with Dementia in acute care

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ABSTRACT

Background

Music presents a powerful emotional, social and cognitive stimulus for people with dementia (PWD) (Särkämö, Laitinen, Tervaniemi, Numminen, Kurki & Rantanen, 2012). Not only does it bypass the economical deficit and ethical risks inherent within traditional, pharmacological and physical treatment methods, it further works to reduce the incidence of the behavioural and psychological symptoms of dementia, thus proffering a whole host of beneficial outcomes for both the individual and wider society (Lin, Chu, Yang, Chen, Chen, Chang et al., 2011). In particular, the use of personally meaningful music preferences (PM) appears be a particularly fruitful yet relatively untapped area of research. Irrespective of the severity of cognitive decline, individuals with dementia often remain responsive to familiar musical preferences where other stimuli have failed (Baird & Samson, 2009).

Accordingly, there is now a growing body of evidence in support of the use of PM as an economically viable and accessible tool in dementia care and treatment, offering a number of positive outcomes for PWD, informal carers and healthcare professionals (c.f. Sung, Lee, Chang & Smith, 2011), To cite but a few, research has shown a significant decrease in typical behavioural and psychological symptoms of dementia, such as agitation (Jennings & Vance, 2002), anxiety (Sung & Chang, 2005) and depression (Cooke, Moyle, Shum, Harrison & Murfield, 2010). What's more, further research has demonstrated the propensity of music to facilitate speech reconstruction amongst patients with deficiencies in verbal communication (Suzuki, Kanamori, Watanabe, Nagasawa, Kojima, Ooshiro & Nakahara, 2004); a marked symptom in the latter stages of the disease (APA, 2000) as well as enhance the quality of life of those living with dementia (Davidson & Fedele, 2011) Perhaps most importantly however, music based interventions have recently shown to represent a personally meaningful activity for dementia sufferers as vindicated by their capacity to foster and even reignite one's sense of identity (Vasionytè & Madison, 2013), thus underscoring the need to translate this knowledge to clinical practice for the purposes of implementation into routine care practice (Gallagher, 2011; Gerdner, 2010).

Yet, whilst the use of preferred music in dementia is by no means novel, it may come as a surprise to learn that successful implementation within routine healthcare practice has been stifled by the distinct paucity of empirically validated research and a further lack of contextualisation and ecological validity within formal healthcare settings (Sakamoto, Ando & Tsutou, 2013). Indeed, a substantial review of the literature suggest that this cumulative body of work is compounded by methodological inconsistencies across the literature with particular regard to differences in music modality, assessment instruments, experimental design and failure to assess the interaction effects of other confounding variables (e.g. medication) and impact of disease severity (Sung, Chang & Lee, 2010). Likewise, opportunities and outcomes have largely been confined to that of the alleviation of specific symptoms, particularly agitation (c.f. Gerdner, 2010), despite the apparent propensity for PM interventions to proffer a whole host of positive health-related outcomes associated with dementia. Similarly, a narrow focus upon patient outcomes has led scholars to overlook the importance of evaluating global responses, with regard to current usage, attitudes towards and potential benefits across informal caregivers and health professionals; a paradox which thus compromises the legitimacy and applicability of this tool within formal healthcare (Gallagher, 2011).

What's more, and of definitive significance here, of the research conducted to-date, the clinical application of PM for PWD has largely been confined to community-dwelling participants (e.g. Park, 2013) and those in residential care settings (e.g. Gerdner, 2010). Thus far individuals in hospital settings have tended to be neglected; no study to-date has sought to investigate the role of PM for PWD in acute hospital settings, despite the ostensible potential for this tool and prevalence of PWD within acute care (Dewing & Dijk, 2014).

Aims

This project aims to better understand the potential of personalised music in dementia care and treatment, developing theoretical and practical knowledge to support the use of personalised music in formal healthcare with a focus upon the identification of factors that support and constrain the use of personalised music within formal healthcare settings and the potential global benefits of personalised music for people with dementia (PWD), informal carers and healthcare professionals. Central to this aim is the creation and development of an ecologically-valid, theory-driven and empirically robust protocol for the use of personalised music in the treatment and care of dementia within acute care.

Main Contributions

1. A theoretically driven model of personalised music and dementia in tandem with themes and priorities underpinning the 10 key commitments within Scotland's National Dementia Strategy (Scottish Government, 2013).

2. Dissemination of research findings from the overall body of work via domestic/international conference presentation, peer reviewed publication and relevant public awareness presentations across healthcare settings.
3. Guidelines and recommendations via knowledge transfer documents for the use of a technology-driven personalised music intervention in dementia care and treatment.
4. These objectives will subsequently combine to produce a comprehensive and empirically validated personalised music intervention, facilitated and delivered via a music-based technology alongside key recommendations and guidelines for academics, clinicians, carers and the wider community for the successful and efficacious implementation within acute care.

A four-phase programme of work has been developed in order to meet with the aforementioned aims, objectives and proposed outputs of this study Implications

Implications

Dementia is a complex syndrome that demands individualised care and treatment (Thyrian, Wübbeler & Hoffmann, 2013) and the need to improve the quality of care in acute settings has since been propelled to the forefront of national dementia strategies. At the core of this movement is a further need to identify efficacious, non- pharmacological treatment modes; a key commitment of Scotland's Second National Dementia Strategy (Scottish Government, 2013). It is asserted here that the use of personalised music as a tailor-made, person specific intervention thus presents a markedly unparalleled contribution that might not only help to pioneer a variety of cutting-edge contributions within this field but ultimately, via a greater understanding of the theoretical backbone of such work, herald a more sophisticated insight into the disease itself.

Keywords

Personalised Music, Dementia, Music Listening

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A computational analysis study of children's songs from different countries

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ABSTRACT

Children's musical repertoires can be surprisingly rich, varied and musically interesting. This paper sets out to examine children songs from six different countries/nations of Europe, looking for regularities and patterns. In an attempt to find out what musical characteristics are shared between countries, and what makes each country's music stand out, we calculate several melodic and rhythmic viewpoints, some of which use a pre-existing manual segmentation of the pieces (segmental viewpoints). Results are presented and discussed in terms of their musicological and ethnomusicological validity.

I. INTRODUCTION

Music plays a fundamental role in children's everyday lives. It is not only a means to entertainment and feeling expression, but also to socialisation and education.

One can assume that songs written specifically for children or songs produced/written/sung by children are simple in form and content. Usually, such songs share characteristics connected with primal music fundamentals like the voice and gestures, as well as the motions during the games played while singing (Romet, 1980).

Although children's music has been explored from various perspectives and in a variety of settings, such as cultural and educational, there has been scant research on analysing the actual music and looking for regularities and patterns that emerge. Such a process, would exploit the same tools and methods with which adult music is studied. Moreover, a content-based study can shed light in which musical features are cross-cultural (or shared among some cultures), and which differentiate one culture's songs from the other's.

Multiple Viewpoints (Conklin & Witten, 1995) have been successfully used to represent music texture, in the context of many symbolic music processing tasks such as melody prediction and generation (Conklin & Witten, 1995), melody segmentation (Pearce, Müllensiefen and Wiggins, 2008) and others. The structure of the viewpoint formalism, especially along with the functions (constructors) *link* and *thread* that can be applied to basic viewpoints, offer a great deal of abstraction levels that one can model a melody.

Strategies to discover multiple viewpoint patterns (Conklin and Anagnostopoulou, 2001) have been used earlier for folk melody classification (Conklin, 2013).

Segmental viewpoint patterns (Conklin and Anagnostopoulou, 2006), that is patterns whose elements are melodic segments rather than notes, can emerge in the analysis of a piece segmented to musically meaningful phrases.

In this paper we will start by describing the musical corpus used for the analysis. Section III describes the methodology employed, the viewpoints selected and the pattern discovery approach. Section IV presents some results found, while the paper concludes with a discussion on the results from an ethnomusicological point of view.

II. THE CORPUS

The corpus consists of 100 traditional children's songs from six different countries/nations across Europe: Catalunya (15 songs), England (15 songs), France (15 songs), Greece (20 songs), Spain (15 songs) and Turkey (20 songs). The corpus was collected, used and studied previously in (Anagnostopoulou, Giraud & Poulakis, 2013). Songs that were oldest and more traditional were included, based on information by native speakers of each nation's songs. The songs are segmented based on the lyrics, with a segmentation point at the end of each lyrics' phrase. The original dataset also included some (15) Swedish songs, which, for technical reasons we couldn't process.

The songs were encoded in MIDI format. Consulting the segmentation in the scores, we slip-streamed end-of-segment "dummy" MIDI messages in order to process the files easier. We should note here that exact repetitions were encoded in the songs only in cases of the same melody accompanying different lyrics of the same verse.

III. METHOD

A. Multiple Viewpoints

For each song and each segment, we calculated two kinds of multiple viewpoints. The first set consists of viewpoints derived from basic ones (such as pitch, onset time e.t.c.):

- *rhythm contour*: whether the note value increases or decreases.
- *weighted contour*: referred as weighted pitch code in (Schmuckler, 2010). This contour representation is basic melodic contour notation elaborated by each pitch's durational component, so that each contour symbol is repeated as many times as the number of quavers which it includes (for an example, refer to **Figure 1**).
- *link(contour, rhythmContour)*: linked viewpoint of the pure contour and the afforementioned rhythm contour.

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- *stepLeap*: this is a more abstract interval representation which indicates whether the interval of the previous note is a step or a leap.
- *ffon*: whether the interval from the previous note is a perfect fourth or a perfect fifth.

Figure 1. Example of weighted pitch code (example adopted from (Schmuckler, 2010)). In our study, a weighted contour sequence is a simple contour sequence with the contour symbol repeated as many times as the duration of the note (counting in quavers).

The second set consists of segmental viewpoints:

- *thread(contour, high)*: for each segment we select the highest-pitch note. For the selected notes, the contour patterns are examined.
- *thread(contour, low)*: for each segment we select the lowest-pitch note. Same as before, we examine the contour of these notes.
- *thread(contour, highestDuration)*: for each segment we select the highest-duration note and examine their contour.

The intuition behind the above segmental viewpoints is that in simple songs as children songs, notes with higher note value might be more significant than others, or more memorable. We hypothesised that children's songs may not include very challenging sequences of leaps or large intervals; thus we examined the step/leap viewpoint. Finally, a last hypothesis was that one could expect many easy-to-memorize intervals, such as fifths or fourths; hypothesis to be checked with the ffon viewpoint.

B. Discovery of patterns

To discover interesting patterns, we followed the approach described in Conklin, 2010. A distinctive pattern is one that is overrepresented in a corpus compared to an anti-corpus. The measure of overrepresentation is the likelihood ratio between the observed count in the corpus and the expected count given the anti-corpus probability.

In our analysis, we used two different corpus/anti-corpus schemata:

- each nation's songs are a corpus *(schema a)*. When examining patterns from a song from one nation, we regard all the songs belonging to this nation as the corpus and all the other songs as the anti-corpus.
- nation groups *(schema b)*. We formed nation groups, based on the hypothesis that countries with geographical (and correspondingly cultural) proximity may share musical texture features. Examples of such groups are *Greek and Turkish* and *Catalan and Spanish.* We followed the same approach as above, but regarding the group's songs as the corpus and all the other songs as the anti-corpus.

For each pattern we computed the probability of appearance in the corpus. We discarded patterns that appear less than ten times in the whole corpus and studied the patterns that were at least two-fold overrepresented in a country compared to others.

Figure 2. Example of multiple viewpoint analysis with the used viewpoints. The weightedContour is reported in semiquavers.

IV. RESULTS

Prior to delving to more thorough analysis, we examined the pieces in terms of Huron shapes (Huron, 1996) by determining the shape for every segment. Quite expectingly, most Greek, Spanish and Turkish songs begin with an “ascending” shape and end with a “descending” shape. Most Catalan songs begin and end with a “convex” shape and most English ones begin with a “convex” and end with a “descending” shape. Commenting on the sequences of shapes, when examining sequences of two shapes, we get the results of **Table 1**. Interestingly, in the Spanish songs, the most popular sequence is descending-descending, which suggests that the overall convex shape should realizes itself in bigger than two-segment parts.

Table 1. The most prominent two-segment sequences of Huron shapes for every nation's songs. In Turkish songs, there was a tie, so both sequences are reported.

song's origin	first	second
Catalan	convex	convex
English	convex	convex
French	convex	convex

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Greek	concave	descending
Spanish	descending	descending
Turkish	concave	concave
	convex	convex

Table 2 lists some indicative patterns found by the aforementioned method and are found to be distinctive in a single nation (schema a). **Table 3** lists some examples of patterns distinctive for a group of nations (schema b).

In those tables, the patterns of a linked viewpoint *link(a, b)* are noted as {[a], [b]} and the values of the *ffon* viewpoint are one of {F, T} domain, where F denotes false (not a perfect fourth or a perfect fifth interval) and T denotes true (a perfect fourth/fifth interval).

Results suggest that each nation's songs present different contour patterns, thus differentiating from others. Moreover, countries which are geographically close such as Spain and Catalunya or Greece and Turkey, seem to share more common patterns, suggesting a projection of their cultural similarities in children's songs.

Table 2. Indicative patterns reported distinctive in a single nation (using *schema a*).

viewpoint	pattern	nation
thread(contour, high)	= = = =	Catalunya
thread(contour, low)	+ – –	Turkey
thread(contour, highestDuration)	= = = =	Catalunya
link(contour, rhythmContour)	{=,=} {+,=} {–,=} {–,=}	Spain
link(contour, rhythmContour)	{–,=} {=,=} {+,=} {–,=}	Catalunya
link(contour, rhythmContour)	{+,=} {–,=} {=,=} {+,=} {–,=}	Catalunya
weightedContour	– – – – + + + + – – – – – –	England
weightedContour	+ + + + + + + + + + + +	Turkey
stepLeap	–s –s +s +s –l	England
stepLeap	+s –s –s –s +s	Spain
ffon	F F F F F F F T	France
ffon	T F F F F F F F F	England

Table 3. Indicative patterns reported distinctive in a group of nations (using *schema b*).

viewpoint	pattern	nation group
thread(contour, high)	+ – +	Catalunya - Spain
rhythmContour	= + – = = =	Turkey - Greece
rhythmContour	= = = = +	Catalunya - Spain
link(contour, rhythmContour)	{+,=} {+,=} {–,=}	Turkey - Greece
link(contour, rhythmContour)	{=,=} {+,=} {–,=}	Catalunya - Spain

In the figures that follow some examples of the patterns found and their respective viewpoint sequences are presented:

Figure 3. The pattern {+,=}{+,=}{–,=} in link(contour, rhytmContour) in a Turkish song.

Figure 4. The pattern +s –s –s –s +s **in stepLeap in a Catalan (first) and a Spanish (second) song.**

Figure 5. The pattern = + – = = = **in rhytmContour in a Greek (first) and a Turkish (second) song.**

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Figure 6. The pattern + – + in thread(contour, high) in a Spanish (first) and a Catalan (second) song.

Figure 7. The pattern = = = = in thread(contour, high) in a Catalan song.

V. DISCUSSION

In general, we observe significant rhythmic repetitions inside the songs' phrases and an extensive, repeated use of notes with the same duration – a basic characteristic of children's songs, since they have to be repetitive, vivid and easily memorized.

Discussing the patterns of **Table 2** in the context of the *link(contour, rhythmContour)* viewpoint there are several patterns which highlight a mutual feature of children's songs spread throughout the corpus: the slight melodic development along with a stable rhythmic configuration. Specifically, most patterns correspond to a smooth melodic ornamentation around a significant note – a kind of an enlarged gruppetto or mordent – or to a more adventurous melodic progress in the form of broken chords like a small arpeggio. A noteworthy issue is that all these patterns keep the same note duration – most of the times a small one.

The *weightedContour* viewpoint actually indicates pitch-duration contours between specific notes. Commenting on the = = = = pattern of the *thread(contour, highest)* viewpoint, we could say that most segments in Catalan songs seem to have a consecutive repeated high note, i.e. the tonic, or another important note of a small scale, i.e. a note of a tetrachord.

Comparing English songs with all other songs, we have found out the preponderance of a convex "weighted contour", which probably serves as a finishing motif that ends up in a long duration note. On the other handAt the same time, Turkish songs appear to be heavily founded on ascending motifs of smaller duration notes. Analysis of songs using the *stepLeap* viewpoint illustrates that their fundamental melodic move is the step, which ensues from their unsophisticated linear schema and the prevention of larger melodic intervals.

The above remark about the abscence of large intervals is also highlighted with the *ffon* viewpoint, as the most significant patterns (FFFFFFFT and FFFFFFFFT) appear respectively in French and English songs, which seem to be quite different, if not a little more refined and "modernized", compared with their anti-corpora songs. Contrary to what one would expect, fourths and fifths are not – as a general rule – widely used in children's songs (and in fact they are much less used in Turkish and Greek songs).

Commenting on the patterns shown in **Table 3,** we could say that the + – + pattern, overrepresented in Catalan and Spanish songs, employing the *thread(contour, highest)* viewpoint, appears to have a high occurrence. From a musicological point of view, concerning basic morphological elements of the songs, this is generally explained through the simple 4-part phrasing of the segments, according to a classic 8-bar song form (ABAB or ABAC etc.).

Greek and Turkish songs reveal an interesting pattern of durations = + – = = =, as a result of major repeats of rhythmic motifs. Spanish and Catalan songs also share a common and widely emerged pattern for the *rhythmContour* viewpoint, which is the = = = = + pattern. This pattern most of the times comes up in accordance with a strict phrase repetition as well as a specific phrase formation based on notes of the same duration that end up at a significant note of longer duration, probably also connected with the assignment and phrasing of the song's lyrics.

The = = = = pattern of the *thread(contour, highestDuration)* viewpoint indicates that Catalan and Spanish songs include many segments with the same note durations – for example quavers – or that they are constructed on exact repetitions of the same segments or phrases. We should note here that exact repetitions were encoded in the songs only in cases of the same melody accompanying different lyrics of the same verse.

VI. CONCLUSION AND FUTURE WORK

The computational music analysis carried out in the corpus of children songs suggests that there are differentiating patterns throughout the songs of different nations that can potentially be linked to national and cultural particularities of children's songs, and also patterns that seem to be common in some groups of countries. At the same time, there are many common attributes which are associated with global music norms and universal (transnational and transcultural) connotations.

As a result, some of the viewpoints used in this music analytic study could be used to represent the songs in the context of a machine learning application, such as a classifier.

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However, the efficiency of computational analysis should not leave aside fundamental musical factors that affect our reception and perception of children's songs.

It is obvious that a larger corpus of data with more songs from different countries could bring to light better examples and provide enhanced results. In this respect, it is of particular importance to know how and for what purpose the transcriptions of the songs have been made.

Another direction for future work could be to harvest a more diverse corpus by including adult songs of similar genre, in order to be able to efficiently compare the adult and children music. Such a study could contribute towards the statement that children music is a special musical culture of its own merit.

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Understanding major-minor tonality: Humanities meet Sciences

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ABSTRACT

Tones and sonorities that occur more often in a passage of music are more likely to be perceived as cognitive reference points (tonics). In the European Renaissance, major-minor tonality (MmT) emerged as major and minor triads became the most prevalent sonorities due to their consonance – a combination of smoothness and harmonicity. The scales used in music increasingly corresponded to the pitch patterns evoked by tonic triads, including implied pitch classes at missing fundamentals. Those scales also included leading tones a semitone below the roots of tonic triads; leading tones have a different psychohistorical origin. This theory is tested by comparing three sets of quantitative data: the prevalence of vertical pc-sets in a historical music database, empirical data from perceptual experiments on pitch perception in musical chords, and predictions of corresponding psychoacoustical models. The theory rests on philosophical assumptions about the inherently subjective nature of musical pitches and intervals. Pitch is a quantifiable phenomenal experience that depends on both brain/body states/processes and environmental affordances. Musical intervals are categorically perceived, approximate, learned distances; they are fundamentally psychological and cultural in nature, not mathematical or physical.

I. AN INTERDISCIPLINARY APPROACH

Most Western music, and increasingly (unfortunately) most music in the world today, is based on major-minor tonality (MmT). That makes understanding MmT a central issue in musicology, by which I mean all research about all music, with quality control by international academic communities.

If we want to understand what MmT is, why it is like it is, and how it works, we are challenged to consider the problem from different perspectives. Relevant humanities disciplines include (music) history, music theory and (music) philosophy; relevant sciences include (music) acoustics, (music) neurophysiology and (music) psychology. But most existing literature on tonality focuses on one of these disciplines, and most researchers identify strongly with either the humanities or the sciences.

My approach is to evaluate and, if appropriate, incorporate perspectives and approaches from all relevant disciplines (Parncutt, 2011). Historians understand MmT by studying its historical development, considering individual pieces, composers, styles and genres in their social and historical context. Music theorists study the structure of MmT as represented by musical scores, drawing on their auditory imagination and diverse historical and performing sources, as well as the history of ideas (history of theory). Music philosophers study the aesthetic evaluation of music – beauty, emotion, meaning, enjoyment, subjectivity – in its historical, social and cultural contexts. Acousticians study the temporal and spectral structure of the individual sounds, and associated physical processes. Neuroscientists study brain states and processes while experimental participants listen to musical sounds and patterns. Psychologists study real-time perception and cognition of MmT from the viewpoint of experience and behavior.

Perusing this list, and considering the wealth of research literature behind each point, it appears that humanities and sciences are about equally important for understanding MmT. I will therefore aim for a balance between them, trying to overcome my bias toward sciences (due to my background in physics and psychology) and my relative lack of expertise in humanities by referring to diverse literature sources.

II. HISTORICAL CONTEXT

During the 13th and 14th centuries, musical settings of the Catholic mass became more polyphonic as monophony and parallel motion (organum) gave way to independent voices, first within *ars antiqua* (including the Notre Dame school of Léonin and Pérotin) and later as *ars nova*. In 1322, Avignon Pope John XXII issued a bull entitled *De vita et honestate clericorum* in an attempt to ban polyphony from the liturgy, arguing that sacred music should be "sweet" (not dissonant), "modest" and "grave" (not lascivious, sensuous, intoxicating), and with intelligible text (not "doing violence to the words") (Schaefer, 2008). Two centuries later, similar sentiments were expressed at the Council of Trent (1545-1563) (Fellerer & Hadas, 1953). In spite of such external forms of control, or perhaps inspired by them, the general trend toward more polyphony in sacred music continued. In the early 1360s, Machaut created the first polyphonic setting of the Ordinary of the Catholic Mass. The Italian Trecento (especially late 14th century) produced both diverse secular forms (madrigals, ballads) and polyphonic mass settings in different notations (Nádas & Cuthbert, 2009).

In the Renaissance (c. 1430-1600), the most important forms within which polyphony developed were the mass and the motet. In French universities and cathedrals, composers tried out new compositional ideas in motets in two, three or four parts, written in mensural notation (Bell, 2004). The cyclic mass, often regarded as the central and defining musical achievement of the Renaissance (Kirkman, 2001), was musically organised by basing each movement (Kyrie, Gloria, Credo, Sanctus, Agnus Dei) on the same cantus firmus melody, which was often embellished (paraphrased). Techniques for organising the pitch-time structure included canon (prolation or mensuration) and parody (imitation) of an existing polyphonic texture from a secular source (motet or chanson).

In response to this unprecedented outpouring of musical creativity, religious authorities and musicians came to recognize that the grandeur, beauty, complexity, and organization of polyphony made it well suited, alongside chant, to the dual task of glorifying God/creation and consolidating and expanding the power of the church (Joncas, 1997). This

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general intention can be inferred from the social and historical context of these developments combined with stated intentions to the effect that music "should serve to uplift the faithful" and "arouse their devotion" (Fellerer & Hadas, 1953). God and the church were also glorified by the architectural grandeur, beauty and complex organization of the Gothic cathedral (cf. Strong, 1984). The west front or façade of a cathedral was an impressive representation of divine and institutional power. Both the architecture and the music of the church were splendid, glorious, magnificent, noble, awesome, and resplendent, and both played a central role in the development of European identity and cultural consciousness (Howard & Moretti, 2010). It was in this historical, social, physical, political and cultural context that major and minor triads gradually became more common and familiar, and MmT gradually emerged.

These developments occurred within a broader global context of intercontinental differences. Medieval and Renaissance Europe was politically fragmented: rulers (kings, supported by hierarchies of nobility, aristocracy, clergy, townspeople, traders) competed with each other for resources, including artists and musicians. That can explain why science and technology, and the arts including music, developed faster in Europe than in China, India and the Ottoman empire, with their more centralized power structures. "Competition among rulers tended to protect the cultural and economic elites and minorities (scientists, philosophers, artists, merchants, Jews, Protestants) against the suppression of novelty and dissent. (…) Thus, Hume identifies freedom and competition ('jealousy') among neighboring and independent states as the two main sources of cultural progress" (Vaubel, 2005, p. 278, citing Hume, 1742).

III. THE MAIN SONORITIES

The aim of this contribution is to present and develop a psychohistorical account of the nature and origin of major-minor tonality (MmT). From a music-theoretic viewpoint, this will involve separating and systematically addressing simultaneous (vertical) and successive (horizontal) aspects of musical structure, and considering their interaction.

In MmT, some vertical pitch-class sets are more common than others. Why? On the one hand, more common pc-sets are perceived to be more consonant. On the other hand, in the history of polphony, new sonorities appeared when old voice-leading conventions were applied to new situations and textures (Eberlein, 1994). The main psychoacoustical principles underlying voice leading in western polyphony were presented by Huron (2001). To my knowledge, it is not possible to predict the vocabulary of vertical sonorities in polyphony by systematically enumerating all possibilities and applying voice-leading rules or applying a specific set of rules such as those outlined by P. Schubert (2014). It is, however, possible to quantify psychological theories of consonance/dissonance (C/D) and use them to account for the harmonic vocabulary of MmT.

A statistical analysis of a database of representative vocal polyphony from the 13th to the 19th centuries, and a comparison of findings with predictions of simple psychological models of C/D (Parncutt et al., 2014), combined with evidence from relevant theoretical and empirical literature (summarized by Parncutt & Hair, 2011), has suggested that:

- The vocabulary (prevalence) of musical sonorities (tone simultaneities) depends primarily on their C/D.
- Vertical C/D in turn depends on perceived roughness (Helmholtz, 1863/1954; Plomp & Levelt, 1965), harmonicity (McDermott et al., 2010; Stumpf, 1911), and familiarity (Cazden, 1945; McLachlan, et al., 2013).
- The relative importance of roughness and harmonicity changed as polyphony developed.

For these reasons, those Medieval sonorities that were later identified as major and minor triads gradually became more prevalent by comparison to other possible sonorities playable in the chromatic scale. The first examples occurred in 13th-century polyphony. By the 16th, most or almost all sonorities in works by composers such as Palestrina and Lassus were major or minor triads in root position. Following this development, music theorists such as Lippius (1612) started to regard chords of three or more chroma as sonorities in their own right, to which roots could be assigned, and whose identity was preserved when they were inverted. In the blending of three tones to create a beautiful sonority, Lippius saw a reflection of the divine mystery of the holy trinity (Rivera, 1984). For a historical survey of theoretical writings about triads and their roots and inversions, see Parncutt (2011).

If we represent a chord as a series of intervals in semitones above a root (assuming an approximately, variably tuned chromatic scale), the major triad is 047 and minor is 037. These two *Tn-types* (Rahn, 1980) are unique in their combination of low roughness (no second or tritone intervals) and high harmonicity (the presence of a perfect fifth). Root position enhances their harmonicity. The rank order of the first six Tn types in our database of vocal polyphony is 027, 037, 047, 035, 025, 045 in the 13th century and 047, 037, 027, 025, 036 and 035 in the 16th (Parncutt et al., 2014). The data correlate with simple models of both roughness and harmonicity, suggesting that both played a role in early C/D. The role of harmonicity suggests that chords were being heard as sonorities relative to roots long before 1600, when unclear references to sonority and root were starting to enter the vocabulary of music theorists (Rivera, 1979).

IV. THE ROLE OF MISSING FUNDAMENTALS

The chroma salience profile of a chord can be determined empirically by realizing the chord as a simultaneity of octave-complex tones, presenting it to a listener followed by single octave-complex tone, and asking either how well the single tone goes with the chord or whether the tone was physically present in the chord (with responses on rating scales). Such an experiment should include several different chords, to ensure that listeners do not recognize them and respond on the basis of their music-theoretical knowledge. Each chord is compared with all 12 chromatic pitches; the order of trials is random and different for each listener; and each trial is

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randomly transposed. Another possibility is to present a chord and allow the listener to find the tone that matches it best by clicking on one of 12 icons in a circular display (the chroma cycle).

New data of this kind will be presented at ESCOM 2015. The results of our recent experiments are consistent with the psychological reality of chord roots and missing fundamentals (non-notated chroma) implied by chords of three tones from the chromatic scale (building on Parncutt, 1993, and Reichweger & Parncutt, 2009). For example, the A-minor triad ACE has its (main) root at A and missing fundamentals at D and F. These findings are plausible given their foundation in the theory of pitch perception of Terhardt et al. (1982); the theory is based on a small number of empirically based assumptions that are applied systematically to any possible steady-state sound input, enabling falsification and explaining a variety of data.

The findings of such experiments are also influenced by musical experience: tones that are often heard to precede or follow a chord in music are generally heard to go well with a chord. We test this idea in two ways: first, by correlating psychoacoustical data with profiles from statistical analysis of a music database, and second, by quantifying music-theoretic ideas of chord completion and diatonic scale belongingness. We also compare data with predictions of models of pitch perception, enabling a kind of nature-nurture comparison.

V. THE LEADING TONE

For centuries, music theorists have regarded the leading tone as an essential ingredient of MmT, and crucial for a theory of modulation (e.g. Rameau: Christensen, 1993). In Schenkerian theory, lower leading tones tonicize the tone a semitone above, and hence the triad built upon that tone (Forte & Gilbert, 1982). There is no accepted theory of the psychological origin of the (rising) leading tone.

I argue that the leading tone arose from large differences in frequency of occurrence of diatonic scale degrees, both in chant (Parncutt & Prem, 2008) and later polyphony. If we consider the hexachord *ut re mi fa sol la* as it occurs in real music, the tone *fa* generally occurs more often than the tone *mi*, regardless of whether *fa* is represented by C or F in modern notation, and *mi* by B or E. This can be confirmed for chant by a simple statistical analysis of the *Liber Usualis* using the Distributed Digital Music Archives and Libraries (DDMAL; Hankinson et al., 2012). Medieval listeners may simply have been sensitive to the match between the harmonics of each individual tone and the prevailing diatonic scale: the harmonics of *fa* generally match the diatonic scale above it better than the harmonics of *mi*. Listeners may have learned that wherever two pitches occur a semitone apart, the higher tone is more stable, and hence more likely to be a root or tonic. This simple schema was the basis for later more complex schemas, such as the 1-7/4-3 pattern identified by Gjerdingen (1988).

VI. THE NEUROSCIENCE OF PITCH

What physical processes are observable in the brain when listeners report subjective experiences of pitch? Neurophysiological studies (summarized e.g. by Winter, 2005) ask what is happening in the brain at what location and at what time following the onset of a tonal stimulus. A study of musical pitch would be incomplete without considering the main findings of neuroscientific studies.

Regarding neuroanatomical location, a study on patients with unilateral temporal-lobe excisions found that the Heschl's gyri and surrounding cortex in the right cerebral hemisphere play an important role in virtual pitch perception (Zatorre, 1988). Similarly, a neuromagnetic study (Krumbholz et al., 2003) suggested that neural elements specifically involved in pitch processing are located in the medial part of Heschl's gyrus. In marmoset monkeys, neurons have been located near the anterolateral border of the primary auditory cortex that respond to both spectral pitch (pure tones) and virtual pitch (harmonic complex tones with missing fundamentals) (Bendor & Wang, 2005). Tonotopic maps (frequency-place mappings) can be found in different frequency-processing regions in the auditory cortex; they are evidently crucial for pitch perception (Oxenham et al., 2004), and their structure is clearer in the right than the left hemisphere (Liégois-Chavel et al., 2001).

Many models of pitch perception rely primarily or exclusively on time-domain neural representations. These involve periodicity (Cheveigné & Kawahara, 2002), filtering and halfwave rectification (e.g. Cariani & Delgutte, 1996; Tramo et al., 2001), and harmonic cancellation (Cheveigné, 1998). Meddis and Hewitt (1991) and Meddis and O'Mard (1997) presented a comprehensive temporally based algorithm. Another temporal aspect of pitch perception is the electrophysiological response of the auditory cortex to tone events (event-related potentials). For example, the perception of a mistuned harmonic is associated with a distinctive electrophysiological response that involves a negative peak at roughly 150 ms followed by positive peak at 350 ms after stimulus onset (Alain, et al., 2002).

In general, the auditory system draws on both temporal and spectral information to determine both spectral and virtual pitches (Moore, 2003; Klapuri, 2004). This combination of strategies enables the auditory system to separate voices in everyday sounds (e.g. "cocktail party effect"; Bregman, 1990) and multi-voiced music (Bello et al., 2006). Pitch perception may be conceived of as a hierarchy of integration stages; as the input sound changes, the effective time-scale of processing at each stage is adjusted by a feedback mechanism (Balaguer-Ballester et al., 2009). Pitch perception is part of a more general system for the identification of environmental objects and their states, and as such may be difficult to separate from perception of timbre, loudness and location; its physiological foundation also involves multimodal memory, contextual information, and verbal lexicons (McLachlan & Wilson, 2010).

Scientific research of this kind tends to sidestep questions for which no clear data are available or no clear conclusions can be drawn. That includes the general philosophical problem of the relationship between a subjective experience such as pitch and the apparently "corresponding" neural "foundations" of that experience. Neuroscientific research suggests that certain

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aspects of the underlying processing are happening in certain parts of the brain at certain times, but logically that does not mean that conscious awareness of pitch is associated with those processes. The following two problems are either difficult or impossible to solve. First, there is just too much information: the brain contains about 10^{11} neurons, each of which is connected to up to 10^4 other neurons. For the moment, it is impossible to track a sizeable part that activity or to model it on the basis of existing measurements. Second, even if we had all that real-time data, we still would not know which data or set of data corresponded (e.g. by "emergence"; Thompson & Varela, 2001) to a given pitch sensation and which did not. It would still not be possible to say what causes what (Parncutt, 2014).

VII. PITCH AND THE MIND-BODY PROBLEM

What kind of a thing is a musical pitch? This is a philosophical question with a large literature. Researchers in pitch perception should consider that literature before assuming that they know the answer, or assuming that the answer is simple. I will give a brief introduction and come to some tentative conclusions.

Psychoacousticians are often either monists (believing that only one physical world exists) or dualists (believing that mental phenomena have a separate, non-physical existence). I tend toward the dualist camp, but I also agree with many arguments of the monists. I will consequently aim for a middle path between these extremes, while remaining aware that the middle ground is not necessarily generally closer to the truth. My claims will be agnostic in the sense that I refrain from jumping to conclusions, especially when a conclusion is not necessary for the purpose of understanding pitch and tonality.

I wish to argue first that pitch is purely and inherently subjective, that is, something that is associated with a subject (that which is observing) rather than an object (that which is being observed). In Terhardt's concept of pitch, this constraint applies equally to spectral and virtual pitches: both are subject to the same operational definition, i.e. both are determined in the same kind of experiment. A "subject" has unique consciousness and personal experiences, and pitch belongs to this consciousness and this experience. Like color, pitch is not a physical measurement, because it cannot be measured with physical measuring instruments. A pitch or color is categorically different from the measured frequencies or wavelengths that are its objective acoustical and physiological correlates. Other musical phenomena that exist only in our experience include melody (in the sense of something that sounds like a melody), harmony and tonality. Without subjective experience, these concepts would be meaningless.

To understand pitch from a psychoacoustic viewpoint, subjective measures of pitch ("psycho-") are systematically compared with physical measures such as frequency, amplitude, and phase ("-acoustics"). To accurately measure pitch, a test sound and a pure tone are heard in alternation and a listener actively adjusts the frequency of the pure tone until, in her subjective experience, the two sounds have the same pitch (Terhardt, 1998, p. 312-313; Terhardt & Grubert, 1987). This experiment cannot be performed without the mediation of consciousness: the listener must make a conscious comparison between two experiences. A pure reference tone is appropriate because its pitch is known to be clear and unambiguous; but its pitch also shifts slightly with changes in SPL, so it is important to hold SPL or loudness constant. Other procedures for measuring pitch are generally problematic. If for example listeners match pitch by singing, pitch may be either shifted or ambiguous in both the test sound and the singing voice as internally perceived; and if listeners indicate which of two pitches is higher, results are co-determined by pitch and timbre (cf. Vurma & Ross, 2007).

What do philosophers say about the relationship between experiences such as pitch and the physics (physiology) of the brain? According to epiphenomenalism, brain states cause mental states but not vice-versa (Pockett, 2004). Mental states, including the conscious antecedents of action, are epiphenomenal. The neuroscientific evidence suggests that free will exists only from a subjective or experiential viewpoint - not from an objective or physical viewpoint. I will sidestep the vigorous discussion on this issue (e.g. Walter, 2014) and regard epiphenomenalism as (neuro-) scientifically unproblematic.

Monists may regard this as a contradiction. How can a person have free will in one way and not in another? The kind of dualism that I am proposing can resolve the contradiction. People are indeed responsible for their actions, because responsibility is a concept that belongs to the subjective social world. From an objective physical perspective they are not responsible, but that perspective is not relevant for everyday human affairs, seen from a human perspective. Those who question such dualisms (e.g. Geeves & Sutton 2014, who raise concerns about musical dichotomies such as cognition versus embodiment, and perception versus performance) may be clinging to the positivist scientific notion that we must choose between monism and dualism, or that one of the two is true and the other is false. But monisms and dualisms may also co-exist, creating a dualism at a higher level, consistent with a humanities approach based on the theory of dialectic method or dialectic reasoning. It is possible to transcend opposites and form a new synthesis without rejecting the original opposites, while acknowledging the existence of unanswerable questions (after Gödel, 1931/1992).

Epiphenomenalism introduces are striking asymmetry into mind-body dualism. Subjective experience ("mind") is causally dependent on the physical world, but not vice-versa. But note that the assumption of the primacy of the physical world does not logically preclude the existence of subjectivity or phenomenal experience. The physical world may be closed and complete regardless of whether humans or other beings/agents report the experience of consciousness or subjectivity. In a broader context, the physical world is neither closed nor complete: we do not know, and perhaps cannot know, whether it has spatial boundaries (How big is the universe, or is it infinite?) or temporal boundaries (Did it start, will it end, if so when?). Gödel's incompleteness theorem suggests that such

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questions are inevitable. However, from the practical viewpoint of scientific experiments about physical interactions happening in our everyday lives (such as speech and music), the physical universe may be considered closed and complete.

I am assuming that everything that happens in the physical world is explicable in terms of the "laws of physics", however formulated, either now or in the future. If we are concerned with music perception, we can restrict our consideration to the laws of classical mechanics. Incidentally, one line of consciousness research (e.g. Stapp, 2004) invokes quantum mechanics to explain how consciousness arises from neural processes. But given that the current global consensus of consciousness research is moving in other directions, these researchers may be jumping to conclusions. Quantum observation and subjectivity may be completely unrelated.

If conscious states depend on the physical world but not vice-versa, what aspects of the physical world do they depend upon? It is often assumed that they depend only on brain states, but there is no clear evidence for that, nor is there clear evidence that consciousness depends on *part* of the brain, e.g. the prefrontal cortex. The feeling that our conscious self is located behind the eyes and/or between the ears may be an illusion based on the primary importance of seeing and hearing for environmental interaction; it is also possible to create the illusion that our self lies outside the body (Ehrsson, 2007).

There is convergent evidence that consciousness depends on physical processes both inside and outside of the brain (Menary, 2010). Our awareness of gestural musical gestures suggests at least subjectively that musical consciousness can depend on the entire body, and the experience of performers and audiences in memorable musical performances is consistent with the existence of socially shared subjectivity. Recent literature (e.g. Ryan, 2014) has developed new terminology to explain this phenomenon, the main adjectives being *corporeal*, *performative*, and the "four Es" of Menary (*embodied, embedded, enacted, extended*), and main nouns being *cognition, mind, consciousness, intentionality, articulation,* and *entrainment*. All six adjectives can be combined with all six nouns, making 36 combinations. In this jungle of intuitive writing, which is partially supported by empirical studies (e.g., Godøy & Leman, 2010) it may be difficult to nail down causes and effects; but it can hardly be denied that consciousness depends on corporality, social interaction, and environmental affordances.

On this basis, I argue for an *ecologically informed, minimal mind-body dualism*. By dualism I mean no more than the modest admission of ordinary mortal scientists that they cannot overcome the operational difference between subjective and objective measures. I am combining this conservative form of dualism with an ecological approach, in which perception is direct - meaning that the body and brain resonate with the environment, or more precisely they are part of a physical environment in which things are constantly interacting. Consciousness may be a byproduct of that interaction. It follows that if we talk about "stages of cognitive processing" when theorizing about what happens in the brain, we should remain aware that in reality such stages merge into a single process.

For the purpose of understanding pitch and tonality, it is not necessary to choose among alternatives such as substance dualism, property dualism, or predicate dualism (see the Wikipedia page on dualism). It is not necessary to assume the existence of "mind", "soul" or "spirit" (however defined). Monists may accuse dualists of believing in hocus-pocus, but there is nothing magical about the minimal dualism that I am proposing, whose primary intention is to maintain a strict separation between physical (objective) and experiential (subjective) measures. I am not assuming that a person is composed of some kind of "immaterial substance" (as others who used the expression "minimal dualism" have supposed, e.g. Evans, 2010), but I am not denying it, either. Such questions are beyond the present scope.

On this based we can now attempt to explain consciousness in a positive way that is appropriate for understanding pitch and tonality, as well as art in general, considered as a subjective experience in a social context. In general, animal behavior, and hence (presumably) human experience, depends on physical and informational constraints of environmental interaction (Warren, 2006). For that reason, phenomenal sensory experiences in all modalities, including perceiving, imagining and dreaming, are cognitive *constructs* of objects and interactions in the physical world (Shepard, 1984). Our consciousness emerges (mysteriously, admittedly) from our active interaction with our world, which includes other humans, other animals, and the physical environment (Varela et al., 1991) – an idea that is consistent with observations of the behavioral development of infants and children (Flavell, 1999). Our conscious awareness of the world is based on bodily, environmental and social affordances (Gibson, 1948, 1979), which in turn depend on evolutionary criteria of survival and reproduction (Miller, 2007).

Research in visual perception can be relevant here. Our experience of a visual scene is radically different from the image on the retina. It is a *construction* of the external world that emphasizes gestalt principles and affordances. According to a well-known model of image or scene construction in visual perception (Marr, 1982), the process begins with a 2D primal sketch (representation), proceeds to a 2 ½ D sketch and then to a 3D model. Since vision and audition have broadly similar ecological functions and neurophysiological foundations, pitch is presumably no less "constructed" than a point in a visual image. For this reason, neural models can never fully explain hearing or vision. Instead, they explain aspects of brain function that are associated with hearing or vision.

The relationship of pitch to neurology depends on the "hard problem of consciousness" (Chalmers, 2007): how and why we do have qualia or phenomenal experiences, and how do we know what they are like? How do sensations acquire properties such as colors or pitches during the act of perception? As long as clear answers to these questions are lacking, conservative, positivist scientists should play it safe and assume that all perceived pitches (both spectral and virtual) are like any other phenomenal experiences: they can depend on *both*

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auditory/neural physiology *and* the affordances of relevant sound sources. To equate musical pitch with frequency, periodicity or any other physical measure in the air or brain is to jump to conclusions about the nature of consciousness.

Given that pitch is fundamentally different from frequency (although the two are quantitatively related), it follows that musical intervals are fundamentally different from mathematical ratios (although there is again a quantitative relationship). On this issue, Pythagoreans and generations of music theorists were evidently misled. The intervals between audible harmonics of voiced speech vowels may represent the ultimate origin of Western intervals (Rameau) and they may be primarily learned from voiced speech sounds (Terhardt, 1974). But that does not make them exact, nor does it mean we perceive intervals as ratios. A partial in a harmonic pattern can be mistuned by up to about a semitone and still be recognized as part of the pattern (Moore et al., 1986). This tolerance may be a consequence of the “cocktail party” problem in which the auditory system (in conjunction with vision and other aspects of cognition) is challenged to rapidly and reliably separate a speech signal from its background; understanding speech then necessitates tracking fast changes in fundamental frequency. The auditory system’s tolerance for mistuning may also depend on imperfections of peripheral pitch perception (pitch shifts) and the physical existence of almost-harmonic spectra (piano tones). Moreover, it is mathematically impossible to tune a diatonic scale so that all intervals between all tones are “just”.

Taken together, these observations lead us to expect considerable uncertainty and variation in the size of musical intervals, which is confirmed in empirical research on tuning in performance and perception (Devaney & Ellis, 2008; Loosen, 1995; Rakowski, 1990; Sundberg, 1982) and the categorical perception of musical pitch (Burns & Ward, 1978). We thus have convergent evidence that musical intervals are pitch distances (not ratios) whose size is learned from a cultural tradition and is generally approximate (context dependent) and flexible. It follows that there is no such thing as perfect tuning; every form of intonation is a compromise (Terhardt, 1974).

VIII. A THEORY OF MAJOR AND MINOR SCALES

These interdisciplinary foundations can enable us to formulate a plausible and quasi-complete psychohistoric theory of the nature and origin of major and minor scales, and hence of MmT and the structural foundations of Western music.

Scales are collections of approximately defined pitches, related by approximately defined intervals. Scales and intervals are passed in the manner of an oral tradition from one generation to the next, as musical repertoires are performed using musical instruments and the voice - a process that has been thoroughly studied by ethnomusicologists (e.g. Barz & Cooley, 1997). Diatonic scales (transpositions of the white keys on the modern piano) existed before antiquity; they are based primarily on the octave, fifth and fourth intervals that are perceptible between the lowest partials of voiced speech sounds. Their origin may be based either on the perception of individual complex tones (Stoll & Parncutt, 1987) or the structure and acoustics of musical instruments (Wolfe & E. Schubert, 2010).

Successive (melodic) and simultaneous (harmonic) intervals have different consonance profiles. The smallest intervals (seconds) are melodically consonant and harmonically dissonant. Perfect intervals (octave, fifth, fourth) are consonant both melodically and harmonically: melodically due to tonal affinity (Terhardt, 1984) or pitch commonality (Parncutt, 1989), and harmonically due to smoothness and harmonicity. The relative prevalence of different intervals in music depends primarily on their relative consonance; that is presumably true for both melodic (Vos & Troost, 1989) and harmonic intervals, although in the harmonic case intervals with a high degree of fusion (unison, fifth, fourth) are simultaneously avoided, which may explain preferences for thirds and sixths in two-part counterpoint (Huron, 1991).

Major and minor triads (considered as simultaneities) emerged as the most common sonorities in Western music because they uniquely combined high harmonicity with low roughness (Parncutt, 1988). By the 16th century, most or almost all sonorities in polyphonic textures were major or minor triads in root position. Their prevalence made them clear candidates for cognitive reference points (Rosch, 1975), just as the most stable pitches in a scale tend to be those that happen most often (Krumhansl, 1990) or have the greatest total duration (Smith & Schmuckler, 2004), which makes them candidates for tonics. Moreover, in MmT tonic triads occur more often than other triads (Budge, 1943), but the dominant scale degree occurs (as a single note anywhere in the score) more often than the tonic scale degree (Krumhansl, 1990). Perfect fifth-octave sonorities (open fifths) often act as psychological references in early music for the same reason.

During the Renaissance, older diatonic structures (modes) were gradually transformed into major and (harmonic) minor scales as composers, performers and listeners became sensitive to the pitches implied by major and minor triads and preferred scale steps that corresponded to those pitches. For example, polyphony in the Dorian mode gradually became (rising melodic) minor, while Myxolydian became major, the difference in both cases being the addition of a leading tone. The chord CEG has missing fundamentals at F and A; CEbG, at F and Ab. The other tones of the major and (harmonic) minor scales were filled in by applying two additional principles. Scale degree 2 is a whole tone above 1 to avoid successive half-steps (or an augmented interval between scale steps 2 and 3 in major) and to enable a consonant dominant triad. Scale degree 7 is a semitone below 1 to enable melodic tonicization (leading tone effect).

The clear structure of major and minor keys evidently had the effect of psychologically unifying pieces of music. Unity is an important element of the Western concept of a musical work that dominated historical musicology in the 19th-20th century; thematic and tonal development within a musical work has often been regarded as an *organic* process (Solie, 1980). In the Renaissance, the increasing structural clarity of tonality made musical works sound more unified, but at the same time processes of thematic and instrumental contrast were

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undermining that unity. This trend continued into the baroque and classical periods (the contrasting themes of the sonata form, the competition between soloist and orchestra in the concerto). Tonality may thus have allowed music to hang together in the listener's imagination in spite of other forms of structural fragmentation - just as melodies hang together psychologically if the intervals between successive tones are not too big, especially at fast tempos (Bregman, 1990). Unity was achieved by means of large-scale tonal closure, even if some listeners did not perceive it (Cook, 1987).

In this sense, tonal music may have been perceived as appropriate for the workshop of "One church, one faith, one lord". That is the final line of every verse of the Anglican hymn "Thy hand oh God has guided" with lyrics by Edward H. Plumptre, set to music in 1898 by Basil Harwood. The organic unity of MmT may also be related to the frequent references to "home" in popular music and the idea of the tonic key as "home key" in Anglophone music theory (Parncutt, 2009); for the faithful, church, faith and god represent their spiritual home.

Asymmetries in chord progressions (between successive roots, falling fifths and thirds occur more often than rising fifths and thirds) are an important aspect of baroque and classical music, but not of rock (De Clercq & Temperley, 2011). They may have developed as chord progressions were preferred in which one or more missing fundamentals in one chord were realized as chord tones in the next, facilitating intonation in vocal or instrumental performance and consistent with the implication-realisation idea of Meyer (1956) and Narmour (1990) (Parncutt, 2005). This idea is yet to be examined in detail.

IX. IMPLICATIONS

The present approach differs from other attempts to account for the structure of major and minor scales as follows:

- It avoids mechanistic concepts of consciousness and pitch, and numerological concepts of musical intervals as ratios.
- It incorporates plausible assumptions about the history of music and its perception. It avoids treating (historical) music theory as quantitative ground truth; instead, it is a qualitative history of ideas.
- It incorporates theoretical modules that can be tested and falsified by comparing quantitative predictions with database analyses or results of perceptual experiments.
- It avoids the scientific temptation to reduce a complex system to a single principle. Instead, the theory is consistent with the inherent complexity of music history and music psychology, while at the same time favoring theoretical parsimony. For example, the key profiles Krumhansl & Kessler (1982) are simply equated with the chroma salience profile of the tonic triad, and a simple psychohistorical process is proposed for the emergence of major and minor triads as tonics.

The theory has the potential to inspire new research and new approaches to teaching. In research, existing data can be compared with predictions of new models (cf. Milne et al., 2015). In teaching, the foundations of major and minor tonality can be presented, understood and applied in new ways (Parncutt, 2004).

The theory as a whole gains plausibility from my repeated attempts to synergize the ideas, approaches, results, and ways of thinking of relevant humanities and sciences. I take both sides of the "two cultures" divide (Snow, 1959) equally seriously, while regarding both from a critical distance. This interdisciplinary foundation is coupled with simple principles of empirical data collection of mathematical modeling. First, phenomenal experiences are measured by developing and applying operational definitions. Second, models are constructed based on assumptions derived from relevant humanities and sciences, such as music theory and its history, combined with psychoacoustics. Third, model predictions are compared with measurements. Fourth, models are revised or adjusted to better account for the data. This approach can be applied equally to the study of C/D (roughness, harmonicity, familiarity) and pitch.

This attempt to synergize insights from humanities and sciences raises the question of which other musical issues could be addressed similarly. The separate institutionalization of humanities and sciences, and continuing ignorance and prejudice on each side about the other (Snow, 1959), stand in the way of progress. Moreover, in non-English-speaking countries, the English word "science" is often used incorrectly to refer to all research and scholarship, as if the humanities did not exist. This persistent false translation of the German word *Wissenschaft,* and equivalent terms in other languages, hinders discussion of interdisciplinary issues and productive interdisciplinary collaboration.

Keywords

Major-minor tonality, major and minor scales and keys, polyphony, consonance and dissonance, pitch, interval.

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The Ice-breaker Effect: Singing together creates faster social bonds

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ABSTRACT

Background

Mounting evidence from music psychology and the health sciences demonstrates that singing together benefits individuals' wellbeing. Research also shows that having a larger social network and more meaningful social interaction likewise improves mental and physical health. In this longitudinal study we bring together these two bodies of literature by focusing specifically on the social bonding aspects of singing: we explore whether weekly singing classes create stronger social bonds between class-mates than other activities, such as creative writing and crafts.

Aims

To investigate whether there is something special about singing that creates social cohesion or whether any opportunity for regular and frequent social interaction has similar effects on group bonding.

Method

We collaborated with a charity, the Workers' Educational Association, to set up new adult education classes: four singing classes and three comparison classes (one creative writing class and two craft classes) comprising 84 singers (11 males, 73 females) and 51 non-singers (6 males, 45 females) in total (age range 18-83 years). We followed these classes over 7 months, collecting questionnaire data during three sessions: one in Month 1 (time-point 1), one in Month 3 (time-point 2) and one in Month 7 (time-point 3). The questionnaires included measures of the participants' mood (Positive and Negative Affect Schedule, PANAS) and how close they felt to their class group as a whole (measured using a version of the Inclusion of Other in Self (IOS) scale: a visual, Likert-type scale of how connected an individual feels to the group, with 1 being 'not at all' and 7 being 'extremely'), and were taken before and after the session. We examined change in the IOS and PANAS scores for each time-point, calculated as the after-session score minus the before-session score. At each time-point we also asked participants to list all the people in their class whose names they knew.

Results

Both singers and non-singers felt closer to their class-mates at time-point 3 (an average of 6 out of 7) compared to time-point 1 (an average of ~3 out of 7). However, at time-point 1, singers showed a significantly greater increase in how close they felt to their fellow singers compared to non-singers. In contrast, for the two subsequent time-points there was no significant difference in the change in IOS score between the two conditions (although the difference at time-point 2 approached significance: $p<0.1$).

At time-point 1 singers reported significantly higher positive affect after the class compared to before the class than did non-singers. Paralleling the IOS findings, no differences were found for the subsequent time-points for change in positive affect.

The proportion of their class-mates that participants were able to name increased over time for both singers and non-singers, but a significant interaction effect suggested that the positive trend was steeper for singers compared to non-singers.

Conclusions

Although both singing and non-singing (creative writing and craft) activities increase group connectedness to a similar level over time, singing seems to have a greater immediate effect on both feelings of social closeness and positive mood. Other activities took longer to achieve similar levels of closeness and elevated positive affect. Consequently, singing may provide a quicker boost to wellbeing than other activities through elevating positive mood and may be particularly useful in bonding unfamiliar individuals without the need for sustained prior interaction.

Keywords

Singing, adult education, social bonding, affect

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IDyOM: A computational model of auditory expectation

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ABSTRACT

Background

IDyOM - Information Dynamics of Music (Pearce, 2005) – is a computational model of auditory expectation. It acquires knowledge of musical structure through statistical learning of sequential dependencies between notes in the music to which it is exposed. The model generates a conditional probability distribution governing the next note in a sequence, given the preceding notes. The entropy of this distribution reflects the models' uncertainty about the next note, while the negative log probability (information content) of the note that actually follows reflects how unexpected that note is to the model.

With training on an appropriate corpus of music, research using EEG, behavioural and physiological methods has shown that information content and entropy accurately predict listeners' ongoing expectations while listening to music (Carrus et al., 2013; Egermann et al., 2013; Hansen & Pearce, 2014; Omigie et al., 2012, 2013; Pearce, 2005; Pearce et al., 2010). In these studies, the availability of a computational model has helped to clarify the cognitive processes that are likely to be involved in the acquisition and generation of musical expectations.

Aims

The IDyOM software was made publicly available under an open source software license in June 2014. The current version 1.3 was released on 26 March 2015. The aim of this presentation is to give a demonstration and tutorial on using the software for cognitive modelling of musical expectations.

Main Contribution

The tutorial will cover the following topics. First, how to install and run the software. Second, how to import databases of music encoded in MIDI and Kern formats and export to MIDI and Lilypond. Third, using the multiple viewpoints framework (Conklin & Witten, 1995) to extract symbolic music features from the database. These features relate primarily to the pitch and timing of musical events (although other features can be encoded) and include both basic features (e.g., chromatic pitch) and more abstract features derived form the basic event representation (e.g., pitch interval, contour, scale degree). Finally, the tutorial will cover training and configuring the model and applying it to particular sets of data to generate probabilistic descriptions of musical structure. This will include examples using different training data, model configurations and musical features.

Implications

The computational model has been widely used in published studies of musical expectation and has now been made available as a general resource for the community. This tutorial will ensure that the community are able to fully benefit from the software by presenting and discussing detailed examples of actual usage.

Keywords

Expectation, statistical learning, probability, information theory, auditory perception

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Hand gesture in South Indian vocal lessons: The exploitation of cross-domain mapping as a pedagogic tool

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ABSTRACT

Background

Karnatak vocal lessons in South India present a rich ecological setting in which to explore cross-modal relationships between music and gesture. Vocal teachers gesture spontaneously while demonstrating musical phrases to students, producing a continuous stream of melody and hand movement. There is little verbal interaction in such lessons, and teaching is imparted largely through demonstration and gesture. Existing literature on music and gesture has focused primarily on performance (for example, Clayton 2007 and Davidson 1993), with only a few studies exploring gesture in music transmission (examples include Fatone 2010 and Rahaim 2012). As the communicative goals of a teacher differ from those of a performer, gesture in pedagogic contexts merits further examination, particularly to gain insight into use of cross-domain mapping between gesture and music as a tool for preventing and correcting student error. The present paper draws also on research on gesture in mathematics learning where the use of gesture to repair trouble spots in lessons has been examined in studies such as Alibali et al. (2013).

Aims

This paper presents a case study in which two vocal lessons given by different teachers are examined for correspondence between musical pitch in sung phrases and position in space of co-occurring hand gestures. During interviews conducted in the course of this research, teachers commonly mentioned that their gestures convey information to the student on the correct performance of *svaras* (scale degrees) and *gamakas* (ornaments), mapping pitch onto the vertical axis with their hand movements. The present paper asks whether mapping can also be found in other axes, as suggested by Rahaim (2012), and explores how such cross-domain mappings are used by teachers to prevent and repair student error.

Method

Seven hours of vocal lessons given by eight teachers were videoed in the homes of music teachers in South India. After each lesson, semi-structured interviews were conducted with participants. Videos of the lessons were coded in *ELAN* (Lausberg and Sloetjes 2009) for qualitative analysis of the relationship between music, physical movement, and pedagogic interaction. Teachers' hand gestures were motion-tracked in *After Effects* to obtain 2D hand position, pitch (fundamental frequency) was extracted in *Matlab* using *SWIPE* (Camacho 2007), and plots of each were examined for correspondence and considered in relation to immediate pedagogic goals. The paper here presents findings from two of the lessons given by different teachers.

Results

Correspondence between pitch and hand position was found during the majority of phrases to varying degrees, both in the vertical and horizontal axes. However, this mapping was not apparent in all phrases. In addition, mapping was not consistent throughout phrases, with certain sections mapped closely and others not at all. Qualitative analysis indicated that when correcting a student, teachers commonly modify their own gestures to index the solution to the student's error.

Conclusions

The results suggest that cross-domain mappings between music and movement, such as those found in experimental settings by authors including Eitan and Granot (2006) are often exploited by teachers in this musical context to help students notice and rectify their mistakes. Karnatak music is replete with rapid and fleeting ornaments that are difficult for novices to perceive. Interviews with teachers and their students, and the results of the video analysis presented here suggest that teachers use hand gestures to help students hear and then imitate what they might otherwise fail to apprehend.

Keywords

Gesture, Cross-modality, Movement, Musical Pitch, South India, Karnatak, Carnatic, Vocal Lessons, Music Pedagogy

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Grief, melancholia, and sweet sorrow: Typology of music-related sadness

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ABSTRACT

Background

Recently sad music and its effects on the listener have received considerable attention in music and emotion research. The dominant psychological view on sadness assumes that it is one of the basic emotions, which has a certain function: it is an emotion experienced in the face of an event described as unpleasant, such as response to a loss. Often a distinction between active distress (grief) and passive depression (sadness) is been made. In the context of art, however, these two categories are not directly applicable since sadness is often related to pleasurable emotions and it has been shown repeatedly that sad music induces mainly pleasant or mixed emotions at the most. While the ways in which sad music can be used as a tool for affect regulation have been identified, the results have been discrepant since maladaptive aspects of sad music listening have also been presented. Hence, there remains a puzzle of how to characterize this elusive set of affects associated with music-related sadness.

Aims

The present study aims to expose and delineate music-related sadness. Empirical qualitative and quantitative data were collected to examine the descriptions of emotions induced by sad music.

Method

Open-ended answers from 363 participants were analyzed using thematic analysis method. A follow-up survey of the attitudes, functions, and emotions related to sad music were collected from 1747 participants.

Results

The analysis revealed a range of emotions experienced while listening to sad music were classified into three categories: *Sweet sorrow* (33%), *Melancholia* (53%), and *Grief* (13%). These categories seemed to differ depending on the contextual aspects, such as social context, and mood, and the type of music that was described. Also the mechanisms (particularly memories) distinguished the categories clearly. A quantitative analysis of the emotion terms and mechanisms associated with the identified categories supported the notion of their distinct qualities.

Conclusions

In contrast to past research, the results suggest that negative emotions, particularly grief, have a place within music-related sadness, which may partly explain the inconsistent findings of the past studies.

Keywords

Music, emotion, sadness, grief, induction, regulation, mechanisms

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The composer-performer and the problem of notation in indeterminate music

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ABSTRACT

This study is centred on composer-performer's indeterminate notation, more specifically in works where the composer is one of the performers involved. Three composer-performers were interviewed on their processes of composing indeterminate chamber music. The topics of the interviews included: musical elements left to performer's choice; practice of collective improvisation; composer's personal expectations; issues on the development of the notation; and collaboration between composer and performer. The material was analysed and organized into four categories: 1) composer-performer writing indeterminate music; 2) considerations of notation; 3) considerations on improvisation; 4) aspects of performance/interplay. The participants have reported benefits of collective improvisation, interplay, liability on other performer's musical taste, and capability of understanding the composer's intention through notation.

I. INTRODUCTION

In order to elaborate this study, the bibliographical survey covered two different subject of analysis: the indeterminate notation and the composer-performer.

The literature about indeterminate notation is quite extensive and pursuits a significant variety of applications. Among the most representative authors are Cage (1961), Behrman (1965), Cardew (1971), Stone (1980), Müller (1994) and Zampronha (2000). The American composer John Cage was one of the leading figures on the new forms of music notation, and therein, indeterminate notation. His contributions are not only on composing and essaying but also on researching and collecting data about new notation systems and possibilities. Perhaps his most significant editing contribution is "Notations" (1969), a compendium containing manuscripts from 269 composers from diverse styles of notating. This volume constitutes a great practical source for composers to understand the role of notation. Similarly, Theresa Sauer published "Notations 21" (2009), a compendium specifically featuring graphic scores by composers from over fifty countries. In Europe, Carl Bergstroem-Nielsen (2002) developed an annotated bibliography with almost 1000 entries about notation and improvisation. The bibliography is divided in two volumes: "Experimental Improvisation Practice and Notation 1945-1999: An Annotated Bibliography" and "Addenda 2000-". The Danish composer and teacher maintains an online archive called "International Improvised Music Archive", including the two volumes of the series and a collection of other essays and researches about the same subject.

Discussions on contemporary composer-performers have been growing considerably only in recent years. Among the published material, Benson (2003), Pritchett (2004), Perotto (2007), Silva (2008), and Oliveira (2009) are the selected authors for this bibliography survey. In these studies, the main focus is the compositional aesthetics and technical procedures of the composer-performer. The Brazilian composer-guitarist Leonardo Perotto (2007) discusses broadly the compositional production of composer-guitarists. According to Perotto, the aim of his study is "to debate how the interpretative action – the idiomatic knowledge of the guitar – and the creative action – compositional knowledge – bond together in order to redirect the literature of the instrument, renewing the repertoire both technically and stylistically" (Perotto, 2007, p. 1, translated by the author).

Sadly, none of these authors discuses both composer-performer and indeterminate music as a unity. If, on the one hand, the literature on composer-performers seems to be reluctant when it comes to discussing scores that deal with any kind of indeterminacy, on the other one hand, none of the cited authors of indeterminate notation approach the compositional process of a contemporary composer-performer. In the first case, it is more likely so because the intention is to cover the historical context, the musical/cultural panorama, the idiomatic writing, the innovative technical means, and a functional analysis of the harmony. Besides the fact that the majority of these investigations are addressed mainly to the solo repertoire, which is not the case in this study, it effectively leaves the notation process and the performer's capability of choosing and improvising as a secondary priority.

II. CONTEXT AND AIMS

This study derives from a preliminary stage of a Doctoral research project (first author), a composer-percussionist now working with an ensemble of indeterminate music. The aim is to compensate for the lack of studies about composer-performer's indeterminate notation through verifying and equating the strategies used by three composer-performers when composing and performing indeterminate chamber music.

III. METHOD

A. The participants and their pieces

The participants of this study were three composer-performers: Elder Oliveira (1989), a Brazilian composer and saxophonist currently living in Aveiro, Portugal; Georgia Koumará (1991), a Greek composer and multi-instrumentalist currently living in Berlin; and finally, composer-performer John Teske (1984) an American double bassist and conductor.

Elder Oliveira's "Surface" (2013), for saxophone and percussion, "is based on sound production originated through physical gesture. Longing to explore a sonic diversity, the gesture becomes decisive to allow the sounds to be transformed.

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Therefore, the gesture becomes an important element on supporting and conducting an improvisation, in its composition and aural perception. Between the different physical gestures explored and suggested, the circular movements represent a continuous that undergoes transformation. Through movement and visual characteristics, the listener is free to associate sonic characteristics to mental images. Thus, the physical gestures used in the piece become metaphors that will eventually contribute to the performance" (Oliveira, translated by the author).

"Astropedo" (2012) by Georgia Koumará is written for prepared piano and vocalist (not a singer in its classical term). Even though the piece allows a great deal of choice from the performer, the composition is quite detailed in its performance's aspects, as it specifies the lighting and other theatrical features. According to the composer, "the main aspect of the work is endless brutal violence, power, and vividness, creating a soundscape of craziness by getting their performers to the physical and psychological limits" (Koumará). The prepared piano is mostly percussion-like sounds and the vocalist embraces different psychological moods and conflicts throughout the performance. Still according to Koumará, the works also requires the vocalist to hold a light, giving to the performer "a 'leader' role when she switch [*sic*] it on and off. The whole piece works like a pagan rite" (*idem)*.

Finally, John Teske wrote "Six graphic scores" in 2010 and revised in 2012. The work calls for one or more players/singers. Although the notation gives plenty room for improvisation, the free-handed marks on blank music sheet deliberately denote texture, relative duration and density. The graphic notation is designed to give an abstract conception of the composer's musical conception. Nevertheless, the work is cohesive and objective in its narrative. John Teske describes the creating process as follows:

> For a few years I had been thinking a lot about where I put my attention and where we collectively put our attention; how we can have focus, lose it, and return to it. These scores are based on the idea of sound coming in and out of focus. The original scores allowed for a wide range of interpretations. After a number of performances I wanted to add more direction to the work by defining pitch centers and removing the urge for excessive volume. I hope these revisions allow the listener to focus on the subtle changes in pitch and texture (Teske).

B. The Interviews

The methodology chosen for this paper is qualitative research based. Three structured interviews were held between November and December 2014 via electronic mail. The number of participants and interviews is grounded on the statement below:

> When it comes to qualitative studies, a limited number of interviewers are indeed enough for obtaining the results, whereas the representative sum, in statistical matters, is not applied. The criterion that determines the significance of the material becomes the quality of the investigation aims, making use of the diversification of the interviewees and guaranteeing that no important situation is left behind. Therefore the individuals are not chosen in regard to the numerical importance of its representation, but rather its exemplification (Ruquoy, 2005, p. 103, translated by the author).

The criteria for selecting the participants were:

- To be an active composer-performer;
- To be at the beginning of their careers;
- To have a work for an ensemble that includes his/her own instrument;
- To have written a piece within the last five years;
- To belong to different nationalities;
- To include both genders.

The interviews included an entry extracted from a music dictionary, as cited below:

"**Indeterminacy** – A term used by John Cage to describe music that does not follow a rigid notation but leave certain events to chance or allows performers to make their own decisions when performing it" (Dictionary of Music, 1995, p. 121).

The reason for using this entry lies on the fact that the definition of indeterminacy is still ambiguous for many composers. Therefore, in order to momentarily set a definition for this compositional procedure, we attempted to unify the thought on this matter and give coherence and direction to the answers of the participants.

The topics of the interviews included:

1) *General background.* This topic covered their academic background; the frequency of their performances in ensembles of indeterminate music; the relation of their instrument to indeterminacy; and regular practice of collective improvisation.

2) *When composing.* In this topic, the interviewees where asked about the differences of developing indeterminate and "highly determinate" music; collaboration between composer and performers; and the verbal communication to the other performers of the ensemble.

3) *When editing the score.* The questions selected for this section included the software used in the process of computer editing; exposing personal expectation through lecturing and through demonstrating passages on their instrument; the visual aspect of the score and the signs utilized; and finally the musical aspects that the interviewees left indeterminate on the selected scores.

After the initial contact with the participants, another interview was made containing only one question submitted in May 2015. It relates to the difference between a regular composer and a composer-performer. The question was: In your opinion, what is the difference between a composer who is also a performer and a composer that does not play any instrument on a regular basis?

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IV. FINDINGS

The material of the first interview (held in 2014) was organized into four categories:

A. Composer-performer interacting with the other performer(s).

As stated by one of the interviewees, the possibility of working with other performers during the compositional process "is always better when you have constant interaction and discussion with the performer. (...) He can give you more ideas and different opinions that will change the development of the piece" (Koumará). According to her, the other player's contribution increases the interaction by allowing the ensemble to "understand the piece easier" (*idem*), as well as providing a better opportunity to "bond with it" (*idem*). Furthermore, Elder Oliveira says that he "can work with performers that have a different background and interact with it" (Oliveira).

Nevertheless, in "Six Graphic Scores", the process of interacting with other performers gained yet another assessment. John Teske attests that the score worked as a proof for making sure the composer's expectations was indeed achieved at the moment that the performer read the score. The experience was held when he first rehearsed and performed "Six graphic scores". On that occasion, the work was played twice at the same event – first with an instrumental dectet, then a vocal dectet – so the composer could in fact "understand the differences in interpretation and if the scores could in fact be performed by 'any ensemble'" (Teske). The experience proved that the work can be performed by any ensemble regardless its nature and size.

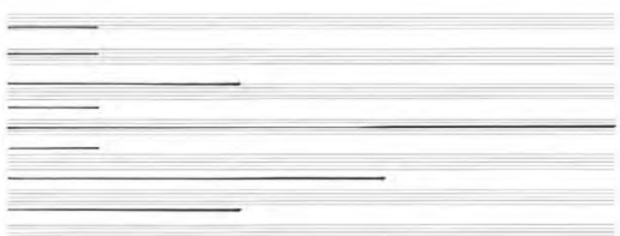

Figure 1. John Teske's Graphic Score Nº 4. Different Layers implying polyphony.

B. Considerations of notation.

> Experimental composers are by and large not concerned with prescribing a defined time-object whose materials, structuring and relationships are calculated and arranged in advance, but are more excited by the prospect of outlining a situation in which sounds may occur, a process of generalizing action (sounding or otherwise), a field delineated by certain compositional rules (Nyman in Sansom, 2001, p. 30).

This statement is taken out of an article about abstract expressionism and free improvisation but it suits a great deal on this particular study. Although subtle, all the works in this study require a certain degree of chance and choice on performance. Through various notation nuances, the composers somehow anticipated the result of these operations. All the composers were aware of the possibilities of their ensemble and, because of it, permitted themselves to be more flexible when notating their ideas. As stated by one of the participants, this prediction can be achieved by the inner earing: "By utilizing the inner hearing, the composer has a very proximate sense of what is going to be heard" (Oliveira). In other words, "the graphic aspect reveals what is underneath all music scores: that the notation is a communication in which nothing is transmitted; nothing is given" (Zampronha, 2000, p. 145, translated by the author). Similarly to what is said by Zampronha is Oliveira's statement: "One do not need a score in order to make music. It simply contributes to communicate. What I could not do graphically, I would verbally" (Oliveira).

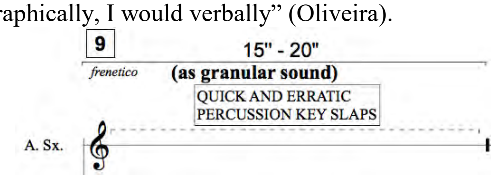

Figure 2. Helder Oliveira's "Surface". Verbal indication of timbre.

However, indeterminate music cannot be miss-understood as free improvisation. Indeterminacy implies a combination of determined and undetermined terms or, in other words, assertiveness and liberty. Yet the degree of liberty can vary dramatically from composer to composer. With it we are not attesting that a more precise notation inhibits the performer's opportunity to be free to choose. The indeterminate music is simply a way of expressing the composer's idea in a more interactive and altruistic way.

In spite to "highly-determined scores", Oliveira believes that "this style of composing contains incoherencies and dualities as far as its playable aspect" (Oliveira). As an extension of it, "the extreme determination inhibits the activity of the composer to respond to an acoustic situation" (*idem*). On the contrary, Oliveira has "taken decisions at the compositional process that can be excluded at the moment of the performance" (*idem*). These decisions become strategies to adapt the work to adverse situations, i.e., acoustic disadvantages. Georgia Koumará's opinion is rather punctual: "If the composer really had specific sonorous expectations, he would have written them in the score in a way that these expectations are [*sic*] obvious" (Koumará).

Moreover, John Teske claims that, regardless the style and philosophical trend, scores have to be clear and assertive in its notation: "I was much more interested in writing material with intention and allowing indeterminacy to occur through the interpretation of performers" (Teske). Further, he concludes: "Since I'm interested in how musicians may interpret my ideas, I usually give players freedom to play how they think it should sound. If it is too far from my ideal sound, I will go back and edit the scores to be more clear" (*idem*).

Elder Oliveira synthetizes the discussion with this statement: "The score symbolizes the movement. It is a representation. The performer is free to interpret it" (Oliveira, translated by the author).

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C. Considerations on improvisation.

While Koumará claimed to use improvisation as a fundamental tool for composing, Oliveira and Teske have shown that the process of notating goes more towards the rational side of creating. According to the first, “the inspiration for this piece comes from the use of improvisation, as I am until today an active improviser” (Koumará). Later, John Teske mentions “the idea of crafting the architecture and mood of a piece while allowing freedom in the individual details” as being aesthetically attractive to him. As an alternative to the rational side of creating, Koumará proposes a rhetorical question: “How to compose a piece that is completely notated but will enables us, to perform and interpret it and interact with each other in a more spontaneous way, as in an improvisation” (Koumará). The answer is given later: “Me and my friend Sapfo (the singer) used to improvise a lot together for many years. So we wanted to transcend our limits and try to see if we can interact with the same speed and vividness with a written score” (*idem*). In fact, Astropedo requires a great deal of improvisation, whereas the written parts work as a role model for the improvisations.

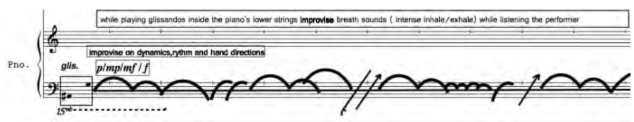

Figure 3. Georgia Koumará’s Astropedo. Improvisation suggested on piano part.

According to Astropedo, “the pianist and the vocalist must create a bond with each other while rehearsing the piece to accomplish a psychological connection with each other. One must always follow the other in a continuous interaction” (Koumará). This statement requires a great deal of partnership from both performers, achieved here through time, practice, and mutual collaboration.

D. Aspects of performance/interplay.

The first aspect analysed in this category was the presence of a conductor and their contribution. Results are not conclusive. For one of the participants, the activity of a conductor was proven to be unnecessary, hence style of the writing and the pro-active participation of the composer as a performer: “For the premiere, we considered following a conductor or a clock but as we rehearsed we realized that listening to each other was just as effective as in other types of music” (Teske). However, another participant brings out a positive aspect of working with a conductor when they mention a past experience passed under Iancu Dimitrescu’s (1944) direction. The interviewee claims that “the mediation was intended to minimize the inconvenient of the performance” (Oliveira, translated by the author).

Regarding control over the musical elements, the participants have a clear distinction of what were going to be controlled either previously by the composer or at the moment by the performer(s). Elder Oliveira states for “Surface”: “I intended to have the control over the process of sonic transformation. Also, I wanted to have a fluid narrative throughout the piece, so I had to get rid of all the processes and materials that would lock me or the performers up” (*idem*).

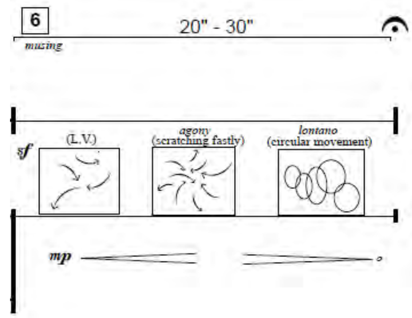

Figure 3. Helder Oliveira’s Surface. Sonic transformation.

For “Six Graphic Scores”, John Teske outlined the relative pitch, duration, articulation and density but the exact details are left up to the performer. Sometimes this is fully improvised, other times we divide the parts and orchestrate in rehearsal to make sure all elements of the score are covered” (Teske). Later, he adds: “For each element, I sketched out options of determinacy and how I would notate it. Typically I will reference this chart to make decisions about what my musical priorities are and what I am deciding to (or willing to) allow to be out of my control” (*idem*).

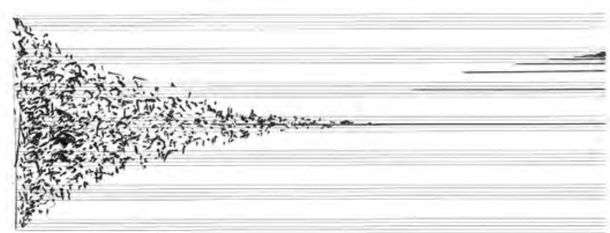

Figure 4. John Teske’s Graphic Score Nº 5.

Finally, Georgia Koumará states: “In Astropedo I left only the tempo parameter open with the indication: as fast as possible, and also the exact notes of the singer's part as well as in the pianist's part are not fully notated. The score specifies only the register, high/higher, middle, low/lower or lowest” (Koumará).

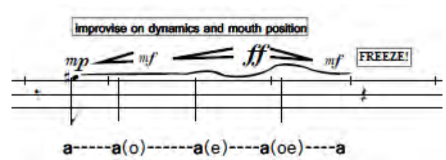

Figure 5. Astropedo. Vocal part.

The last topic analysed was the physical aspect of the performance. In regard to what occurs in Oliveira and Koumará, movements of the body play an important role in narrative purposes. According to them, the physical condition defines much of the compositional decisions where made attending to

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body movement. For “Surface”, “the compositional thought was developed over the performance’s movement” (Oliveira). In other words, “the score synthetizes the expression of the body and translates what the body expresses in sound” (*idem*). Koumará relates the movement to the musical shapes by giving “details about sounds and/or actions-movements in [her] scores, so the sound is always shaped” (Koumará). In her piece one can find several indications of body movements as shown below:

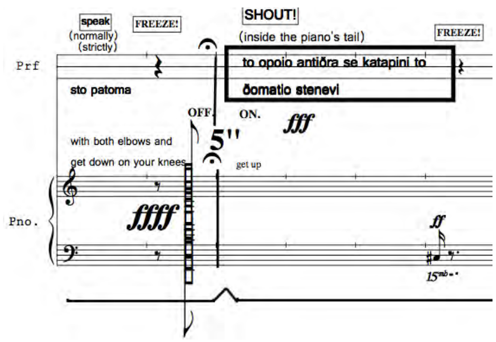

Figure 6. Astropedo. Body-performance instructions.

Table 1. Synthesis of the responses.

	Koumará	Oliveira	Teske
Use of theatrical/gestural features	High	Medium	Not mentioned
Level of indeterminacy	Low	Medium	High
Use of improvisation as tool for defining compositional parameters/strategies	High	Medium	High
Use of schemes, charts and/or sketches on the compositional process	Not mentioned	Not mentioned	High
Acoustic concerns	Not mentioned	High	Not mentioned
Other performer’s feedback	High	Medium	High

About to the interview held in May 2015, the opinion of the participants about the difference between a composer and a composer-performer is summarized as following:

> I've seen composers who haven't played for some time lose touch with how music is actually rehearsed and performed - sometimes this can be excessively difficult passages, awkward transitions such as quick page turns or adding mutes, etc. On the other hand, in my own music I've been trying to play less on my own works, as it is hard to hear the entire piece when within the ensemble (Teske).
>
> The composer-performer knows a great deal of the idiom of the instrument, and applies it either to make use of the knowledge, either to subvert it. The composer must know the instruments he/she is writing for, whereas the composer-performer is submerse to the most peculiar characteristics and the most relevant discussions about the instrument. This status will inevitably help by leading him/her towards the compositional decisions (Oliveira, translated by the author).
>
> I can admit that this double identity has helped me to develop my musical aesthetics and compositional techniques and also made me a better performer and musician. A composer who has performed also a lot of music, contemporary or classical, and has improvised a lot with other musicians tend, in my opinion, to have a better understanding about the way the instruments works and write in a more ‘correct-musical’ way. By this I mean that a composer-performer will have in mind the construction of the instruments, the different possibilities they have, the musical gestures they offer etc. Additionally, through the process of listening to the others (during an improvisation for example) he can explore in a more interactive way new sonorities and structural functions. On the other side, since I know many very good composers who do not play an instrument in a regular basis, I believe that this more ‘theoretical’ approach to sound and to composition have also advantages. The most important: The composer can set his imagination free to create the sound he wants and create new sonorities that were never heard before (Koumará).

V. CONCLUSION

The results revealed a predilection on compositional technique and control of sonic transformation through instrumental experimentation *in loco*. Additionally, the liability on the other performer’s musical taste and the collaborative processes showed to be indeed crucial to the course of composing.

When discussing the categories “considerations on improvisation” and “aspects of performance/interplay”, the participants have reported that collective improvisation becomes a key factor in the decision of elements left to choice. This suggests that indeterminacy, when used by composer-performers, comes directly from playing their own instruments as opposed to theoretical choices. In other words, “the enforcement of improvised aspects in composition contributes to the reintegration of the spontaneous and creative features into music” (Kutschke, 1999, p. 149).

According to the interviewees, the composer-performer’s creative procedures contrasts to the other type of composer on the process of communication and self-evaluation, allowing him/her to better understand the other performer’s point of view and the advantages of writing for his/her own instrument. Improvisation certainly becomes a key factor on indeterminacy. Also, the knowledge of idiomatic writing allows the composer-performer to reflect and choose the compositional intention based on empiricism. In short, the composer-performer allows the very nature of his/her own language to speak directly to the performer through music notation, defining strategies and equating determinacy and indeterminacy fluidly. In conclusion, the option for indeterminate music "led to an openness towards the role of notation and the development of graphic scores and a shift by performers towards a more improvisational role" (Sansom, 2001, p. 29).

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The competence of performance: Mental aspects of succeeding and failing in musicians

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ABSTRACT

Background

Being good when it counts (Eberspächer, 2004) is crucial for professionalism of musicians. Music performance anxiety (MPA) is prevalent even among well experienced professional musicians. It may impair cognitive and motor aspects of performance and is therefore often experienced as existence-threatening. The amount of experience seems to be no significant impact on the occurrence of mpa to have (Mornell, 2002). Research in sports psychology suggests a specific competition-related expertise: a set of cognitive skills that foster the ability to perform under challenging conditions significantly (Janelle et al., 2007). Due to diverse identified similarities of the development of excellence in sports and music (Hagemann et al., 2007), a competition-related expertise – or performance competence (PCO) – can also be assumed for musicians as having extensive potential for influencing MPA and the capacity to perform the personal best.

Aims

The presented study investigates the PCO and its correlation with MPA in challenging situations in musicians: H_0: $r_{MPA,PCO} = 0$; H_1: $r_{MPA,PCO} \neq 0$ (Significance level α=≤0.05).

Method

A questionnaire for the evaluation of PCO was constructed. MPA was evaluated with an own German translation of the revised Kenny music performance anxiety inventory (Kenny, 2009; K-MPAI-d). Further MPA influencing variables were evaluated with the following questionnaires: fear of negative evaluation (SANB-5; Kemper et al., 2011), PANAS-d (Krohne et al., 1996), coping with stress (SVF-44; Janke et al. 1995), NEO-ffi (Borkenau et al. 1993). Sample (n=130; n_{female}=64; n_{male}=65; M_{age}=29,52 years (SD=12.03; min=17; max=76)) consists of 55 professionals, 60 students und 15 amateurs ($n_{classical/jazz}$=124; $n_{rock/pop}$=3; n_{other}=3). CPO and K-MPAI-d were tested with explorative factor, scale and item analyses. Hypothesis of correlation of PCO and MPA was tested by correlation analysis (Cronbach's α: p≤0.05). K-MPAI-d was tested with factor, scale and item analyses.

Results

Six well interpretable factors of PCO were found (Cronbach's Alpha and sample items in brackets): conviction of performance competence (α=.918; e.g. *I am deeply convinced that I am able to retrieve my best performance when it matters most*; *I know exactly what I can do to be able to provide my personal best even under difficult conditions*), progress focussing (α=.847; e.g. *I am happy about every little practice progress; By practicing I gain self-confidence*), deficit orientation (as impairment factor) (α=.858; e.g. *I think in everyday life most of what did not work well in a performance; After a prelude situation I evaluate my performance against the failed points / false notes*), relation to teacher (α=.912; e.g. *My teacher is pleased with every one of my progress; My teacher understands exactly what I need*), concentration (α=.793; e.g. *I'm not able to concentrate very good in general; While practicing, I'm with my attention precisely at what I'm doing* [reversed]), and practice strategy (α=.789; e.g. *If I can not play a certain passage, I analyze exactly on which technical aspect it refers to; Practicing for me is the deliberate induction of tangible improvements up to the desired state*). Hypothesis of correlation between MPA and PCO was affirmed: negative correlations between factors of PCO and MPA (positive between MPA and deficit orientation). Moreover, correlations were found between PCO and the other evaluated MPA influencing variables. Moreover positive correlations were found between PCO (resp. negative with deficit orientation) and personality traits extraversion, openness, agreeableness and conscientiousness, positive affectivity and the positive coping strategies of stress. Negative correlations were found between PCO and neuroticism, fear of negative evaluation, negative affectivity and the negative coping strategies of stress.

In this sample, the factor structure of the K-MPA-I as published by Kenny (2009), could not be replicated with the German version KMPAI-d.

Conclusions

The findings indicate that a specific PCO could improve the ability to perform the personal best, even under potentially anxiety triggering conditions. Further research is needed to examine these assumptions as well as the question, whether PCO also moderates the relation between personality factors and MPA. Moreover, it is necessary to examine the relation of the PCO factors found to established constructs like self-efficacy. Sample size and the pending validation of the PCO questionnaire and of the German translation of the K-MPAI-d are limiting factors of this study. Nevertheless, as part of the professional training, PCO can make a significant contribution to the success of musicians.

Keywords

Peak Performance, Music Performance Anxiety, Performance Competence, KMPA-I, Performance Psychology, Practicing

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The musical self-concept of Chinese music students

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ABSTRACT

Background

Individualistic and collectivist social orientations influence the self-concept of individuals in various areas (e.g. Heine, 2001). In the educational environment, the academic self-concept has been widely investigated in several Western and Asian countries with differing societal settings (e.g. Marsh & Hau, 2004; McInerney, Cheng, Mok, & Lam, 2012; Yeung & Lee, 1999). The musical self-concept was studied by, among others, Vispoel (1994) and Sanders and Browne (1998), and more recently by Buchborn and Painsi (2010) and Spychiger, Olbertz and Gruber (2010) who developed the Musical Self-Concept Inquiry (MUSCI). However, despite the relevance of the musical self-concept to a person's musical development and achievement, to date there has been no research exploring how the musical self-concept emerges in different societal settings. In particular, there have been no enquiries yet in the Chinese music education environment.

Aims

This study aimed to examine the musical self-concept in a Chinese context and characterise musical self-concept types in Chinese university music students.

Method

The musical self-concept of Chinese music students ($N = 97$, Bachelor's and Master's music students) at a university in Beijing was assessed through the Musical Self-Concept Inquiry (MUSCI) on 12 dimensions covering ability, social, emotional, spiritual, cognitive, and physical aspects (Spychiger et al., 2010). The data were first analysed with a factor analysis to examine the adequacy of the scales (factors) for the Chinese setting and to enable an adaptation of the MUSCI. Thereafter, a cluster analysis led to an aggregation of the cases with similar manifestations of the measured factors: the musical self-concept types. Sociodemographic data (age, gender, main instrument, age at which the instrumental training was started, parents' musical activity, practice hours per day, level of education or current year/level of studies) and information on professional perspectives and aims were collected through closed-ended and semi-closed-ended questions. This information was further included in the interpretation of the self-concept clusters.

In addition to the characterisation of the clusters according to the significant differences of the factor manifestations and the (non-significant) sociodemographic tendencies, the findings were compared to Spychiger et al.'s musical self-concept types (2010).

Results

The factor analysis led to an adapted measurement instrument called MUSCI-2 with the following eight factors which corresponded largely to the original MUSCI dimension:

I Achievement and Ambition ($\alpha = .919$)
II Mood Management ($\alpha = .846$)
III Ability and Expertise ($\alpha = .715$)
IV Technique and Information ($\alpha = .731$)
V Dance ($\alpha = .794$)
VI Rhythm and Movement ($\alpha = .881$)
VII Spiritual Experiences ($\alpha = .716$)
VIII Community and Communication ($\alpha = .701$)

The cluster analysis resulted in three significantly distinct clusters and corresponding musical self-concept types. The clusters were tested for differences of the factor manifestations between all clusters with the Kruskal-Wallis H-Test and for pairwise differences with the Mann-Whitney U-Test.

According to the H-Test factors I, II, VI, VII, and VIII contributed to the cluster membership on a high significance level ($p < .0001$), and factors V ($p < .01$) and III ($p < .05$) on a lower significance level. The clusters did not differ significantly regarding factor IV. The pairwise comparison between clusters 1, 2, and 3 regarding the factors (except factor IV) was significant for 12 of the 21 cluster combinations with medium to large effects ($p < .01$, $r > .3$). The professional aims and perspectives, and the aspects of the students' sociodemographic background did not differ significantly between the clusters (Kolmogorov-Smirnoff-Test $p > .05$), however, some trends emerged.

Students in cluster 1 were characterised by high values on factors I and III, dealing with musical ambitions and perceived musical skills. As indicated by the high values of factors II and VII, the students use music to influence their mood and to enable spiritual experiences. According to the values of factors V and VI, they easily move to the rhythm of music, but do not like to dance. Moreover, the high values of factor VIII show that persons in cluster 1 get in contact with other people through (their) musical activity.

Students in cluster 2 are characterised by a lower achievement motivation than persons in cluster 1 and 3 (factor I). They also have lower values on the factors II, VII and VIII, indicating that they rather oppose to an influence of music on their mood and on spiritual or social experiences. The factor manifestations of factors V and VI allow for the assumption that persons in cluster 2 do not (like to) dance or move to the rhythm of music.

Students in cluster 3 perceive their musical ability as average (factor III). As indicated by low values of factors VII and VIII, the connections of music and spirituality, and music and social or communicative aspects seem to be of lesser importance. According to the values of factors V and VI, persons in this cluster put much emphasis on the rhythmic aspects of music: they reported being able and liking to dance or move to the rhythm of music. As indicated by the values of factor I, students in cluster 3 were characterised by high musical ambitions and a striving for high performance or achievements.

Regarding the sociodemographic variables, students in cluster 1 tended to be older compared to the other clusters. In contrast, persons in cluster 3 seem to be rather young and below the age of 20. This pattern is mirrored in the level of studies: students in cluster 1 tend to be Master's students and students in cluster 3 Bachelor's students. In addition, most persons in cluster 1 were studying a Western instrument or were singers, while persons in cluster 2 tended to be studying a Chinese instrument. Clusters 1 and 2 also differ regarding the practice hours. The former reported practicing between 2.6-4 hours per day; the latter only 2.5 hours or less. Parents of students in cluster 2 play an instrument less often than students' parents in clusters 1 and 3. Furthermore, cluster 2 has the highest proportion of males, and a slight tendency for a later start of the main instrument could be observed. Although teaching is the most frequently mentioned career goal in all clusters, persons in cluster 3 show a tendency for a performing career, and persons in cluster 2 seem to consider a career in another field (e.g. composing) more often than in the other clusters.

Conclusions

The three self-concept types mainly differed in the students' perception of their musical achievement and ambitions; their rhythm, movement and dancing affinity and skills; their spirituality in relation to music; and the communicative aspect of music.

Next to the differences of Spychiger et al.'s (2010) and our samples with regards to sociodemographic aspects and with reference to comparative self-concept research in individualistic and collectivist countries, the distinctions of the results might be reflected in societal settings. For example, the statements that focussed on the ambitious striving for high achievement were much stronger in the Chinese sample in contrast to those relating to musical ability that were of higher importance in Spychiger et al.'s findings. This could for example partly be explained by the emphasis that is placed on self-cultivation, effort and practice in the educational environment of Confucian Heritage Cultures such as China (e.g. Li, 2005; Wang, 2013).

The findings support and further develop the construct of the musical self-concept at the core of the MUSCI, while highlighting characteristics specific to the musical self-concept in a Chinese educational setting. The identification of the three self-concept types offers the first empirical grounds for future investigations of the interdependence between musical self-concept, education, and talent development in societies with differing views of the self.

Although the existing MUSCI scales have now been adapted for further use in a Chinese setting, there is still a need for additional validation studies. Not only should the adapted version of the MUSCI, the MUSCI-2, and thus the different aspects or dimensions of the musical self-concept be further assessed, but also the influence of sociodemographic aspects. Possible sociodemographic characteristics of musical self-concept types could perhaps not be observed in this study due to the sample size: the number of persons per cluster per possible manifestation of a variable has not been high enough to result in statistically sound differences. In that regard especially, validation studies should aim at a higher number of participants.

Research which includes a cross-cultural comparative perspective remains a desideratum and could shed further light on the culturally induced differences in the musical self-concept of music students, professional musicians, and non-musicians.

Keywords

Musical self-concept, China, higher music education, musical ability

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Non-isochronous meter in poetry and music

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ABSTRACT

Musical meter is the measurement of the number of pulses between regularly recurring accents. Poetic meter is a regular alternation of prominent and less prominent syllables. Stress or prominence is though the main indicator for hierarchical organization in music and poetry. While poetic meter involves repetition of some basic prosodic unit, musical meter refers to temporal periodicity. Periodic temporal expectancies, caused by a perceptual isochronous pulse, play a basic role in music cognition. While western music usually consists of isochronous meter, Serbian folk music brings richness of regular and irregular alternations of duple and triple rhythmic groups within metrical pattern. Horizontal polymeter, relatively often in Serbian folk music, exists within isochrony (e.g. 2/4+3/4), non-isochrony (7/8+9/8+7/8+10/8) and in the alternation of isochronous and non-isochronous meter (4/8+ 5/8, 6/8+7/8, 3/4+5/8). On the other hand stands vertical polymeter which refer to repeating vertical hemiola, explaining the presence of metrical levels and audibility of the isochronous subdivision. The circulation of duple and triple hemiolic ratio presents the main feature of Serbian language, due to the most frequent words are two-syllable and three-syllable. Non-isochronous meter in Serbian folk music seems to originate from non-isochronicity of speech and asymmetry folk poetry. Iambic 7-syllable verse corresponds to 3+2+2 metrical pattern in music, while asymmetric or iambic 8-syllable verse may induce 3+2+3 or 3+3+2 metric patterns. Asymmetric 10-syllable verse, as one of the oldest and most frequent in the Serbian oral tradition, may evoke 10/8 time signature with different duple and triple beat combinations.

I. (NON)ISOCHORNOUS METER

Meter is the measurement of the number of pulses between regularly recurring accents (London, 2012). Metrical hierarchy in speech and music is based on stress or prominence (Selkirik, 1984). A perceptual isochronous pulse, which in music engages periodic temporal expectancies, playing a basic role in music cognition (Jones and Boltz, 1989), appear to play no role in ordinary speech perception (Pitt and Samuel, 1990). A pulse is one of a series of regularly recurring, but the human mind tends to organize such equal pulses into structured groups (Cooper & Meyer, 1960: 3). Therefore, some of the pulses in a series must be accented and then referred to as beats. That is the moment when metric context appears, thus presenting a series of beats (which could be duple or triple) that listener abstracts from the rhythm surface (London, 2004: 4), i.e. identifies a repeating pattern of pulses by taking the accented beat as the first pulse in the group until the next accent appears (Lerdahl & Jackendoff, 1983). Any metrical line is subdivided into a number of smaller subgroups which each has 2 or 3 members.

As being one of the aspects of musical organization, meter is hierarchically organized, and the highest level of metric pattern and levels of rhythmic structure are always isochronous (London, 1995). Western music theory dated from the 19th century presuming meter as isochronous (London, 2004). Although meter tends to be regular, irregularities occur within metric organization (Meyer, 1956). While the metrical structure of western music usually consists of an isochronous meter, the music of some other cultures, among which stands the Serbian music (central Balkan), features non-isochronous meters (Phillips-Silver & Trainor, 2007). Simple metrical structures (isochronous meter) consist of the regular duple or triple rhythmic groups, while complex (non-isochronous) metrical structures present regular or irregular alternation of duple and triple rhythmic groups.

A. Metrical organization in music and language

Familiarity with varied metrical structures enhances sensitivity to the metrical organization of unfamiliar music (Kalender et al, 2012). While western adults have difficulty in detecting metric-violating changes in Balkan music with a complex meter, western 6-month-olds detect such meter-violating changes in Balkan music with a simple or complex meter (Hannon & Trehub, 2005). Unfortunately, by the age of 12 moths, western infants, just like western adults, fail to detect meter-violating changes in Balkan music with a complex meter (Hannon & Trehub, 2005). We can draw some parallels with infants' sensitivity to non-native phonetic contrasts which are being lost as they learn the sounds of their native language: from being a citizen of the world, the infant becomes a member of a specific culture (Patel, 2008: 82).

Music and language are closely related cognitive and neural systems. While phonetics is the study of speech sounds, acoustic structure of speech and the mechanisms by which speech is produced and perceived, phonology studies sound patterns of language – how speech sounds are organized into higher level units (syllables and words) (Patel, 2008: 37). It seems that music meter and sound structure have some analogies: hierarchical organization, grouping patterns, patterning of stress, and auditory distinctive features (Chomsky & Halle, 1968). Meters should be based on linguistic categories originated in Universal Grammar (Hanson and Kiparsky, 1996), but there are cognitive hypotheses on metrical units are counted and grouped together (Fabb, 1997). Phonemes could be compared to pulses: phonemes do not have meaning, but inside words they can even change the meaning. The same is with a pulse: only by listening to the pulse level we cannot determine whether meter is duple or triple. But, by putting the accent on a pulse and getting the pulse group inside a framework of periodic temporal beat pattern, we finally receive the meaningful metrical anticipation. The ability to extract meter may help the infant to learn, for example, tonality,

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because structurally important pitches tend to occur on metrically strong beats (Hannon & Johnson, 2005).

B. Rhythm of speech

Speech is not isochronous and it's not organized according to the metric accent (Dauer, 1983) and periodicity does not play a role in speech rhythm (Patel 2008: 176). Music is in the first place speech and rhythm: rhythm is regulated by the words and non-isochronous beats are conditioned by the rhythmic word shapes in the accompanying verse. Serbian asymmetric poetry is the example of non-isochronous metrical grouping of duple and triple beat within regular or irregular meter. It is most likely that accent of the word tells us the position of duple and triple beats within the metric line/verse.

Serbian folk singing is inspired by the rhythm of speech. Speech is not isochronous because it is a product of linguistic structure. It is not organized according to principle of syllable isochronicity (Dauer, 1983) and thus has no highly predictable metrical patterns. When transposing such non-isochronous speech into music, there is a great need to respect accents of vowels. Those accents have the influence on vowel duration, so the countless combinations of duple and triple metrical patterns have being reached. In order to respect word accent, in Serbian folk songs we can often meet *horizontal polymeter*. The example of horizontal polymeter within the isochrony is the song named "Igraj, Jano, da igramo!". In this song we hear the alternation of 3/4 and 4/4 time signature:

Figure 1. The Serbian folk song "Igraj, Jano, da igramo!"

Horizontal polymeter within the non-isochrony can be heard in the song "Kad se zeni koji kucu nema", where the initial 7/8 time signature changes into 9/8 and lastly into 10/8. Except for musical expressivity, the meter is being changed due to the old Shtokavian dialect where the accent stands on the second syllable in the words *koji* and *nema*:

Figure 2. The Serbian folk song "Kad se zeni koji kucu nema"

Finally, horizontal polymeter exists in the alternation of isochronous and non-isochronous meter, such is the case with the song "Vila bana sa planine zvala", where 6/8 and 7/8 time signature regularly changes:

Figure 3. The Serbian folk song "Vila bana sa planine zvala"

In the Serbian language, the most frequent words are those of two-syllable and three-syllable, therefore the main characteristics of the Serbian language is circulation of duple and triple hemiolic ratio. However, horizontal polymeter, as well as all the other types of non-isochronous meter, should not be mixed with the term of polyrhythm (or *vertical polymeter*), which refer to repeating vertical hemiola. This 3:2 relationship is typical for polyrhythmic textures in West African music (Agawu, 2003: 92).

C. Non-isochronous iambic meter

Oral poetry begins with the voice and an oral poetics returns to the voice (Tedlock, 1977: 517). Hence, poetry is defined by the fact that it conforms to metrical rules and predictable metrical patterns exist in poetry genres (London, 2004). The same as in music, the meter is the unit of rhythm in poetry – the pattern of the beats (a foot). Each foot has a certain number of syllables in it, usually two or three syllables. Specific types of meter differ according to which syllable is accented and which are not. Iambic meter is one of the most prominent metric types in the poetry of different cultures. Its origins date back to the Homer's poem "Margites" (7th century BC). Much later, in the most Western cultures, the iamb has become the dominant foot type for literary poetry.

Iambic meter in poetry, where the exchange of short and long syllable appears, presents the rhythmic texture of non-isochronous lyric meter. Non-isochronous meter allows the poet to imitate the flow of natural speech. Iambic is the most conversational meter since speakers most often use iambic rhythm in daily speech (Aristotle, 1996). As being non-isochronous, iambic meter admits substitutions of unequal duration, while isochronicity requires substitutions of equal duration. Following Aristotle (1996), iambic meter was the ideal for raillery and expressions of passion, due to it suits to daily speech. Sequences that vary in duration are grouped iambically (Hayes, 1995) and by the rule, music starts with the up-beat and flowing from preparation to action, i.e. from uplift to impact (Riemann, 1877). The weak-strong pairs correspond to short-long sound and it seems that iamb is conditioned by the physiology of respiration. That could be another reason to believe that non-isochronous meter in music originates from non-isochronous of speech and folk poetry.

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II. NON-ISOCHRONOUS METER IN SERBIAN POETRY AND MUSIC

Rhythm plays an important role in poetic meter in the opposition between 'syllable-timed' and 'stress-timed' languages. In poetry, the meter of a verse can be described as a regular alternation of prominent and less prominent syllables (Hayes 2009). Metrical poetry is typically assumed to display hierarchical organization (stanzas, lines, feet, syllables). Thus, poetic meter involves repetition of some basic prosodic unit, rather than temporal periodicity which refers to musical meter (Patel, 2008: 155).

If we want to understand meter we should take into account human temporal perception, cognition and rhythmic behavior (London, 2006). The best way to perceive this kind of irregular metric structure is to use movement (tapping or dancing) while listening to this kind of music, which influence infants and adults' encoding and retention of ambiguous metrical patterns (Phillips-Silver & Trainor, 2007). But, there is another suggestion for understanding the non-isochronous meter.

When reading Serbian early romantic and folk poetry, we can hear the non-isochronous meter flowing in our audio perception. It is necessary to tap the pulse level, i.e. the beginning of each duple and triple rhythmic group. The right hand can interpret the rhythmic group, while the left one keeps the pulse. While trocheic meter will help perceiving strong and even positions, iambic meter help perceiving and understanding non-isochronous meter. Namely, while reading Serbian asymmetric folk poetry, we may hear non-isochronous metric grouping of duple and triple rhythmic groups. The rhythmic groups are made according to 2-syllable and 3-syllable words, but also according to the syllables (2 or 3) that do not create a word, but create the group upon the accent and meaning of the higher syntactic level.

Some authors claim that in complex meter, metrical accent is not coincide with the long or triple – it can falls on each position inside the metrical pattern (Povel and Essens, 1985). Yet, the triple rhythmic group is being slightly accented due to its longer duration and even retained and extended in interpretation. Therefore, in the following text, the triple rhythmic group will be underlined with red, while the duple rhythmic group will be colored green.

Unlike the Western music tradition, which is characterized by isochronous meters, in Serbian folk music tradition isochronous and non-isochronous metric patterns are equally represented (Milankovic et al, 2006). The great number of Serbian folk songs includes both duple and triple rhythmic group within regular and irregular meter. Both isochronous and non-isochronous patterns are organized hierarchically. Non-isochrony may figure not only at the beat level, but also at higher levels: isochronous beats are organized non-iscohronously at the next higher level, and isochronous beats are combined with non-isochornous beats, resulting in non-isochrony at the next higher level (Milankovic et al, 2006). If the subdivision level is isochronous, then the beat level is non-isochronous (London, 2005: 69).

Both isochronous and non-isochronous beats follow the rhythmic word shapes within the verse by combining both duple and triple rhythmic groups. It is necessary to repeat that statistically the most frequent words in Serbian language are two-syllable and three-syllable words. This closely point to the organization of non-isochronous patterns and duple and triple beats alternation in Serbian folk music. All Serbian folk songs, which are quoted in the following text, have been notated by the famous Serbian ethnomusicologist Miodrag Vasiljevic (Vasiljevic, 1996).

A. 7-syllable poet meter and 7/8 non-isochronous music meter

Iambic 7-syllable meter appears in the early romantic Serbian poetry of Jovan Grcic Milenko in the song named "Planinska slika". Here we can hear the flow of regular 3+2+2 metric pattern in each verse line:

Ja na-đoh iz-vor ba-jan	3+2+2
u krš-noj, div-ljoj go-ri	3+2+2
Tu po-tok ved-ro sja-jan	3+2+2
Pla-nin-ski strah - žu-bo-ri	3+2+2

In Serbian folk music tradition the 7/8 time signature is often present. While the combination of 3+2+2 and 2+2+3 is the most common, the symmetric pattern of 2+3+2 is unusual. The following song "Nedo, Nedo, bela Nedo" presents the combination of 3+2+2 metric pattern, the same that we already noticed in the above poem "Planinska slika":

Figure 4. Serbian folk song "Nedo, Nedo, bela Nedo"

B. 8-syllable asymmetric poet meter and 8/8 non-isochronous music meter

Asymmetric 8-syllable iambic meter brings continuation of all possible duple and triple rhythmic group combinations (3+2+3, 3+3+2 and 2+3+3). Depending on the verse, both duple and triple rhythmic group may be found on each of three positions (initial, middle and final). In the following folk song we can hear and see the symmetry inside the verse (3+2+3): the first and the third position of the triple rhythmic group can be heard in the Serbian song "Stojanke" by the poet Dragutin Ilic:

Sto-jan-ke, mo-ri Sto-jan-ke	3+2+3
Sto-jan-ke, be-la Vra-njan-ke	3+2+3

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Ko-ga - te maj-ka ro-di-la 3+2+3
Na – sto – je o-kom vo-di-la 3+2+3

Unlike the finding that the structure of non-isochronous patterns in Serbian folk songs is asymmetric (Milankovic et al, 2006), and that asymmetric structure such as 2+2+3, 3+2+2 or 2+3+3 occurring as non-isochronous meters, symmetric ones such as 3+2+3 or 2+3+2 are conspicuously absent (Milankovic et al, 2006). However, as we already noticed, symmetrical types of structure are present in iambic asymmetrical poet meter. It could be the reason why the 8/8 time signature presents curiosity in the Serbian folk music heritage. It exists as the part of some songs that start and end in different time signature. In the following song, named "Sta s'ono cuje na onoj strani?", the 8/8 phrase appears as the middle one between the initial in 4/4 measure, and the final in 3/4. Here is the excerpt of 8/8 phrase which is grouped in asymmetric 2+3+3 metrical pattern:

Figure 5. Serbian folk song "Sta s'ono cuje na onoj strani?"

C. 10-syllable asymmetric poet meter and 10/8 non-isochronous music meter

Asymmetric 10-syllable iambic meter can be used for perception and understanding of 10/8 time signature where duple and triple rhythmic group is differently placed. The traditional Serbian folk song named "Bistra vodo", presents the example of asymmetric 10-syllable meter, where each verse has different combination of duple and triple rhythmic group, depending on two-syllable and three-syllable words and syntactic grouping according to the accent and meaning:

Bi-stra vo-do - moj stu-den kla-den-ce 2+3+2+3
Jel - te – sko-ro dra-gi – po-ho-di-o 2+2+3+3
Ka-zi dra-gom – da – do-ve-ce do-dje 2+3+3+2
Na-bra-la sam - po pla-ni-ni cve-ce 3+2+3+2

In Serbian folk music, 10/8 time signature is rarely used. One of the example of this specific metrical grouping is the song named "Ima majka dve devojke". The claim that tempo of complex meter doesn't have to be fast (London, 1995: 59) is confirmed with so many slow Serbian folk songs being written in the complex meter. The following song is written in the slow tempo which makes the perception of the non-isochronous meter more complicated:

Figure 6. Serbian folk song "Ima majka dve devojke"

III. CONCLUSION

In both western and non-western music, isochronous and non-isochronous patterns are present. Both of these patterns are based on isochronous pulses, which only in non-western music (especially in Balkan and therefore Serbian music) form series of duplets and triplets (duple and triple rhythmic groups). The position of duplets and triplets depends on the accent in word, such as in folk songs, both in poetry and in music. If we count the number of those isochronous pulses within the non-isochronous metric pattern, we shall reach the exact time-signature.

It could be difficult to claim that song preceded speech, or that speech appeared first. What is known is the fact that speech is non-isochronous and music may be either isochronous or non-isochronous. It seems that poet meter of Serbian folk songs and early romantic poetry (influenced by the folk poetry) had a great effect on non-isochronous meter in music. What we have found is matching between the asymmetric poetry verse (most often 7, 8 or 10-syllable iambic meter) and non-isochronous meter in Serbian folk songs. Thus, 7-syllable poet verse match 7/8 meter of the song, 8-syllable asymmetric verse match 8/8 meter, while 10-syllable asymmetric verse match 10/8 music meter.

In music we can recognize a wide range of possible combinations within the set of non-isochronous patterns, and these patterns vary from isochronous (e.g. 2/4, 6/8) to non-isochronous (e.g. 7/8 [2+2+3 or 3+2+2]). These patterns can be further combined within a single song and, in some cases, a song may include bars with both isochronous and non-isochronous beats (3/4+8/8+5/4, 5/8+3/4+7/8, 5/8+6/8, or 5/8+4/4) What is interesting to point out is the presence of almost all available combinations of duple and triple rhythmic groups in one verse, while there are some limitations in the organization of rhythmic groups within non-isochronous music meter. While in 7-syllable and 8-syllable verse we can find all possible combinations of duple and triple rhythmic groups within a verse, in 7/8 and 8/8 metrical patterns of Serbian folk songs we cannot find symmetric pattern of 2+3+2 or 3+2+3. This symmetry in poetry and asymmetry in music stays as a question for further investigation.

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Web-based testing of congenital amusia with the *Montreal Battery of Evaluation of Amusia*

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ABSTRACT

In this article we present the results of a web-based testing of 117 German undergraduate students with the Montreal Battery of Evaluation of Amusia (MBEA; Peretz et al. 2003). The MBEA is used to assess congenital amusia, a neuro-developmental disorder present in approximately 4% of the population, according to Kalmus & Fry (1980). Recently, criticism has arisen concerning the usage of the MBEA in relation to the prevalence of congenital amusia in the general population and the statistical evaluation of the results (Henry & McAuley, 2010; 2013, Pfeifer & Hamann 2015).

We compare the results of our web-based study to a group of 111 German students that was tested with a computer-implemented MBEA version under laboratory conditions (Pfeifer & Hamann 2015). We found significant differences between the web-based and the laboratory group based on their sum of correct responses. A Signal Detection Theory analysis of the data, which factors out response bias, however, shows that the discriminatory ability of both groups seems to be fairly similar. The results of the current study are used to critically discuss the validity of a web-based MBEA specifically but also web-based testing more generally as a means of diagnosing congenital amusia.

I. INTRODUCTION

Congenital amusia is an innate perceptual disorder affecting the perception of both music and speech. This disorder is not caused by a hearing deficit or any form of brain lesion (Ayotte, Peretz & Hyde, 2002). As the exact neural underpinnings are still under investigation, no neurological markers can be used to diagnose congenital amusia. Instead, behavioral markers such as pitch perception deficits and a pitch memory deficit are employed. The main tool used to diagnose amusia nowadays is the *Montreal Battery of Evaluation of Amusia* (MBEA; Peretz, Chambod & Hyde, 2003), which was originally developed to confirm acquired amusia in patients with brain lesions.

Peretz *et al.* (2003) used the MBEA to test 160 participants without known neurological problems, who were not selected for musical ability. For each participant, the number of correct responses per MBEA subtest and an average score of the six subtests were calculated. As cut-off scores for congenital amusia, Peretz *et al.* propose 2 standard deviation (SD) below the mean of the 160 participants, thus an average score of correct responses below 21.6, or 76.6%. According to Peretz et al. (2003: 65), the MBEA subtests provide a sensitive measure since less than 20% of their participants obtained perfect scores for each subtest, only 3% had a perfect score for all subtests and less than 2% had average scores that were below 2 SD of the mean (i.e. were diagnosed as amusics). These average scores approximate a normal distribution, though the scores for the individual subtests display a skew to the right.

While the MBEA is mostly conducted in a laboratory, there are two exceptions described in the literature that employ the MBEA in online testing. Stewart and colleagues use two MBEA subtests for pretesting potential congenital amusics via the web (see e.g. Liu et al. 2010, 2013; Williamson & Stewart 2010). Peretz *et al*. (2008) designed a web-based amusia test based largely on the MBEA, which was also employed by Provost (2011). This test is considerably shorter than the MBEA (only 3 subtests with 72 melodies in total) and participants have to spot incongruities in these melodies (off-beat or out-of-key tones) rather than comparing two melodies as in the MBEA. Peretz *et al*. (2008) used the MBEA to validate this web test and found that 19% of people diagnosed as amusic with the MBEA in a laboratory would not have been diagnosed as such with the web-test. This result contradicts the expectations that participants tested online should perform equally well or slightly worse than lab-tested participants due to uncontrolled testing conditions (such as noise, unrestricted amount and length of breaks, etc.). Peretz *et al.* explain their findings with the difference in task between the two tests: for the MBEA (tested in the lab), participants have to compare melodies, which is more demanding than the online test of detecting incongruities, because it requires participants to hold pitch information in their working memory, while the web test does not involve working memory.

A discrepancy between web-based and laboratory results occurs quite often in psychological research, and Krantz & Dalal (2000) comment that this does not demonstrate a lack of validity of web-based experiments, since most variables seem not to be influenced by varying environments. However, for auditory research a stable and quiet environment is crucial, as Krantz & Dalal (2000) point out, and therefore online testing in auditory research in general and a web-based assessment of amusia in particular might be problematic and lead to misdiagnoses.

In the present study, we compare the results of a web-based testing to a testing in the laboratory, where we employ exactly the same test (the full MBEA) in both conditions. Participants were German undergraduate students who had to participate in the experiment to obtain course credits. The data of both testing methods were collected by Pfeifer & Hamann (2015), but only the results of the laboratory testing were analyzed in that study. In the present study, the results of the comparison are discussed together with general advantages and disadvantages of online testing of potential amusics. We propose the use of different

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cut-off scores for online testing and provide a list of criteria that should be controlled for when testing online.

II. METHOD

A. Participants

131 first year undergraduate students in general linguistics at the Heinrich Heine University Düsseldorf participated in our study for course credit. 14 participants dropped-out of the study nonetheless. A total of 117 participants remained and was analyzed. Of these, 23 reported technical difficulties but these participants finished the study nonetheless and their data were included as the problems were mostly related to the loading of the soundfiles.

The participants were not preselected for the presence or absence of musical disorders such as amusia, or specific levels of musical experience. All participants gave informed written consent to participate in this study and received course credit for their participation. All data were collected in accordance with the declaration of Helsinki.

All participants had normal hearing (as assessed by pure tone audiometry at 250-8000 Hz, where normal hearing was defined as a mean hearing level of 20 dB or less in both ears). 99 of the participants were female and 18 were male. 107 participants were right-handed, 9 left-handed, and 1 was ambidextrous. The age and years of (music) education of the participants can be found in Table 1.

Table 1. Participant details

	Age	Years of education	Years of music education
Mean	22	14.7	6.3
Range	19-36	12-22	0-17

B. Stimuli

The MBEA consists of six subtests, three testing melodic organization (scale, contour and interval subtest), two testing temporal organization (rhythm and meter subtest) and one assessing melodic memory (memory subtest). The musical phrases used in the six subtests were all specifically composed for the MBEA and follow the principles of the Western tonal system. For the metric test, the phrases are polyphonic and have a mean duration of 11 s, for the other five subtests they are monophonic and last 3.8 to 6.4 seconds (mean of 5.1 s). For a more detailed description of the stimuli, see Peretz et al. (2003).

C. Procedure

The participants were informed before the experiment that they should use headphones and take the test in a quiet environment without any distractions. For the first four and the sixth subtest, participants received two examples with feedback before the beginning of each subtest. For the fifth (meter) subtest, participants received four examples, instructing them what a march and a waltz sound like.

At a later point, the participants came to the laboratory for a hearing test and to fill in a questionnaire about their linguistic and musical background. A test administrator was present to answer clarification questions about the questionnaire. At this point, participants could ask questions about the nature of the study.

The procedure of the MBEA is the same for the first four subtests (scale, contour, interval and rhythm): The participants are presented with two practice trials and 31 experimental trials. A trial consists of a target melody and a comparison melody separated by a 2-second silent interval. Each trial is preceded by a warning tone and followed by a 5-second silent interval. 15 trials have comparison melodies that are identical to the target melody and 15 have comparison melodies that are altered in one note (see Peretz et al. 2003 for details). In addition to those 30 trials, each of the first four subtests contains a catch trial (where the pitch of the comparison melody was noticeably different) to ensure that the participants were paying attention and not simply guessing.

For the first four subtests, participants are asked whether the two melodies they hear are the same or different. In the meter subtest the participants have to judge whether the presented melody (a two-phrase sequence in duple or triple meter) is a march or a waltz. In the memory test, participants are also presented with single melodies, half of which already occurred in the previous subtests and they have to indicate for each melody whether they have heard it before during the previous subtests.

III. RESULTS

In the following, we will first provide the sum of correct responses of the web-based group and we will compare the results to that of the group tested under laboratory conditions from Pfeifer & Hamann (2015). We then provide the signal

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Table 2. Results of the web-based group compared to mean scores of the laboratory group and percentage of amusics by Pfeifer & Hamann (2015).

Group		**Scale**	**Contour**	**Interval**	**Rhythm**	**Meter**	**Memory**	**Average**
Web-based	**Mean correct responses**	24.97	23.86	23.21	24.87	24.09	26.34	24.56
	SD	3.03	3.38	3.89	3.80	5.29	3.09	3.94
	Perfect score %	0.9	0.9	1.7	5.1	15.4	5.1	0
	Cut-off (2 SD)	18.91	17.1	15.43	17.27	13.51	20.16	16.68
	Cut-off (%)	63.03	57.00	51.43	57.57	45.03	67.20	55.60
	% below cut-off	5.1	5.1	4.3	8.5	6	6	6.7
	% below cut-off (cut-off scores Peretz et al. 2003)	20.5	34.2	29.9	26.5	37.6	14.5	34.6
Laboratory	**Mean correct responses**	24.95	24.68	24.32	25.84	26.07	27.51	25.56
	SD	2.73	3.01	3.29	2.64	3.65	1.77	3.09
	% below cut-off	4.5	7.2	7.2	4.5	6.3	7.2	5.4

Table 3. Distribution analysis for the web-based group per MBEA subtest. Bold indicates $p < 0.001$, italics $p < 0.05$.

Subtest	**Skew**	**SE Skew**	**z Skew**	**Kurtosis**	**SE Kurtosis**	**z Kurtosis**	**Kolmogorov-Smirnov Test**	
							D	**p**
Scale	-0.93	0.22	***-4.18***	0.61	0.44	1.36	0.16	***0.00***
Contour	-0.45	0.22	*-1.99*	-0.43	0.44	-0.96	0.12	***0.00***
Interval	-0.47	0.22	*-2.09*	-0.40	0.44	-0.90	0.09	*0.01*
Rhythm	-0.96	0.22	***-4.31***	0.28	0.44	0.64	0.15	***0.00***
Meter	-0.85	0.22	***-3.80***	0.13	0.44	0.29	0.15	***0.00***
Memory	-1.39	0.22	***-6.22***	1.78	0.44	***4.01***	0.20	***0.00***
Average	-0.94	0.22	***-4.18***	0.62	0.44	1.39	0.28	***0.00***

detection measures *d'* and *c* (criterion location) for the data of the web-based testing.

A. Web-based versus laboratory testing

The mean of correct responses, SD and the percentage of participants below cut-off for both the web-tested group and the group tested in the lab are given in Table 2. The cut-off scores are calculated based on our mean minus 2 SD. For the web-based sample, we additionally calculated the percentage of participants below cut-off employing the cut-off scores established by Peretz *et al*. (2003).

The mean of correct responses for the web-based group is generally lower than for the lab-tested group (though it is almost identical for the scale subtest) and the web-based group shows more variation (SD is larger for every subtest). Based on the mean of correct responses and on the average across all subtests, 6.7% of the web-based participants would be diagnosed as amusics because their mean correct scores fall below the cut-off score of 16.68 (or 55.6%). For the laboratory-tested group, this would be only 5.4% of the participants. If the original cut-off scores from Peretz et al. (2003) were applied to our data, 34.6% of the web-tested participants would be categorized as amusic.

Calculation of skew and kurtosis showed that all subtest scores and the average score for the web-tested group (like that of the lab-based group in Pfeifer & Hamann) exhibit a negative skew, indicating a build up of high scores, see values in Table 3. Especially the memory subtest exhibits a significant ($p < 0.001$) kurtosis value, indicating that it is not normally distributed. In addition, the Kolmogorov-Smirnov tests yielded significant results as well. The data are therefore not normally distributed and non-parametric statistics are required.

The variances between the web-based and the laboratory groups differed significantly for four of the six subtests (for the results of Levene's Test and Mann-Whitney-U tests, see Table 6 in Pfeifer & Hamann 2015). The contour and interval subtest and the average of all subtests reached significance at $p < 0.05$ and the meter and memory subtests reached significance at $p < 0.01$.

Because of this difference in variances, Pfeifer and Hamann (2015) only analyzed the laboratory group. In the present study, the results of the web-based group are further examined.

B. Analysis of web-based scores with Signal Detection Theory

As was shown by Henry & McAuley (2013) and Pfeifer & Hamann (2015), signal detection theory (Green & Swets 1966; Macmillan & Creelman 2005) seems to be a more appropriate scoring procedure for the MBEA, as it offers a bias-free measure of discriminatory ability. Table 4 gives the means and standard deviations of *d'* and *c* for the web-based group.

An analysis of skew and kurtosis of *d'* showed that the mean scores on the scale, contour, interval and rhythm test are normally distributed, while meter and average mean scores exhibit a significant ($p < 0.05$) negative kurtosis value and the memory subtest exhibits a highly significant skew ($p < 0.001$).

Based on the discriminatory ability (*d'*), cut-off scores were calculated, once with mean minus 1 SD, once with mean minus 2D. The obtained percentage of amusics varies

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Table 4. Means and SD of *c* and *d'* for the web-based group, including cut-off scores and z-scores used for normality analysis. Bold indicates $p < .001$, italics $p < .05$.

		Scale	Contour	Interval	Rhythm	Meter	Memory	Average
c	**Mean correct responses**	-0.07	0.17	0.39	0.09	-0.11	-0.27	0.03
	SD	0.52	0.50	0.58	0.55	0.33	0.46	0.54
d'	**Mean correct responses**	2.34	2.00	1.95	2.40	2.27	2.88	2.31
	SD	0.93	0.93	1.04	1.12	1.59	1.03	1.17
	z skew	-0.68	1.58	0.66	-0.56	-0.07	***-2.89***	-0.51
	z kurtosis	-1.13	-0.55	-0.65	-0.81	*-2.28*	-0.16	*-2.54*
% below cut-off (Mean – 1 SD)		17.90	12.80	17.10	15.40	15.40	17.10	16.50
% below cut-off (Mean – 2 SD)		1.70	2.60	1.70	1.70	0.90	2.60	1.40

accordingly (see the last two rows in Table 4). Which cut-off score to use is an arbitrary statistical decision, and is therefore not further discussed in the present paper.

IV. DISCUSSION

In the current paper we analyzed a sample of 117 individuals tested with a web-implemented version of the MBEA (Peretz *et al.* 2003). The data were collected as part of a larger study with a comparison between a laboratory group and this web-based sample. Parts of these data were already compared to a group tested in a laboratory (N = 111), c.f. Pfeifer & Hamann (2015). However, Pfeifer & Hamann focussed their analysis on the laboratory group and discussed in detail the problem of different applied cut-off scores and the possible existence of different amusic subtypes. In the present discussion, we will first focus on the results of the group tested with the MBEA via the web compared to the lab-tested group by Pfeifer & Hamann, then move to implications and limitations of web-based testing with the MBEA and finally discuss general limitations of web-based testing in auditory research.

A. Web-based vs. lab-based testing with the MBEA

Before looking in detail at our results, we have to note that, like in the studies by Wise (2009) and Pfeifer & Hamann (2015), the MBEA cut-off scores proposed by Peretz *et al.* (2003) yielded a very high and improbable percentage of amusics (34.6%) for our web-based group. We therefore used the cut-off scores calculated on the basis of our own data.

For the scoring based on the sum of correct responses, a slightly higher proportion of web-tested participants fell below the cut-off score and thus was diagnosed as amusic (6.7%) than for the group tested in the lab (5.4%). This contrasts with the findings by Peretz *et al.* (2008) who report that 19% of their participants were diagnosed as amusic in the laboratory would have been missed as such by their online test. As explained by Peretz *et al.*, their findings are due to a difference in task: whereas for the on-line test participants had to spot possible incongruities in melodies, for the lab-used MBEA they had to compare two melodies at a time, which is more demanding as it requires the storage of pitch information in the working memory. For the present comparison between lab and web-based testing we used the same test (the full MBEA), hence the differences we found have to be attributed to the testing method.

When looking at the differences in performance in the individual subtests, we found that the scoring based on the sum of correct responses yielded non-normally distributed results that are highly negatively skewed for all subtests. This is in accordance with the findings by Wise (2009) and Henry & McAuley (2010), and led us to use non-parametric statistics for the comparison of the two groups. Mann-Whitney-U tests revealed significant differences between the groups on the contour, interval, meter and memory subtests as well as on the average score, with the performance on the web-based version being worse.

For the further analysis of the scores we then employed the signal detection theory (SDT) measures *d'* and *c* (as suggested by Henry & McAuley 2013). For the lab-based sample tested by Pfeifer & Hamann (2015), the *d'* scores for all subtests and the average score were all distributed normally, indicating that the discriminatory ability of this group was fairly consistent. For the web-based group tested in the present study, only four of the six subtests are distributed normally. The meter subtest exhibits a significant kurtosis value, while the distribution of scores on the memory subtest is highly significantly negatively skewed and platykurtic, i.e. it contains many high scores but also exhibits a long-drawn tail to the left with low scores and an overall flat distribution. For these two subtests, the web-tested group thus shows less discriminatory abilities. Possible explanations for this difference in discriminatory power and also for the statistical difference in correct scores between the web-tested and the lab-tested groups for four of the subtests are discussed below in sections B on MBEA-related issues and section C on web-based testing in general.

B. The MBEA as a web-based test and its limitations

The MBEA was not designed for web-testing, and some of its properties do not seem to make it ideally suited as a web-based test for amusia. In this subsection, we discuss two of these properties, namely length and lack of measures to ensure participants' attention as possible reasons for the low performance of our participants on the last two subtests of the MBEA.

With respect to length, the whole MBEA takes on average 50 minutes to complete under laboratory conditions. While the majority of our participants also completed the web-based version within 50-60 minutes, some took over 90 minutes. This time seems to be too long for a web-based study, as the literature shows. Reips (2002) suggests "a few minutes", Honing & Ladinig (2008) 15 minutes, and Gingras *et al*. (2015) 30 minutes as preferred length for web tests. While Peretz et al. (2008) used a shorter web test loosely based on the MBEA, this yielded misdiagnoses in both directions, as discussed above. Some studies (e.g. Liu et al. 2010, 2013; Williamson and Stewart 2010) only use two subtests of the MBEA for pretesting participants via the web, as mentioned in the introduction.

In order to ensure the participants' attention, the MBEA contains four catch trails (as described in the methods section). All of our participants that finished the web-based test had scored correctly on all four catch trials. However, it is a relatively low number of catch trials and the manipulation in the catch trails stands out so much from the experimental manipulation that anyone paying only the slightest bit of attention should be able to identify them. The catch trials are therefore not enough to ensure a participants' lasting attention, especially in web-testing, where a very quiet and non-distracting environment cannot be assured.

Both factors, length of test and inability to ensure participants' attention, could thus have led to a worse performance of the web-tested group. Especially lack of attention during web testing could contribute to the lower and non-normally distributed discriminatory ability on the last two subtests but especially on the memory subtest as this test relies on how much participants paid attention to and remember from the first four subtests.

C. General limitations of (auditory) web-based testing

There are a number of advantages as well as limitations of web-based testing that are not specific to the MBEA but apply to all, or at least all auditory, web-based studies. Especially the limitations will be discussed here (as possible explanation of our findings). These issues are not new and have been raised before (see for example Mehler 1999; Krantz & Dalal 2000; Reips 2002; Birnbaum 2004, and a discussion on the auditory mailing list: Auditory 2007) but we will discuss them in light of our experiences with the MBEA. Where solutions have been proposed in the literature (e.g. Reips 2002; Birnbaum 2004), they are also outlined.

The obvious **advantages** of web-based testing are that it is relatively easy to gather large heterogeneous data samples as well as to reach specialized populations easily. This can be achieved at much lower costs and at a higher speed than in traditional laboratory settings, while offering a greater external validity and using more automated processes, which makes data analysis faster as well (Reips 2002). Furthermore, web-based studies using highly standardized procedures are easily replicated (Birnbaum 2004) and provide a much more natural listening setting (Honing & Ladinig 2008) that avoids an experimenter bias, i.e. participants do not feel pressured to respond in one way or the other due to the presence of the experimenter.

Though motivation to take part in a study is usually an advantage of web-based testing, our participants had to take part in the study for course credit and therefore were not as intrinsically motivated to participate as other subjects in music-related studies (see e.g. Honing and Ladinig 2008 on their very positive experience with musically interested participants in music-related web testing). However, our laboratory participants also had to take part for course credit, therefore a low motivation cannot explain the difference in performance between the two groups.

The most prominent **disadvantages** of web-based testing in general are the high drop-out rates and multiple submission, both of which are threats to the internal validity of studies (c.f. Reips 2002; Birnbaum 2004).

Generally, a **drop-out rate** of 30-40% has been reported for web-based studies (Reips 2002). In our study, we observed a dropout rate of only 10.7%, which can be attributed to the fact that students had to participate in the study for course credit. In addition, we assured our participants of confidential handling of the data before the study. We also made them aware of the possibility of back-tracing data to participants, and the availability of an explanation of the aim of the experiment after participation, thereby showing that the data were actually analyzed and used in a scientific context. This latter fact greatly interested at least part of the students and many of them not only wanted to be informed about the general outcome of the study but also about their personal results.

Reips (2002) proposes the use of the so-called high hurdle technique against high drop-out rates. With this technique a web-study is designed in such a way that 'obstacles' that test participants' patience are put at the beginning, e.g. the collection of personal data or a screen that takes long to load. With this, it is hoped that all impatient participants or participants that are unwilling to provide personal information are filtered out before the beginning of the actual study. This method not necessarily reduces the drop-out rate but ensures that uninterested participants drop out as early as possible thereby avoiding incomplete datasets. Other measures against a high drop-out rate can be the promise of rewards or a design of the test that is visually appealing or intellectually challenging, as is recommended by Honing & Ladinig (2008) However, as Reips (2002) points out, experiments that are too interesting or engaging might provoke **multiple submissions**. Our MBEA-online version was designed in such a way that it exactly mirrored the visually rather plain instruction screens that were used for the computerized laboratory version of the MBEA implemented with Praat (Boersma & Weenink 2011), again not tempting our participants to perform the test several times. Reips (2002) makes several suggestions for the avoidance or the control of such multiple submissions, such as the collection of personal data for identification, the tracking of IP-addresses, the implementation of a username and password-dependent access. All of these were implemented in our study and we did not have a single multiple submission. The same is observed by Birnbaum (2004) who found only one instance of multiple submission in a dataset of 1000 submissions.

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A further disadvantage of web-testing is the **lack of control** pertaining to technical factors (e.g. internet speed or usage of headphones) and environmental factors (like noise or distractions). Both can influence the data considerably (Mehler 1999; Auditory 2007). It has been argued that lack of control is not actually an issue and that web-based studies have a much greater external validity (Reips 2002; Gingras et al. 2015) through their large participant numbers that cancel out the possible noise in the data (McGraw et al 2000). However, Krantz and Dalal (2000) argue that for auditory research, a stable and quiet environment is crucial for the success of the experiment. Auditory (2007) shows that many researchers are in doubt about the use of web-based experiments in auditory research, since it cannot even be controlled whether subjects wear headphones or what the level of background noise is during the experiment.

Concerning internet connection and speed, Reips (2002) advises to pre-load all soundfiles. This takes longer at the beginning of the experiment but ensures then that the experiment can start and run smoothly. To ensure smooth running, experiments should be checked beforehand on different operating systems and with different browsers (Reips 2002). In our web-testing, we followed these recommendations, but nevertheless 23 of our participants encountered technical difficulties. These could mostly be resolved by updating browser versions or installing or updating plugins. However, this factor might have influenced the difference in performance between the two groups in our experiment.

Further issues on lack of control that clearly influenced our results are the environmental factors. We instructed all participants to wear headphones (not to use their computer speakers) and to take the experiment in a quiet room without distractions or interruptions. Whether they followed these instructions could not be checked. Furthermore, they were asked to finish the experiment in one instance and to only take a break when they needed one. As we logged the time of day during which participants took the test and how long they took for every subtest, we could see that data was submitted round-the-clock and that some participants took very long to finish certain blocks, not all did thus follow our instructions. A possible way around this last problem could be the exclusion of participants on the basis of such long times. The long breaks taken by some participants could contribute to the lower and non-normally distributed discriminatory ability especially on the memory subtest.

Lack of control of the environmental factors on the site of the experimenter is thus a crucial point that makes web-based testing unsuitable for the MBEA or for more than just a pre-screening.

A general point of concern with web-based testing not connected to performance is that **of security/privacy concerns**. Via http protocols or Javascript it is possible to track sensitive information about the participant: Which operating system and browser are used, screen resolution, loading times, which link referred them, and even the location can be tracked and logged. Participants need to be informed what data is or even can be collected about them and how it is being stored. However, this information is often not provided, which raises ethical concerns. Indeed, many ethics committees do not approve web-based studies and some journals will not accept web-based studies for publication (Auditory 2007; Honing & Ladinig 2008).

One last concern that is also related to ethics is important to consider when screening for amusia online, be it with the MBEA or any other kind of test, namely that of **diagnosis**. Most participants that will voluntarily seek out a web-based amusia test do this because they suspect that “there is something wrong” with them, i.e. that they have a perceptual deficit and are amusic. These participants naturally take a test like that to get to know their results on that test. However, it is questionable whether and how these participants should be informed of their results. In the case of the present study this was comparatively simple. Participants did not automatically receive their results. Pooled results were presented to all participants. More interested participants could request their personal results, which they were then given including a detailed explanation of what these results meant or did not mean. However, this is not possible with large online samples stemming from the general public. It is questionable whether a relatively simple web-based test should “diagnose” people with a life-long affliction. In a lot of cases when amusics were diagnosed in our laboratory, they were glad when they learned of their amusia because they finally knew “what was going on” with them. However, in a few cases it was almost traumatic for people and these people should not be confronted with a diagnosis like that while sitting alone in front of a computer screen without further explanation.

Finally, this last example also nicely exemplifies another issue of web-based testing: **Self-selection**. While it is argued that a more heterogeneous pool of participants can be reached via internet – and this is certainly true if compared to the normal psychology undergraduate participant pool – the sample one obtains might still be biased. Only people very interested in their own musicality or people doubting their musicality will actively seek out web-based musicality or amusia tests. This also yields a participant pool that does not reflect the normal population but rather two extremes.

While web-based testing thus offers many advantages and is suitable for many kinds of research, we would like to caution that it might not be suitable for the diagnosis of amusia (with the MBEA or another test). Web-based tests can certainly be used as pre-screening tools (as parts of the MBEA are used at the moment) and can be very useful as such. But for the various reasons outlined above, an amusia diagnosis, even if it is no medically recognized diagnosis, should not take place via a web-based test.

Concerning the MBEA, we showed that even though the sum of correct responses differed significantly between our web-tested and laboratory-tested groups, their discriminatory ability was relatively similar. Only the last two subtests showed differences between the two groups, but these can probably be attributed to some properties of the MBEA that make it in its entirety unsuitable for online testing.

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Ginsborg, J., Lamont, A., Phillips, M., Bramley, S. (Editors)

Towards a combined theory of psychological time during music listening and dynamic attending theory

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ABSTRACT

Background

Listening to music has been shown to influence perception of how much time has passed, with estimates of elapsed duration varying according to, for example, whether a concurrent task is employed (Bailey & Areni, 2006), the modality and distance of modulation of the music (Firmino et al., 2009; Ziv & Omer, 2010), and preference for / liking / enjoyment of the piece (Areni & Grantham, 2009; Ziv & Omer, 2010). Results have largely been discussed in terms of attention and memory, but few studies explore the link with literature relating to timing and entrainment.

Aims

This paper aims to explore whether timing research, and dynamic attending theory in particular (Jones & Boltz, 1989), may be useful in investigating results found in explorations of music and sense of psychological time.

Main Contribution

Research has demonstrated that listeners entrain to their preferred metrical level, or spontaneous tapping tempo. Music's metrical framework allows elements in the musical structure to be attended to, processed and stored efficiently. In models of psychological time, the more attention required to attend to an event, the longer it is often judged to have lasted. Hence music with a strong metrical framework may require less attentional resource, and be deemed shorter than non-metrical sequences. There is some evidence that unpredictable occurrences harness attention, and therefore lengthen judgement of elapsed duration (Tse et al., 2004). Research has also suggested that experienced musicians give shorter estimates than non-musicians of musical extracts with a regular sense of pulse at 100bpm, as musicians store the material more efficiently (Phillips & Cross, 2011).

Implications

The predictability of musical events within a metrical pattern may be central to exploring how music listening effects perception of elapsed duration. Furthermore, research relating to psychological time is expanding beyond the examination of prospective and retrospective experiences of duration alone, and towards models informed by neurological oscillations. These studies invite consideration alongside Jones 'metric binding hypothesis' (Jones, 2009), which proposes that the coincidence of multiple oscillations, when entraining to a musical pattern, may facilitate bonds and clusters being recognized within the framework. This metric binding may allow further flexibility in the allocation of attentional resource during music listening.

Timing research, dynamic attending theory, and the metric binding hypothesis do appear to be potentially valuable in exploring results relating to music and psychological time. However, a more developed theory is required, after which empirical testing may follow.

Keywords

Music and time, dynamic attending theory, entrainment.

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Understanding audiences for the contemporary arts

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ABSTRACT

Background

The growing body of research with audiences (see chapters in Burland & Pitts, 2014) has increased understanding of motivations and experiences in the concert hall and across other art forms, highlighting the personal, social and musical enrichment that people seek in their live arts consumption. Audiences for the contemporary arts, however, remain something of a mystery, both to arts organisations and to researchers: their affiliation away from the 'mainstream' invites investigation of their routes into arts engagement, and their attitude to risk and challenge might be presumed to be different from that of most classical music audiences. This project sets out to uncover some of those routes, motivations and attitudes, and to work with arts organisations to consider the impact and application of understanding audience experience.

Aims

This paper reports on the first stage of what we hope will become a nationwide project which aims to understand (i) audience experience of live contemporary arts, (ii) the value of those arts to individuals and society, and (iii) strategies for sustaining and growing audiences across art forms and genres. Our research questions addressed these areas through consideration of (i) who is coming to the contemporary arts, and what experiences are they having of this work?, (ii) what value do the contemporary arts have for audiences, and how is this articulated? (iii) what strategies are contemporary arts organisations currently employing to develop relationships with audiences, and what strategies might they employ in the future?

Method

From October 2014 to May 2015, we worked with Birmingham Contemporary Music Group (BCMG) to build a network of arts organisations across Birmingham, who shared through interviews and discussion groups their challenges for building audiences and developing wider access to contemporary arts events. We then took a qualitative research approach to our work with audiences, carrying out 56 life history interviews with regular and infrequent attenders across art forms, and conducting 'audience exchanges', in which participants attended unfamiliar art forms for the first time and reflected on these in group discussion.

Results

Our preliminary findings uncover routes into contemporary arts through volunteering and creative practice, and show audience members' fascination with work being made 'now' and with access to the backstage processes of that creation. Our participants reflected on the meaning of 'contemporary', arriving at a collective definition that encompasses work that is 'of its time' and in the tradition of experimental art forms, and which offers challenge and provokes both thought and emotional response. The interview material also highlighted a number of facilitative organisational conditions for contemporary arts engagement, showing how audiences favoured opportunities for 'backstage' access to the creative process, and welcomed festival conditions or free access to events, that enabled them to try new things. There was debate around how much it was necessary to 'understand' new art, and how wanting to be challenged, but not necessarily expecting to like everything, was a facilitative audience attitude. For arts organisations, there are challenges of creating these facilitative conditions and attitudes, while combining deep participation with broad inclusivity. The notion of 'cultural citizenship' was used by one participant to describe the variety of ways in which people might engage with or support the contemporary arts, and this is potentially a useful framework for understanding audiences for the contemporary arts, and the different needs and expectations that they bring to their arts engagement.

Conclusions

Our research makes recommendations to contemporary arts organisations, who could adapt their marketing and presentational practices to encompass the backstage access, opportunities for discussion, and social context for arts engagement that feature prominently in our audience members' discourse. The research also makes an academic contribution to understanding of 'the contemporary' and how audiences engage with that mode of arts consumption, in ways that are distinct from the audience behaviours noted in previous studies of music, dance and theatre. We will conclude our paper by reporting on the next steps for this project, which we hope will include a nationwide phase of research, building new networks of contemporary arts organisations in three more cities, through which comparisons across regions and across art forms can be made.

Keywords

Audiences, contemporary arts, music, dance, theatre, art, community, motivation, experience

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Edwin Gordon's "Advanced Measures of Music Audiation" (AMMA): A critical evaluation

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ABSTRACT

Background

Edwin Gordon's music learning theory (2012) is a widely accepted model of music aptitude (Shuter-Dyson, 1999, p. 627). It is closely related to his concept of "music audiation" which is an innate capacity for acquiring musical skills (Gordon, 2012, p. 3). Following from this, only a learning environment adapted to an individual's level of audiation can maximize a person's final musical achievement. In order to design such an optimal learning environment in the context of music education, it is important to first measure music audition in a manner consistent with state-of-the-art psychometric standards (Bond & Fox, 2007). For this, Gordon developed a number of tests: among them the *Advanced Measures of Music Audiation* (AMMA, Gordon, 1989). Until today, the AMMA has not been validated either by means of classical test theory or the use of item response theory (IRT).

Aims

Our aims were two-fold: first, to analyze the item and person parameters as well as the internal test validity by means of IRT methods and goodness-of-fit tests; second to optimize the AMMA by removing those items that would not meet the criteria of the Rasch model.

Method

A total of N = 364 participants (175 female, $M_{age} = 18.7$ years) gave written informed consent for participation. All participants were tested in small groups with sessions lasting no longer than 45 minutes. Next, we analysed our sample's response data by means of IRT analyses. To establish internal test validity, we used an iterative approach by removing those items with the strongest misfit until the maximum model fit was reached.

Results

Gordon's AMMA (1989) only met psychometric standards after removing the majority of the items. Based on the remaining items (10 out of 30), however, the optimized version of the AMMA contains only items with a low to medium difficulty level and is therefore no longer suitable for a selective discrimination between different levels of music audiation.

Conclusions

The AMMA test is largely an inappropriate measurement for the quantification of both music audiation and – by proxy – of music aptitude. Due to its insufficient internal validity and inability to discriminate, results from previous studies using the AMMA should be interpreted with caution.

Keywords

Music education, Advanced Measures of Music Audiation (AMMA), Gordon, testing theory, internal validity.

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The origin of music and the Baldwin effect

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ABSTRACT

The origin of music has been explained as either the result of natural selection or as a cultural invention. On one hand the cross-cultural diversity of music supports the claim that music was created thanks to cultural flexibility. On the other, the fact that music is easily recognizable, and that no culture exists without music suggests that it could be an adaptive phenomenon. The aim of this paper is to suggest that the most probable scenario of music origin is the result of Baldwinian evolution in which some culturally invented behaviour was transformed into an instinctive behaviour by the means of natural selection. Similar explanations have been proposed for the development of language and birdsong evolution. Music is a phenomenon in which structures are transmitted by imitation. This indicates that music is a good example of a ritual culture. In this respect, music resembles animal songs (e.g. birdsongs) which are characterized by instinctive and inventive components. This is exactly what can be expected as a result of the Baldwinian mode of evolution. It is proposed that the evolution of music started as the invention of sound sequences which was used for ritual purpose, and as the ritual was an important part of social life its performance gained a consolidating function. Cultures that encompassed such a ritual therefore began to act as a selective environment. After many generations an individual was born better predisposed to memorize sound sequences thanks to the regularity present in the ritual.

I. INTRODUCTION

The cultural diversity of music is enormous both in terms of general complexity and particular features such as scales, rhythms and forms. Such elements within each musical culture constitute musical traditions which have changed throughout history. In this respect music does not resemble human instinctive vocal expressions such as laughter (Owren, Philipp, Vanman, Trivedi, Schulman, Bachorowski, 2013; Provine, 2000) and crying (Zeskind, 2013). Therefore, music is understood as an unquestionable part of human culture. In accordance with this intuitive notion some contemporary scholars (Pinker, 1998; Patel, 2008; Parncutt, 2009; Wilson, 2012) suggest that music is a cultural invention rather than an adaptation. However, the cultural character of music does not explain the fact why music is so ubiquitous (Blacking, 1973; Cross, 2001) and spontaneously performed by children (Trehub, 2003) in comparison to other solely cultural phenomena such as writing and playing chess. From this perspective, music is similar to language which is often understood as a human-specific adaptation (Bickerton, 2009; Pinker, 1994). The resemblance between music and language has led us to consider music as either a derivative of language (Patel, 2008), as part of a broader, adaptive communicative continuum (Arbib, 2013), or even as a more general phenomenon which includes speech as a special type of music (Brandt, Gebrian, and Slevc, 2012). However, because music seems to possess features which are absent from speech (a set of pitch classes (musical scale) and regular beat (Fitch, 2006)) the idea that music is a human-specific adaptation is still very popular. The origin of music as the result of natural selection was first proposed by Darwin (1871). Various explanations for the adaptive character of music have recently regained popularity among many scholars (Brown, 2000; Fitch, 2006; 2012; Roederer, 1983; Store, 1990). Although all of these proposals indicate the possible adaptive value of music as a whole behavioural entity, there is still no agreement as far as the structural definition of music is concerned. In other words, there is the open question as to which musical features are necessary to admit that certain sounds are music.

It seems that syntax is a necessary condition of music as a biological phenomenon. In fact syntax differentiates music from all other vocal expressions except speech. The syntactic correctness of one's culture-specific music, like one's mother tongue, is intuitively recognizable (McMullen & Saffran, 2004) which indicates some hereditary predisposition. This necessitates that natural selection preferred individuals who were able to organise sounds in accordance with some generative rules thanks to a particular genetic predisposition. However, what kind of evolutionary advantage could have given the ability to syntactically organise sounds in case nobody except the one individual was able to do this? It seems that syntax only makes sense if it is recognisable by a group of individuals. In other words, someone has to recognize the correctness of a particular phrase in order to make use of syntax as a feature of a communicative system. Without the recognition of a syntactic order by others the effort spent applying the generative rules seems useless. Because in evolution accidental mutations or recombination are the sources of variations (Darwin, 1859; Dawkins, 2006) our ancestors who were endowed with the propensity to use musical syntax had to differ genetically from others. However, syntactic communication must necessitate at least two individuals. Therefore, in order to make syntax operational, the accidental mutation or recombination that enabled an individual to organize vocal expression syntactically had to happen at least twice among individuals living together, which is extremely improbable. Moreover, as musical syntaxes differ depending on the culture, the accidental appearance of the inborn proclivity to organize sounds syntactically seems even more mysterious.

The most popular solution for this problem is to understand musical syntax as an epiphenomenon of language syntax (Lerdahl & Jackendoff, 1983) or of other general, mental mechanisms (Krumhansl & Cuddy, 2010; Huron, 2006) which evolved because of functions unrelated to music. In fact, it has been shown that implicit learning of hidden generative rules is

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possible for various types of stimuli such as artificial grammars of number sequences (Reber, 1976), foreign language grammar (Ellis, 1993) and the organization of transportation systems (Broadbent, 1977) which all suggest a general mechanism of syntactic processing. On the other hand, the implicit learning of language and musical syntaxes in childhood is incomparable with the implicit learning of any currently known artificial syntax (Dor & Jablonka, 2000). Additionally, it has been observed that implicit and incidental learning of musical syntax in adulthood is constrained by some characteristics of melody (Rohrmeier & Cross, 2013). The effect of the implicit learning of musical syntax has been observed independent of musical expertise (Rohrmeier, Rebuschat, Cross, 2011). These observations indicate possible specialization for music processing because the implicit learning of musical syntax is especially sensitive to pitch distribution. In contrast, the implicit, statistical learning of language phonotactic rules is sensitive to the spectral changes of sound (Pierrehumbert, 2003). Since the lateralization of music processing in new-born babies has been observed only for the tonal (syntactically well-organized) examples (Perani et al., 2010) (right hemisphere dominance in comparison to left hemisphere dominance in the case of speech (Pena et al., 2003)) it is reasonable to suppose that musical syntax is not only the epiphenomenon of language syntax but is also an indispensable part of music understood as a human specific adaptation. A possible explanation for the problem of the appearance of musical syntax is the evolution of music by the means of the Baldwin effect.

II. BEHAVIOURAL TRAITS AND THE BALDWIN EFFECT

Baldwinian evolution is the process by which some culturally invented behaviour is transformed into an instinctive behaviour by the means of natural selection (Baldwin, 1896). This specific kind of evolutionary process was initially proposed independently by three authors Henry Fairfield Osborn (1896), Conway Lloyd Morgan (1896), and James Mark Baldwin (1896) but was coined the "Baldwin effect" (Simpson, 1953). Although the Baldwin effect has seemed to have been rather neglected in the last century it has recently regained popularity (cf. Weber & Depew, 2003). The main idea claims that if animals face a new challenge they often adapt to this challenge behaviourally by the means of learning (Jablonka & Lamb, 2005). If the challenge influences the selective pressure then the animals must learn the adaptive behaviour in order to survive. In other words, only animals which are able to learn this new, adaptive behaviour will survive and reproduce. If the challenge lasts many generations and learning allows the population to face this challenge long enough, then it is possible that some hereditary variation will appear that causes either an individual response to the challenge without learning or it learns the adaptive behaviour instinctively. A rigid, hereditary response is preferred by evolution as learning is usually costlier than an instinctive response. The Baldwinian scenario shows how previously learned behaviour is transformed into instinctive behaviour by the means of natural selection (in the case of an environmental challenge) or sexual selection (if the challenge equates to mating preferences).

Learning is an especially important factor which drives the evolution of animals with a nervous system (Verzijden, Cate, Servedio, Kozak, Boughman, Svensson, 2012; Dukas, 2013). It is the result of the fact that learning allows individuals to increase their behavioural repertoire in the response to environmental challenges (Jablonka & Lamb, 2005). In social animals cultural information often becomes an important part of the environment creating a so called cultural niche (Godfrey-Smith, Dennett, Deacon, 2003). The obvious examples of culture are various forms of learned communication systems. Since learning is an important part of communication observed among birds and mammals it is probable that the Baldwin effect could have influenced the evolution of birds' and mammals' communicative abilities. In fact, the Baldwinian mode of evolution has been hypothesized as the cause of the evolution of songbirds' songs (Morgan, 1896; Simpson, 1953) and language (Deacon, 1997; Dor & Jablonka, 2000; 2001). Birdsongs and language, like music, are characterized by implicit learning and cultural variations (local dialects) (Fitch & Jarvis, 2013; Rothenberg, Roeske, Vos, Naguib, Tchernichovski, 2014). These two characteristics of behaviour are congruent with the expected results of the Baldwin effect (Dor & Jablonka, 2000). Additionally, the Baldwinian scenario of language evolution solves the problem of the first appearance of grammatical language in a non-lingual society. It is very probable that in the beginning the prepositional communicative system was socially invented by pre-linguistic hominines.

Culturally transmitted forms of simple, meaningful, gestural and vocal signals are observed among our closest relatives – chimpanzees (Slocombe & Zuberbühler, 2005; Gruber & Zuberbühler, 2013). Some restricted forms of learning related to vocal communication are also noticed among other primates (Chow, Mitchell, Miller, 2015). These observations indicate that the common ancestor of the human and chimpanzee lineages was smart enough to socially invent a simple communicative code. Therefore, it is reasonable to suppose that a more sophisticated form of such behaviour could have served as a prepositional communicative system among our ancestors. This communicative system could have been preserved for many generations and, in accordance with Baldwinian explanations, the advantage of propositional communication directed the selective pressure towards faster learners. An accidental hereditary trait which predisposed an individual to implicit learning of this system became successful and eventually led to the proliferation of the predisposition to implicitly learn a language (Dor & Jablonka, 2000). Was a similar process responsible for the evolution of music?

III. THE UNIQUENESS OF MUSIC AMONG ANIMAL SOUND EXPRESSIONS

Many animal sound expressions are often described as music. Birdsongs, cicada calls, gibbon songs etc. resemble music to a

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greater or lesser extent. In fact, elements of some animal sound expressions not only resemble musical features but they are almost identical to them. For example, the characteristics of birdsongs such as rhythms and pitches are based on the same acoustical features of sounds (time relations and frequencies F0) as rhythms and pitch classes in music. It is probable that the manipulation of pitch in time by singing birds creates expectations in conspecifics, as in the case of music listeners, which leads to emotional responses based on those similar to human mesolimbic reward pathways (Earp & Maney, 2012; Rothenberg et al., 2014). On the other hand, there is no evidence that birdsongs are based on musical scales (Araya-Salas, 2012). Similarly, the vocal expressions of primates are absent from musical intervals. In contrast to animal sound expressions the musical syntax is at least more complex (Fitch & Zuberbühler, 2013). It seems that although the animal world is full of vocal communications based on the continuous modulation of sounds, the specificity of music consists of using discrete elements (pitch classes and their durations) according to certain generative rules (Merker, 2003). The uniqueness of musical syntax opens the question of the human-specific function of musical syntax and its evolutionary origin as well as the role of learning in this process in comparison to the evolution of animal songs.

IV. LEARNING ABILITIES AND RITUAL CULTURE AMONG HOMININES

Language and musical abilities of *Homo sapiens* seems to be unique among all animals. However, because evolution is usually gradual (Darwin, 1859; Theißen, 2009) there has to be continuity between our ancestors and modern day humans as far as mental abilities are concerned. The sudden accidental appearance of language and musical abilities is especially improbable (Dor & Jablonka, 2000; Deacon, 2010; Podlipniak, 2015) as language and music are complex phenomena which involve many different mental mechanisms (Fitch, 2006). Therefore, one should expect that elements of these mechanisms are present among our closest relatives. In fact, certain observations of primates suggest that pre-musical and pre-lingual hominines were endowed with abilities which were later involved as the important components of language and music. An obvious component of both speech and music is the expressive modulation of tempo, dynamics and different forms of emphasis. This feature, known as "expressive phrasing" (Brown, 2000) or "expressive dynamics" (Merker, 2003) is also observed among non-human mammals and is strictly related to emotional communication. Some of the elements of this form of communication are universal among different mammalian taxa (Zimmermann, Leliveld, Schehka, 2013).

However, music is composed of sounds perceived as discrete elements which are organized according to some generative rules. The use of such a system necessitates recognition of certain discrete elements (pitch classes and their rhythmic relations). Moreover, in order to use this system as a communicative tool, these elements have to be learnt to be imitated. The ability to vocally imitate sounds is called "vocal learning" (Janik & Slater, 1997). This ability is observed mainly among social animals especially among birds (Brainard & Doupe, 2002) but also in some species of mammals (Prat, Taub, Yovel, 2015; Ridgway, Carder, Jeffries, Todd, 2012; Stoeger et al., 2012) which suggests that the social environment plays an important role in the evolution of vocal learning. Although *Homo sapiens* is the only species of primates able to use complex vocal learning (Janik & Slater, 1997) simple forms of vocal learning have been recently observed among chimpanzees (Watson et al., 2015). Therefore, vocal learning either evolved independently within the chimpanzee and human lineages or, more probably, the common ancestor of both possessed the ability of simple vocal learning. If this is true then the beginning of complex vocal communication of hominines could have started long before the appearance of grammatically complex language. The development of laryngeal control among hominines which probably happened more than 600 000 years ago but no earlier than 1.7 million years ago (Morley, 2013) enabled hominines to use more precise vocal imitation. The imitation of sound is crucial for another important characteristic of human culture – that of ritual (Merker, 2012).

The ritual culture, in contrast to instrumental culture, is based on learning by imitation (Jablonka & Lamb, 2005). In this process the structure of a ritual, whether it is a song or dance, is literally duplicated by a learner (Merker, 2005). Although every ritual has its biological function the particular components of ritual are not derivable from the function of the ritual (Merker, 2012). This means that the structure of ritual can be shaped to some extant independently from its role e.g. as a fitness indicator in mating. Musical structure is an obvious example of ritual culture as there is a need to imitate melody literally in order to recognize it as an example of the same prototype. Every inconsistency of an imitated excerpt is usually interpreted as a violation of the original version (Merker, 2005). In fact birds distinguish between structurally different songs specific to their species (Rothenberg et al., 2014) that is similar to the recognition of melodies by humans. Additionally, the human ability to create an enormous number of melodic variants and the lack of propositional meaning make from music an ideal tool of ritual. However, musical structure is a powerful source of eliciting emotions. This emotional reaction to the structural properties of music depends on these properties. For example the recognition of pitch centre is usually accompanied by the emotions of stability and relaxation (Steinbeis, Koelsch, Sloboda, 2006). Although this reaction is a result of successful prediction (Huron, 2006) the specificity of the experienced stability in response to music in comparison to other successful predictions suggests a special, biological function of musical structure (Podlipniak, 2015). This function has to be a function of an ancient musical ritual.

V. PROTO-SINGING AS A CONSOLIDATING VOCAL RITUAL

The first form of music was most probably singing (Morley, 2013). It is even likely that the evolution of the human larynx was related to singing rather than speaking (cf. Clegg, 2012).

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Although the ability to produce harmonic sounds is needed to pronounce vowels as well as to organize speech prosody, the vocal control over the first harmonics (F0) is crucial mainly for musical pitch structure. This control must have co-evolved together with the sophistication of vocal learning, which enabled our ancestors not only to produce monotonous singing (Bannan, 2012) but also to achieve spectral and temporal synchronisation between individuals. This is possible because learning enables individuals to internally represent perceived sounds and motor patterns (Dukas, 2013) which are necessary to produce sound.

The fact that from a global contemporary perspective music is mainly a social activity (Cross, 2005) suggests that at some point in time hominines started to sing together. Independent of what kind of cooperative singing it was – whether they sang simultaneously or in turn-taking mode – this activity necessitated some kind of coordination. Because the coordination of timing during vocal turn-taking is learned not only by humans but also by non-human primates (Chow, Mitchell, Miller, 2015) hominines were able to culturally invent group vocalization. In order to coordinate vocal expression hominines had to share the mental representations of their vocalization. Such synchrony between mental states is called the alignment of brain states (Bharucha, Curtis, Paroo, 2013). In the case of singing hominines had to align emotional (cf. Cheng & Durand, 2004), motor and cognitive (cf. Mercado, Mantell, Pfordresher, 2014) representation which are all crucial during vocal learning. The alignment of brain states fosters group identity and leads to social cohesion (Bharucha, Curtis, Paroo, 2013) which has an adaptive value (Wilson, 2012). Therefore, coordinated vocalizations could have been ritualized as a kind of consolidating rite. However, in order to synchronize musical structure hominines had to expect not only the timing or shape of a phrase but also the precise sequence of pitches in time.

VI. THE EMERGENCE OF MUSIC-SPECIFIC PREDISPOSITIONS

Vocal expression of harmonic sounds and their imitation are not sufficient enough to create music. The interpretation of sounds as being musical is connected with the attribution of music-specific, structural relations to sounds. Therefore, the emergence of music should be understood as the appearance of generative rules governing pitch order in time. It is proposed that the first appearance of pitch structure was the result of cultural invention by hominines. Since the vocal anatomy and the neural control of it similar to that observed among modern humans evolved most probably between *Homo ergaster* and *Homo heidelbergensis* (Morley, 2013) this invention could have occurred even earlier than 600 000 years ago that left enough time for the evolution of musical predispositions by the means of the Baldwin effect. It is also probable that the invention of musical structure happened long before the appearance of language and cognitive flexibility specific to modern *Homo sapiens* (Mithen, 2006). The most significant element of the invention of musical structure was hierarchy. Because non-human primates are very conservative in preserving cultural traditions, the ritualized sound structure invented by hominines could have been cultivated in an unchanged form throughout many generations. This circumstance became an ideal cultural environment for the Baldwinian process.

In the beginning the learning of the pitch sequence of the ritual was very strenuous and time-consuming. However, the more frequent occurrence of some pitches and regular time measures of their duration enabled the organization of mental representations by the means of chunks of notes. Accidentally, one individual was born with the predisposition to memorize certain elements of musical structure more efficiently. One of such predispositions can be the ability to recognize pitch centre (Podlipniak, 2015). However, since musical structure is usually based on a time framework perceived in reference to the internal representation of a musical pulse, then the vocal learning of pitch structure could have been also facilitated by the predisposition to join the motor representation of regular movement with sounds. Such a predisposition is observed among other vocal-learning species (Patel, Iversen, Bregman, Schulz, 2009) which suggests that it helps to synchronize the mental representations of vocal expressions. However, it seems that in the case of hominines the predisposition to mentally represent pitches in a hierarchical structure incorporated the ability to synchronize movement with sounds in a music-specific way. It could have probably happened because of the specific consolidating function of the hominines' vocal ritual.

VII. CONCLUSION

The observed coexistence of instinctive and inventive components of music is exactly what can be expected as a result of the Baldwinian mode of evolution. This proposed speculative scenario for the origin of music indicates how Baldwinian evolution could have operated among hominines. Further research is needed to elucidate the possible evolutionary changes which led to the appearance of a musical ape. The most important fields of studies that can help to broaden the knowledge of music origin include comparative research of vocal communication among primates and other vertebrates, neuropsychological and developmental research which can help to explain brain mechanisms involved in music processing as well as comparative studies between different kinds of music and speech. Despite having a speculative character, the Baldwinian explanation for the evolution of music opens new possibilities for the better understanding of the rules by which musical structures are organized and remembered by the modern human mind.

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Links between musical and linguistic abilities in preschoolers: The role of the family's musical environment

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ABSTRACT

Background

Associations between musical and linguistic abilities have been widely explored in adults and school aged children with many studies relating linguistic advantages such as verbal memory (Franklin et al., 2008), phonological awareness (Moritz, Yampolsky, Papadelis, Thomson, & Wolf, 2013) and syntax processing (Jentschke & Koeschl, 2009) to years of musical training. Relevant research in preschoolers is either limited to children ≥ 4 years (e.g., Anvari, Trainor, Woodside, & Levy, 2002) or explores links between single linguistic and musical aptitudes (e.g., rhythm synchronization and speech encoding; Woodruff-Carr, White-Schwoch, Tierney, Strait, & Kraus, 2014) rather than evaluating a broad range of linguistic and musical skills. Furthermore, the effect of environmental factors such as parent's musical experience and the home musical environment in the musical and linguistic development of young children has been understudied.

Aims

This research is designed to explore associations between a broad range of musical and linguistic abilities in 3- and 4-year-old children with the aims of a) examining these links more extensively and at a younger age than previously studied, b) examining whether cognitive factors such as memory and general ability could have a mediating effect on these links and, c) evaluating the effect of parents' musical experience and home musical environment on the musical and linguistic development of young children.

Method

Two nurseries in the area Greater London have agreed to participate in this research. Participating children complete a novel comprehensive battery of age-appropriate musical tasks. These tasks were created ad-hoc to evaluate perception and production of a wide range of musical elements such as pitch, melody, rhythm and tempo, as the existing musical tasks appropriate for this age group (Gordon, 1989) are limited to melody and rhythm perception. Well-established standardized measures are used to evaluate linguistic (CELF-Preschool-2; Wiig, Secord, & Semel, 2004) and cognitive skills (WPPSI- IV UK, Wechsler, 2013). Parents/guardians complete three subscales from the Goldsmith's Musical Sophistication Index (Müllensiefen, Gingras, Stewart, & Musil, 2014) providing information about their own musical experience, and a variation of the Linguistic & Musical Experience Personal and Family Profile questionnaire (Franco, Brunswick & Kiakides, 2014) providing information about the child's exposure to music within the family.

Results

Preliminary results from an ongoing data collection appear to support the widely reported music-language association not only in 4- but also in 3- year-old children, with musical abilities being related to linguistic abilities such as sentence and word structure, phonological awareness and vocabulary. However, we anticipate that the full data set will further elucidate specific rather than general links between musical and linguistic abilities that are stronger than others and will shed light on the role of general ability and memory on these links. Finally, given recent evidence that early musical input (i.e. home environment or music classes) appears to play a role in the development of communication (Gerry, Unrau, & Trainor, 2012; Franco, Kozar, & D'Odorico 2014), we expect that the family's musical environment will be associated not only with children's musical abilities but also with specific aspects of their language development.

Conclusions

This investigation sheds light on the early development of the music-language association and contributes to the debate of whether or not language and music rely on shared mechanisms for sound category learning (see Patel, 2008). Moreover, revealing links between specific musical and linguistic abilities could directly inform practices for the early assessment and intervention of language related disabilities. Finally, this study aims to provide novel insights on how the family's musical environment might affect musical and linguistic skills at a young age.

Keywords

Musical ability, language, home environment, preschoolers

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Peeling the onion: Interpersonal relationships in the music classroom

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ABSTRACT

The research applies social penetration theory (Altman and Taylor, 1973) to investigate how interpersonal relationships influence musical participation and learning outcomes during group music making. The research design draws on constructivist approaches to investigate collaborative learning that show how knowledge is shared and created. The research aims to highlight the links between musical participation, language and interpersonal relationships. Episodes of class music lessons recorded over three weekly lessons were transcribed and provided the data for analysis using an adaptation of a sociocultural discourse analysis framework. The framework is specifically designed for the study and description of classroom talk and is based on a typology for disputational, cumulative and exploratory talk. The adaptation incorporated both verbal and non-verbal aspects of musical participation. The analyses indicated that relational closeness, integral to social penetration theory, was a feature of successful musical participation when most of the talk was exploratory and/or cumulative.

Background

Social penetration theory (Altman and Taylor, 1973, 1987) underpins research into a wide range of interpersonal contexts - e.g. romantic, friendship, parent-child, employee/employee and student/teacher (Taylor and Altman, 1987). Altman and Taylor (1987) use the analogy of an onion to visualise how relationships evolve. The thin outer layers represent initial and relatively superficial relationships, e.g. one's public persona. As relationships deepen over time, the layers peel away and gradually become thicker to represent how people reveal more about themselves to each other. One of the first studies to focus on friendship groups and classroom musical participation was conducted by MacDonald, Miell and Morgan (2002). They focused on verbal and musical collaborations to argue that 'music provides another channel of communication between children besides their talk. This other channel can express thoughts, emotions and ideas just as words can' (MacDonald et al, 2002, p. 407). Furthermore the musical and verbal communication styles of friendship pairs were found to be qualitatively different from non-friendship pairs. The importance of how relationships impact on the quality of learning is supported by findings from Azmitia and Montgomery (1993), Hartup (1996) and Youniss (1999) to suggest that 'relational closeness is associated with the sharing of ideas, exchanging points of view and a collective approach to challenging tasks' (Mercer & Littleton 2007, p. 31). More recently Finney (2011) has provided another dimension to propose that classroom music should be regarded as 'an ethical pursuit….in which relationships can be thought of as playfully dialogic, where teacher and pupils remain curious, and where attention is paid to what is taught and why' (Finney 2011, pp. 8-9).

Aims

The aim of this research is to show how social penetration theory can provide a rationale for determining and promoting successful musical collaboration by focusing on the links between music making, language and relational closeness.

(Success is defined here as the extent to which students are able to work together to compose music that relates to curriculum guidelines. Topics are set and assessed by the teachers in line with the school's curriculum and assessment system.)

Method

The methodology draws on Vygotskian (1978) approaches to learning and development to show how 'shared knowledge is both invoked and created' (Littleton and Mercer, 2012, p.234). Transcripts and videos of episodes from music lessons were analysed by adapting Mercer's (2007) sociocultural discourse analysis approach. The adaptation incorporated both verbal and non-verbal aspects of the musical interactions (Preston, 2013, p. 215). The research design provides a synthesised approach to explore the links between joint intellectual activity and the co-construction of knowledge and the extent to which relational closeness is allied with successful musical interaction. The extracts of talk used in the presentation are representative of Mercer's (2007) typology for three types of talk: disputational, cumulative and exploratory.

The first episode is a transcription of the interaction of five year 7 pupils (aged 11 and 12 years) and exemplifies cumulative talk as they composed music that showed their interpretations of the musical elements through performance of their graphic score. The second is a transcription of the interaction of four year 8 pupils (aged 12 and 13 tears) and exemplifies exploratory talk as they were engaged in a composing module on African Drumming. The third is a transcription of the interaction of four year 9 pupils (aged 13 and 14 years) and exemplifies disputational talk as they were engaged in composing a song in Britpop style. In each case, the modules were delivered over three weekly lessons, each lasting 60 minutes. In week one, the lesson consisted of teacher-led whole class activities to introduce the topic followed by associated listening and singing. In week two, groups were formed and they began their compositions. The music was rehearsed, performed and assessed in week three.

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Results

Year 7. This episode showed how cumulative talk was co-constructed and how the group members dealt with the conflict between their agreed musical objectives. It would appear that the members of this group had the required interpersonal skills and musical knowledge to communicate with each other and provided an example of how the two aspects are mutually dependent.

Year 8. Here, the year 8 group collaborated to consolidate and organise musical content including call and response and ostinatos in drumming and singing. There is evidence to suggest that the members of this group are beginning to be 'playfully dialogic' in that, in terms of the features of exploratory talk, they demonstrated critical engagement with each other's ideas, active participation through playing and singing and offering alternative views.

Year 9. In comparison with the previous episodes, two important differences emerged. Firstly, the year 7 and 8 participants negotiated and agreed their musical roles and there was someone who assumed the role of musical director. However, it was not until the teacher entered the group that this occurred here. So perhaps what was missing for the these students was 'relational closeness' as they showed a lack of understanding to work within each others' musical strengths and needed someone to take the lead.

Conclusions

Three areas emerged for discussion. Firstly, the year 7 and 9 students seemed to experience some tensions in their efforts to complete the activities set by the teacher. As the time for classroom assessment became more imminent, they were increasingly concerned with showing they had achieved the lesson objectives rather than considering the more musical aspects of the performance. Thus time constraints, the drive to fulfill the learning objectives set by the teacher and the pupils' awareness of the assessment requirements can create barriers that prevent pupils from interacting musically and at a deeper level. Secondly, the layout and design of the music classroom may not always support effective musical interaction in that restrictions of time and/or space may provide limited opportunities for groups to call upon the teacher for help and advice. Instead, they are 'cast out', surviving on their own creative resources to produce an outcome with little or no help to support group processes of negotiation and agreement. The year 7 group worked in a cramped space, not much larger than a store cupboard, and the year 8 group was in a corridor outside the classroom. They were only able to work together because of their ability to communicate and rehearse effectively. Conversely, the year 9 boys were in a large classroom with access to a range of resources and expensive equipment but were only able to produce a performance with help. Furthermore, the teacher's expertise was directed at arriving at a performance for assessment, which took place a few minutes after this episode. Thirdly, it would seem that there is a need to support group composing much more perceptively by preparing pupils to understand what working together *to create music* involves. At the beginning of this paper, reference was made to Finney's (2011) notion of pupils being 'playfully dialogic', which highlights the need to consider more carefully the importance of the relationship between music making, language and communication in the music classroom. The findings from the analyses presented here suggest that there are several avenues to pursue, the most relevant being the extent to which relates to pupils' understanding of what it is to communicate through and in music. The examples provide 'in the moment' examples of musical participation to focus on joint intellectual activity and the co-construction of knowledge. However, it would appear that, for some students, this may the outer layers of the onion. More research is required to peel back the layers to assist students to gain a deeper understanding of the purpose and nature of collaborative learning in the music classroom.

Keywords

Social penetration theory, relational closeness, sociocultural discourse analysis, group music making

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The impact of live music on older people in hospitals: Physical, cognitive, social and emotional implications

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ABSTRACT

Background

The event of hospitalization in the life of an older person is often associated with long-term increased risk of death (Inouye et al., 1998) and even if the underlying reasons are not yet known, one of the main predictors of such risk has been attributed to depression (Covinsky et al., 1999). Psychosocial interventions are precious therapeutic allies to improve the daily care of older people, including those with dementia (Vernooij-Dassen & Moniz-Cook, 2014). Elevate is an art-based programme at Salisbury District Hospital that aims to contribute to the healing and wellbeing of the older patients in the hospital by bringing different art forms into the hospital, with a main focus on music, both live and recorded.

Aims

The aim of the study was to investigate the impact of live and recorded music on the older patients in the hospital.

Method

To collect data on the interaction between the artists, the patients, and the hospital staff an interactive observation grid was used (Preti & Welch, 2011) with the purpose of documenting a wide range of behaviours (musical and non-musical). The observation findings are based on 27 days of observations (approximately 68 hours). Overall, 594 participants were observed. Of these 338 were patients, 213 hospital staff and 43 caregivers. Semi structured interviews were conducted with 23 patients, 23 hospital staff and 2 caregivers. All data were transcribed and all the files were imported into Altas.ti 7.Thematic analysis informed by grounded theory were performed on all the data.

Results

From the data analysis it emerged that both recorded and live music had four different types of impact on the patients: 1) Physical engagement: Patients engaged with the music at a physical level by tapping their foot or clapping their hands in time with the music, singing along or just moving their lips. 2) Cognitive engagement: The artists were noticed to use a set of techniques, musical and verbal, aimed at eliciting a direct response from the patients. These were to: i) establish an introductory conversation to find out more about the patient; ii) leave a gap in the song to be filled by the patient; iii) give the patients a time-related clue when introducing a song. 3) Social engagement in relation to: i) the interaction with their caregivers; ii) the provision of a more relaxed occasion to interact with the hospital staff; iii) the relationship between the different patients in the bay. 4) Emotional engagement, as the music was often associated with memories and emotions.

Conclusions

Both live and recorded music appeared to have significant physical and psychological impact on the older population in the hospital. Music was not only a distraction for these patients but also an occasion to practice mild movements and engage in musical activities that stimulated social and cognitive engagement

Keywords

Old people, hospital, wellbeing, social engagement.

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Digital delivery of instrumental lessons in remote rural areas

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ABSTRACT

Background

Tuition in Western classical music has traditionally been based on a master-apprenticeship model with one-to-one lessons, though lessons at the earlier stages of learning are frequently delivered in small groups, or more recently, whole classes (Hallam & Creech, 2010). Studies of children's instrumental lessons have previously explored the types of behaviours occurring within lessons (Kupers, van Dijk, van Geert, & McPherson, 2015; Simones, Schroeder, & Rodger, 2015).

The provision of instrumental lessons in the county of North Yorkshire is hampered by its vast area and rural nature, with teachers needing to travel long distances between schools, taking time and adding costs. Internet-based technologies such as pre-recorded videos (YouTube) (Kruse & Veblen, 2012; Savage, 2012; Waldron, 2012) have been explored as a means of delivering instrumental lessons. Video conferencing (Cameron, 2010; Eberle & Titze, 2003) and, specifically, Skype (Dammers, 2009; Pike & Shoemaker, 2013) have been used elsewhere to deliver instrumental lessons, with some success. An opportunity arose to collaborate with North Yorkshire Music Action Zone and YouCanPlay to pilot the delivery of instrumental lessons using Skype in combination with a Roland VR-3EX, an AV Mixer with built-in USB port for Web Streaming and Recording, which offers 3 camera angles and good quality sound.

Aims

The aim of the project was to repurpose existing technology to provide peripatetic music lessons in remote rural communities. More specifically, we wished to investigate a) the technical challenges of these modes of delivery; b) pedagogical aspects of the delivery; and c) the similarities and differences between digitally-delivered and face-to-face instrumental lessons

Method

There were two phases of data collection. Phase 1 involved KS2 pupils (aged 7–11) in four primary schools in rural North Yorkshire, and six instrumental teachers from the North Yorkshire Music Service teaching clarinet, guitar, and violin. Each school employed a different delivery strategy: Skype-to-Skype; Skype-to-Roland VR-3EX; Roland VR-3EX to Skype; and Roland VR-3EX-to-Roland VR-3EX. Teachers were interviewed before and after a set of 14 instrumental lessons. The first and last of these lessons were recorded using Camtasia screen capturing software and used as research data. Feedback questionnaires were gathered from pupils involved in the digital lessons as well as their parents or guardians. Interviews were also undertaken with head teachers or class teachers. Phrase 2 of data collection has involved three schools and employed three delivery strategies: Skype-to-Roland VR-3EX; Roland VR-3EX to Skype; and Roland VR-3EX-to-Roland VR-3EX; similar data has been collected. In addition, face-to-face music lessons given by a range of teachers to pupils of a similar standard were recorded.

The video data were transcribed and coded using Thematic Content Analysis (Braun & Clarke, 2006; Hsieh & Shannon, 2005). Some behaviours identified in previous research were utilized as themes within the data (Simones et al., 2015).

Results

Results reported here refer only to Phase 1 of the project (i.e. the first four schools).

A. Technological challenges.

41 pupils and 26 parents/carers completed feedback questionnaires. 67.3% of pupils said that sound quality was 'good' or 'very good'; 75.6% reported that they could hear what the teacher was saying 'most of the time' or 'all the time'. In post-project interviews, the five peripatetic teachers provided a median score of 7/10 for sound quality. Specific sound-related challenges included noise spillage from adjacent areas in schools; the amplification of background noise in Skype; and reflections of sound in larger rooms. Headphones were sometimes reported to be problematic for younger children, particularly those with stringed instruments.

80.5% of pupils reported that the video quality was 'OK'; the same percentage of pupils reported being able to see what the teacher wanted them to do 'most of the time' or 'all the time'. Teachers gave a median score of 4/10 for video quality. Teachers' views of pupils were sometimes limited: they were not always able to see the whole of a pupil or a group of pupils, or to see the detail they required. This was alleviated somewhat by the Roland VR-3EX when it was employed at the school. Similarly, teachers using the device were able to show pupils closer views of specific parts of their instrument. Although the different camera views were not always explored fully in the first lessons, by the end of the set of lessons, teachers and pupils seemed to have established specific positions for cameras and switched between the different views easily.

The quality of the internet connection seemed to be variable: 51.2% of pupils described it as 'okay', with 22% ticking the 'Bad' category, 21.9% ticking the 'Good or 'Very good' categories. Teachers gave a median score of 5/10 for connection quality.

B. Pedagogical aspects

In initial interviews, teachers had expressed concern about teaching children to assemble instruments; this proved to be largely unproblematic when a standard protocol was demonstrated to pupils. There were some problems tuning instruments; these were overcome with adult help and in some cases, the use of a tuning app. Few problems were reported in teaching beginner technique, though teaching bow hold was reported to be very challenging. The main challenge for all teachers was the inherent time-delay using Skype: teachers were unable to count a beat alongside a pupil playing. In group lessons, some teachers overcame this problem by asking children to count for one another. Providing a musical accompaniment for pupils was reported to be challenging.

Teachers reported that the pupils concentrated well, and all the children reported enjoying the lessons ‘a bit’, ‘quite a lot’ or ‘very much’, with 63.4% in the latter category. Parents’ reports of their children’s enjoyment were slightly lower (though the difference was not significant in a paired samples t-test), but still very positive. The vast majority of pupils (87.8%) reported practising between lessons. Parents were slightly less positive about the amounts of practice, but the majority reported their children doing some practice between lessons. It is worth noting that lessons took place twice a week, allowing less time for practice between lessons than in standard weekly music lessons. Parents gave positive feedback about children’s progress, and most of the children (65.9%) and many parents (46.3%) wanted them to continue to learn their instruments ‘quite a lot’ or ‘very much’. Face-to-face delivery was seen as preferable to online remote delivery by both children and their parents, but 39.0% of children and 29.2% of parents wanted the lessons to continue over the internet. The project did enable some children to receive a short period of music lessons who would otherwise not have had this opportunity: 73.1% of parent respondents would not have sought out instrumental lessons for their child if this opportunity had not been available; 76.9% of parents reported that they had never previously sought out instrumental tuition for their child; and 52% of parents reported that their children had not previously received instrumental tuition.

C. Similarities and differences between digitally-delivered and face-to-face instrumental lessons

The most obvious potential difference between digitally-delivered and face-to-face lessons is the use of touch. North Yorkshire Music Service, however, have a ‘no touching’ policy, and so this difficulty had already been overcome by the participating teachers, who use other techniques (demonstration and description) to convey their ideas to pupils. Teachers reported that they felt they had talked more in lessons than they usually did, and preliminary analyses of the data suggest that seem to indicate more talking in Skype lessons and less ‘modelling’ or accompanying behaviour. The data are being coded using categories used in existing research (Simones et al, 2015) as well as novel categories arising out of the current data. Further analysis of the video data is currently underway.

Conclusions

All teachers reported finding the digital teaching more challenging than their usual face-to-face teaching. All children made progress, however, and all teachers reported that they would undertake similar teaching again. The digital delivery format has the potential to provide greater access to instrumental lessons for children in North Yorkshire and other rural communities. It may be possible to develop guidelines for the remote delivery of music lessons to aid their success.

Keywords

Music education, technology, instrumental lessons, peripatetic teaching.

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Music based intervention to target stress and cognitive dysfunction in type 2 diabetes

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ABSTRACT

Background

As per the 2015 report of the World Health Organization, diabetes is estimated to be present in approximately 9% of the population, of which 85-90% is non-insulin dependent diabetes mellitus or type2 diabetes (WHO, 2015). Type2 diabetes is a complex metabolic disorder with insufficient insulin production or inefficient insulin action, hyperglycaemia, insulin resistance, oxidative stress, inflammatory cytokines, leading to cognitive deficits and increased risk for multiple clinical conditions like dementia, stroke and several other microvascular and macro-vascular impairment (McCrimmon, Ryan, & Frier, 2012). High levels of psychological stress are considered one of the causal and maintaining factors of this condition. In this review paper we examine the nature of cognitive deficits associated with type2 diabetes, added effect of stress and anxiety on the illness condition as well as cognitive functions and the role of music based intervention to tackle both cognitive impairment as well as reduction of stress. Previous studies have reported promising results with neuro-music therapy in alleviating cognitive dysfunctions in various clinical conditions with injury to the brain (Thaut, Mcintosh, & Hoemberg, 2015; Hegde, 2014). Future empirical research in this regard will have far reaching implications in the treatment program of type2 diabetes to reduce stress and improve cognitive functions.

Aims

To present a review of the literature hitherto on cognitive deficits observed in type2 diabetes, to examine the effect of anxiety and stress on this condition and the role of music based interventions in addressing cognitive impairment as well as reduction of stress.

Main Contribution

Literature search was carried out using PubMed-NCBI and advanced Google scholar for peer reviewed articles - reviews, quasi experimental, experimental, cross-sectional and randomized control studies- using the following terms: diabetes mellitus type2, cognitive deficits in diabetes, cognition and music, diabetes mellitus type2 and music, diabetes and music, hyperglycaemia and music, cognition and music, and cognitive impairment and music. Our main focus was on cognitive deficits reported in type2 diabetes. To the extent of review of literature, there is no systematic study so far examining the effect of music based intervention targeting cognitive dysfunction in type2 diabetes. Therefore, effectiveness of music based intervention in other clinical conditions with known cognitive deficits has been referred to in order to propose our theoretical hypothesis. The studies reviewed in this paper, provide links between stress and hyperglycaemia, hyperglycaemia and cognitive dysfunction and the role of music based intervention in targeting cognitive dysfunction. The compilation of our findings is presented in three sections.

Stress and hyperglycaemia

Levels of psychological stress are considered to be one of the chief causal and maintaining factors of type2 diabetes (Mooy, Vries, Grootenhuis, Bouter, & Heine, 2000). Prolonged stress causes structural changes in the brain, especially, the hippocampus (McEwen, 1999).The pathophysiology of the sensitivity of the hippocampus causes neuronal degeneration in the brain (Esch, Stefano, Fricchoine, & Benson, 2002), affecting its functions (Kumar, Looi, & Raphael, 2009). An association between glycated dysfunction and stress was also found (Alipour et al., 2012). Hence, it may be deduced that psychological stress can modulate insulin metabolism.

Hyperglycaemia and cognitive dysfunction

The causal effect of hyperglycaemia on cognitive dysfunction has been reported (Kumar et al., 2009) as patients with type2 diabetes often show deficits in attention, information processing, executive functions, learning and memory. These deficits are due to neural slowing, increased cortical atrophy, microstructural abnormalities in white matter tracts and changes in concentrations of brain neurometabolites (McCrimmon, Ryan, & Frier, 2012; Mark,Strachan, Deary, Ewing, & Frier 1997; Cosway, Strachan, Dougall, Frier, & Deary, 2001) .

Cognitive improvement with music based intervention

There are only a handful of studies examining the role of music in treating patients with type2 diabetes. Listening to music reduced hyperglycaemia (Cioca, 2012), hypertension (Khoshkhou, 2010; Mandel, Davis, & Secic, 2013) and anxiety (Mandel, Davis, & Secic, 2013). Role of music in reduction of stress and anxiety has been well demonstrated (Thoma, et al., 2013; Labbé, Schmidt, Babin, & Pharr, 2007). No study so far has examined the effect music based intervention targeting cognitive dysfunction in type2 diabetes. However, inferring from the findings of previous studies in neurological and psychiatric conditions with cognitive dysfunctions, anxiety and stress, neuro-music therapy will prove to be an effective treatment method to target cognitive dysfunctions as well as levels of stress in type2 diabetic patients. Neuro music therapy improved the executive function of the traumatic brain injured patients (Thaut et al., 2009). The intense pleasurable

experience during music listening with emotional responses to it activates the reward centres of the brain, the nucleus accumbens by releasing dopamine via the striatal dopaminergic system (Salimpoor, Benovoy, Larcher, Dagher, & Zatorre, 2011). The physiological connectivity of the mesolimbic system was enhanced with listening to music in healthy individuals (Menon & Levitin, 2005; Vink, Bruinsma, & Scholten, 2013). Music listening has shown to improve mood and cognitive functions such as focused attention and verbal memory during recovery from stroke (Sarkamo, et al., 2008). There is growing evidence of the effectiveness of music not only to alleviate stress and anxiety but also to improve cognitive functions of healthy individuals as well as people in a host of clinical conditions. This should prove true in a chronic condition of hyperglycaemia such as type2 diabetes.

Implications

Music based intervention can be used to target cognitive dysfunction as well as stress and anxiety levels in type2 diabetes patients.

Keywords

Diabetes Mellitus, type2 diabetes, cognitive dysfunction, stress and anxiety, music based intervention.

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A grammatical model of butterfly schemas in the late-Classical style

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ABSTRACT

This paper presents a model of local multiparametric structures termed 'butterfly' schemas, which comprise a number of congruent grammatical features: harmonic progressions that are spatially close in terms of pitch-space theory and which have a chiastic (symmetrical) harmonic tension curve that starts and ends on tonic harmony; a texture that is homogeneous, with regular textural accent; a metrical structure that is uniform in all layers; and harmonic-rhythm ratios that partition the schema simply and proportionally. While some theories of schemas focus on the mental association and statistical correlation of the schema features in a particular time and place or, alternatively, explain schemas as the products of generic tonal grammars, the present paper explains butterfly schemas as grammatically congruent relationships between multiparametric features that are common in a particular geography and history. A survey of European instrumental music, *c.* 1750 – *c.* 1850, shows that butterfly schemas are more common in the late-Classical period (*c.* 1750 – *c.* 1800) than the early-Romantic period (*c.* 1800 – *c.* 1850). This suggests that butterfly schemas are dependent on the grammatically congruent relationships between multiparametric features which are more prevalent in the late-Classical period than the early-Romantic period.

I. INTRODUCTION

Schemas receive various definitions and explanations in music theory (Meyer, 1973, Lerdahl and Jackendoff, 1983, Gjerdingen, 1988, Lerdahl, 2001, Temperley, 2001, Zbikowski, 2002, Kaiser, 2007a, 2007b, Byros, 2009a, 2009b, 2012a). Theories of schemas generally fit into one of two categories: schemas formed psychologically through the statistical correlation of features in a particular time and place (Gjerdingen, 1988, Byros 2009a); and schemas that comprise features that are congruent structures in generic tonal grammars (Lerdahl and Jackendoff, 1983, Lerdahl, 2001, Temperley, 2001). This dichotomy indicates a conflict in the explanation of schemas, as schemas are situated structures in the former category, and generic structures in the latter. Neither approach arguably sufficiently accounts for the commonality of particular schemas in the late-Classical style. This paper combines the features of the schemas of Gjerdingen (1988, 2007) in a parent class, termed 'butterfly' schemas, which have normative features with distinct, grammatically congruent relationships. This aims to show that butterfly schemas are commonly produced by congruent grammatical relationships in particular styles. Focus is given to the grammar of the late-Classical style.

Longuet-Higgins and Steedman (1971, p. 223) introduce the concept of the 'rule of congruence', where musical structure is preferably congruent in a particular parameter, necessary to infer meaningful structure from the play of congruity and noncongruity in music (Longuet-Higgins and Steedman, 1971, p. 224). This congruity in a single parameter may be termed 'uniparametric congruence' (hereafter 'UC'). UC in a particular parameter is observable as simplicity, uniformity, stability, parallelism, relatedness, symmetry, or reinforcement. For example, UC features in the late-Classical style are chords closely related to the tonic, phrases that have parallel rhythms or pitch contour in grouping, or bars (and hyper-bars) that are uniform in metrical structure. UC is the norm in musical structure for grammars to be comprehensible.

An extension of this principle of congruence can be used to model the relationships between multiparametric features of grammars. 'Multiparametric congruence' (hereafter 'MC') refers to the synchronicity between UC features, observable as the corresponding onsets of those features, such as where UC harmony occurs with another feature, like UC metrical structure. The concept of MC is implicit in *A Generative Theory of Tonal Music* (Lerdahl and Jackendoff, 1983) (hereafter 'GTTM'), which conceives its system of well-formedness and preference rules in terms of congruence between parametric features. MC is also fundamental to the observations of grammatical relationships by other theorists (Cooper and Meyer, 1960, Berry, 1976, Lester, 1986; see Pople ,2004, for a critique of the implicitness of grammatical rules and preference rules in music theory and analysis). MC is realised in particular grammars in various and distinct ways because of the different UC features that correspond in those grammars. Broadly, MC between parametric features in the late-Classical style is harmony close in pitch space to the tonic occurring with strong beats in the metrical structure, and strong beats in the metrical structure occurring with textural accent. These relationships might be different, not present at all, or be replaced with different features and relationships in other styles.

Similar to Longuet-Higgins' and Steedman's rule of congruence in single parameters, in order to comprehend musical structure across parameters, there is a tendency for MC structures to be common forms in grammars. This can be termed the 'rule of MC'. Due to the rule of MC, UC features are more likely to correspond than are noncongruent features. This has important ramifications for the explanation of schemas. Since grammars contain varyingly congruent features that tend towards UC and MC, the commonality of butterfly schemas in the late-Classical period is evidence that the rule of MC is the underlying cause of these schemas.

In order to show the commonality of butterfly schemas in this period, this paper concludes with a survey of European

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instrumental music (*c.* 1750 – *c.* 1850), recording the population of butterfly schemas in the late-Classical period (*c.* 1750 – *c.* 1800) and the early-Romantic period (*c.* 1800 – *c.* 1850). If butterfly schemas are found to be more common in the late-Classical period than the early-Romantic period, then this suggests that the distinct MC grammatical features of butterfly schemas condition the generation of these schemas. It indicates a diverging grammar that constrains the output of the schemas that are generated therein.

II. CONFLICTING EXPLANATIONS OF BUTTERFLY SCHEMAS

GTTM and *Tonal Pitch Space* (Lerdahl, 2001) formulate specific rules that apply specifically to tonal music, but also rules that constitute a 'universal grammar' of music, inspired by Chomsky's (1957) universal grammar of language. GTTM presents schemas as stable descriptions of the well-formedness rules and preference rules in the tonal grammar (Lerdahl and Jackendoff, 1983, p. 289). The rule of MC is arguably implicit in the interactions between features of this grammar. By contrast, Gjerdingen (1988) and Byros (2009a) situate particular schemas in eighteenth-century music through surveys that record the correlation of schema features. Gjerdingen (1988) explains schemas through the psychological association of their features. Schemas appear to rise and fall through time in a Gaussian life-cycle, 'due to the way brains abstract stable categories from a continuum of historical change' (Gjerdingen, 1988, p. 99). Gjerdingen (1988, p. 158) shows that the 1–7…4–3 schema is operative during most of the eighteenth century, exhibiting a Gaussian curve of popularity and typicality that peaks in the early 1770s. However, the predominant focus on the perception and association of schema features arguably limits understanding of schemas because of the absence of a clear method of validation (Cavett-Dunsby, 1990), excepting that minds abstract schema features with reference to an abstract prototype (Gjerdingen, 1988, pp. 99–106).

Despite the differences in approach, many of the schemas of Gjerdingen (1988, 2007) – the 1–7…4–3, Jupiter, Aprile, Pastorella, Sol-Fa-Mi, and Do–Re…Re–Mi – are definable as MC butterfly schemas. They all have harmonic progressions close to the tonic with a chiastic harmonic tension curve, regular, homogeneous textures, simple and proportional harmonic rhythms, and uniform metrical structures. Since Gjerdingen's schemas are broadly situated in the Classical period, this is an indication that the MC grammatical relationships that support these butterfly schemas are likewise situated in this period.

On balance, it is likely that while schemas are rooted in a particular time and place they also manifest universal and generic tonal structuring. However, the share of these factors has not been adequately delineated for various grammars, and in particular has not been explicated in the late-Classical style. Problematically, Gjerdingen's theory does not adequately account for the grammatical relationships in schemas; conversely, GTTM reifies fixed rules of musical structure that do not permit the flexible interplay of particular MC relationships that generate butterfly schemas in the late-Classical style.

A more malleable framework to quantify the congruent relationships between features of grammars and schemas is outlined in this paper through the concepts of UC, MC, and the rule of MC. MC underpins the relationships between features of a particular grammar. Since MC features tend towards commonality in a particular grammar (the rule of MC), the prevalence of butterfly schemas in a particular period and geography provides some evidence that the particular MC relationships of that grammar actually cause them. That is, butterfly schemas are common structures in the late-Classical style because of the tendency of these MC structures to be common in the grammar of this style. However, the projected distribution of butterfly schemas in the survey might require some qualification. While they are relatively common structures, they might not be pervasive in this style because they require the correspondence of a multiplicity of UC features. It is probable that some butterfly schema features, or parts of features, correspond in the particular grammar of the late-Classical style with frequency, but the requirement that all the main features coincide considerably lowers the probability of its generation. Thus, butterfly schemas are relatively common in this grammar, but form a limited part of the style overall.

A further nuance of MC relationships is significant for defining butterfly schemas. MC in grammars is not absolute, but occurs by degree since the features have varying congruence, and MC depends on the correspondence of UC features. This means that while butterfly schemas can be considered a category of MC features, their features actually vary within a limited range. This varying MC in butterfly schemas is differentiated as 'minimally MC' and 'maximally MC' (with varying 'minimally UC' and 'maximally UC' features). The rule of congruence can be applied to variably MC schemas and another claim can thus be made: in a survey of late-Classical and early-Romantic music, maximally UC butterfly schema features (and thus maximally MC schemas) should be more prevalent than minimally UC schemas in both periods. Even though butterfly schemas are projected to be less prevalent in the early-Romantic period than the late-Classical period, maximal UC schema features are prevalent in butterfly schemas of both periods because the rule of MC constrains these particular grammatical features wherever they occur. In early-Romantic music the forms of MC that form butterfly schemas diverge more often than in the late-Classical period.

III. BUTTERFLY SCHEMA FEATURES

Each feature of butterfly schemas, including harmonic progression, textural grouping, and harmonic-rhythm ratio is a highly UC feature of the late-Classical style. These features are combined in order to present a model of MC butterfly schemas.

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A. Harmonic Progression

Lerdahl's (2001) pitch-space theory provides a model that can explain the UC between chords in the harmonic progressions of butterfly schemas. The theory quantifies the relatedness of pitches, chords, and keys in terms of spatial distance. The theory also suggests a number of spaces available for the cognition of pitch distance, such as diatonic space, chromatic space, etc., these being associated with particular periods of music history.

In the harmonic progressions of butterfly schemas, shorter distances in pitch space between chords have greater UC and larger distances have lesser UC. Lerdahl's (2001, pp. 193–248) prolongational functions, which are generalised descriptions of prolongational structure, are useful to understand the general tension path of the harmonic progressions. Figure 1 shows the prolongational functions in the 1–7…4–3 schema in Lerdahl (2001), namely T–Dep–Ret–T, which form a chiastic harmonic tension curve and that define the minimally UC harmonic progression permissible for MC butterfly schemas. The departure ('Dep') and return ('Ret') functions denote non-tonic diatonic harmony.

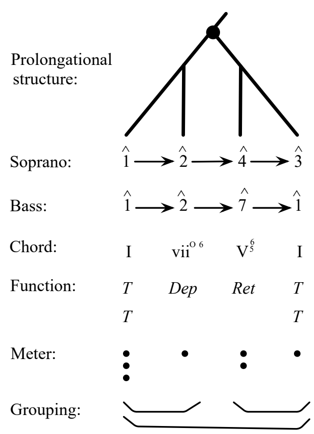

Figure 1. Model of the prolongational functions of the 1–7…4–3 schema in Lerdahl (2001, p. 238).

It is possible to use Lerdahl's (2001, p. 60) diatonic chord distance rule to calculate the relative distances between chords in the Dep and Ret regions and the tonic, which represent the varying UC:

Diatonic chord distance rule (full version) $\delta(x \rightarrow y) = i + j + k$, where $\delta(x \rightarrow y)$ = the distance between chord x and chord y; i = the number of applications of the regional circle-of-fifths rule needed to shift the diatonic collection that supports x into the diatonic collection that supports y; j = the number of applications of the chordal circle-of-fifths rule needed to shift x into y; and k = the number of distinctive pcs in the basic space of y compared to those in the basic space of x.

The diatonic basic space (Figure 2) can be used rather than the octatonic, hexatonic, pentatonic, etc., which are uncommon in the late-Classical period. The octave, fifth, and third of chords have psychoacoustic significance (Lerdahl 2001, p. 79) and so form a basis for quantifying the distances between chords. The preference for the octave, fifth, and triadic levels (in this respective order) are captured by the rule. The rule measures the number of pitch classes in common between chords in each level. This measure of 'depth' in the basic space is combined with the number of steps between chords in the circle of fifths. The distance between keys is also calculated by counting the number of steps in the circle of fifths.

(a) octave (root) level:	0 (0)
(b) fifths level:	0 7 (0)
(c) triadic level:	0 4 7 (0)
(d) diatonic level:	0 2 4 5 7 9 (0)
(c) chromatic level:	0 1 2 3 4 5 6 7 8 9 10 (0)

Figure 2. Diatonic basic space, set to I/C (C = 0, C♯ = 1, …B = 11) in Lerdahl (2007, 24: 4, 331, 2001, p. 47).

Figure 3 illustrates the use of the chord distance rule to calculate the pitch space distance (δ) in the progression I/C to V/C (I and V in the key of C) (Lerdahl, 2007, p. 331). The regional distance between the chords is zero because the chord stays in the same collection (i=0), the V chord moves once up the diatonic circle-of-fifths (j=1), and there are four resultant non-common pitch classes in the octave, fifth, and triadic levels in y compared to those of x (k=4) (each non-common pitch class is underlined in Figure 3) (Lerdahl, 2007, p. 332).

$\delta(x \rightarrow y) = i + j + k = 0 + 1 + 4 = 5$

$\underline{7}$
$\underline{2}$ 7
$\underline{2}$ 7 $\underline{11}$
0 $\underline{2}$ 4 5 7 9 $\underline{11}$
0 2 4 5 7 9 11
0 1 2 3 4 5 6 7 8 9 10 11
δ (I/C → V/C) 0 + 1 + 4 = 5

Figure 3. Pitch space distance (δ) between chord I and V in the key of C, after Lerdahl (2007, p. 331).

The diatonic chord distance rule is used to calculate distances between the tonic and the other chords in the diatonic collection, shown in Figure 4 as the 'chordal core'. The values show the different harmonic distances between chords that are variably UC (and therefore variably MC with other features) when used in the Dep and Ret regions of butterfly schemas.

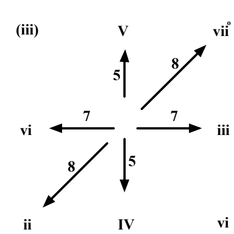

Figure 4. The distances between diatonic chords and the tonic in the 'chordal core', in Lerdahl (2001, p. 80).

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While the Dep and Ret functions represent chords that are relatively close in pitch space, a limited range of distance values occupy these functions. Formally, minimally UC butterfly schemas (T–Dep…Ret–T) have chords in the Dep and Ret regions that do not exceed a distance value of δ=8 from the prevailing tonic key (this being the maximal distance of diatonic chords), but they have a minimal value of δ=5 from the tonic in order to provide the required tension (a chord that is not the tonic). Generally, chromatic harmony in the Dep and Ret regions is too distant from the tonic, exceeding δ=8, and so is not UC and therefore does not permit MC (and indeed is relatively uncommon in the late-Classical style).

The chord distance rule can also be used to measure maximally UC harmonic progressions. In this case, chord V is required in the Ret region, with a distance value of δ=5 (T–Dep–V–T). The onset of the V in this region, which is close to the tonic in pitch space (UC), and which is (hyper)metrically accented, permits greater MC than more distant chords. The Dep region is less significant (hyper)metrically, and so does not require low distance values for MC. To summarise, the harmonic functions and progressions of butterfly schemas exist in two forms. The first form is necessary for MC, and has a minimally UC structure, T–Dep…Ret–T. The second is a maximally UC version, T–Dep–V–T, which results in greater MC with other features.

Interpolated chords (including non-diatonic chords) on weaker beats of each region still permit MC because they are not significant metrically. Appoggiaturas in a single voice permit MC providing that the overall harmony for each region lies within the distance range of the schema functions. Appoggiatura chords (chords which are held over a bass note and then resolve onto a chord consonant with the bass note (Piston, 1941)) do not permit MC because they are significant events synchronous with the metrical structure, requiring an additional function (and region) that exceeds the number of regions allowable in butterfly schemas. A region is here defined as the space that a schema function occupies. The number of regions must not exceed four to comply with the particular MC grammatical characteristics of this schema, namely, a regular and parallel textural grouping and metrical structure.

Figure 5 is an example of a maximally UC harmonic progression (T–Dep…V–T) in a butterfly schema from Beethoven's Piano Sonata Op. 2 No. 3, I, bb. 1–4. The chord distance between I–V (and V–I) is δ=5 (0 + 1 + 4 = 5). The harmonic regions are shown in boxes for each region of the butterfly schema.

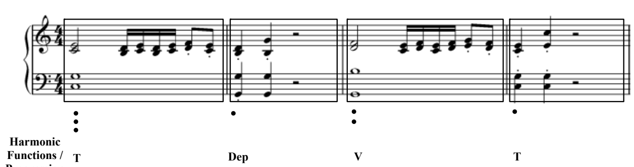

Figure 5. A maximally congruent harmonic progression in a butterfly schema in Beethoven's Piano Sonata Op. 2 No. 3, I, bb. 1–4 (1796).

By contrast, Figure 6 depicts a harmonic schema in Beethoven's Sonata in C minor, Op. 13, I, bb. 1–4 (1798) that comprises a chord which is too distant from the tonic in the Dep region to be a butterfly schema. This passage alludes to a butterfly schema, having the approximate features, but it uses a ♯iv chord on a strong metrical position in the Dep region. The ♯iv chord has a distance value of δ=12 from the tonic ($\delta(x \rightarrow y) = i + j + k$) ($0 + 6 + 6 = 12$), which exceeds the limit of δ=8. The chord can be conceived as a momentary chromatic inflection, so remains in the same diatonic collection (i=0), moves 6 steps away from the tonic on the circle-of-fifths (j=6), and has 6 non-common pitches (k=6).

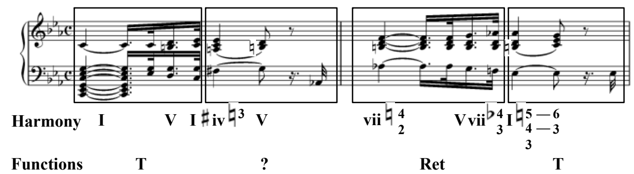

Figure 6. A distant harmonic progression in Beethoven's Sonata in C minor, Op. 13, I, bb. 1–4 (1798).

Relatively large distances between chords in pitch space are perhaps indicative of the harmonic language in use in the (early) Romantic style (Lerdahl, 2001), providing a tentative description of the underlying differences between the Classical and Romantic grammars that generate disparate schemas. It is probable that the early-Romantic grammar, as a whole, has more frequent distant progressions from the tonic than in the late-Classical grammar. Corroboration of the assertion that more tenuous relationships with tonic harmony characterise early-Romantic music may be found in Wollenberg (2011), Steinbron (2011), and Rosen (1980), among others.

B. Textural Grouping

An important cue for metre in the late-Classical style is texture. 'Textural accent' is the accentuation engendered through co-incidence of components in the different layers of texture (Lester, 1986, p. 29). Metre, among other factors, is the sum of various nested textural accents and periodicities. Another concept, 'textural grouping', refers to the consistent onset of textural accents that informs a regular metre and which describes the texture of butterfly schemas. Textural grouping is a normative UC texture of the late-Classical style. Texture is not regularly grouped in this way in all musical cultures. Textural accent can be highly irregular, and thus metre can be correspondingly uneven. The UC feature of textural grouping is a condition of the late-Classical style necessary for MC in butterfly schemas.

The conception of metre in Komar (1971), Yeston, (1976), Lerdahl and Jackendoff (1983), Lerdahl (2001), and London (2004) is that of a static or invariant type of structuring (see Benjamin, 1984 for a summary of the various explications of regularity and irregularity in metre). Through this perspective, metre is hierarchically formed through the interaction of at least two metrical levels (Yeston, 1976) related by a factor of 2 (Komar, 1971). The Metrical Well-Formedness Rules (MWFR)

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3 and 4 in GTTM (Lerdahl and Jackendoff 1983, pp. 69–72) concern the rules of metre in Western music:

MWFR 3 At each metrical level, strong beats are spaced either two or three beats apart.

MWFR 4 (revised) The tactus and immediately larger metrical levels must consist of beats equally spaced throughout the piece. At subtactus metrical levels, weak beats must be equally spaced between the surrounding strong beats.

Figure 7 shows a well-formed metrical hierarchy made up of the multiplication of metrical levels. A higher layer (H) is expressible as the immediately lower layer (L) to the power of 2 ($H = L^2$).

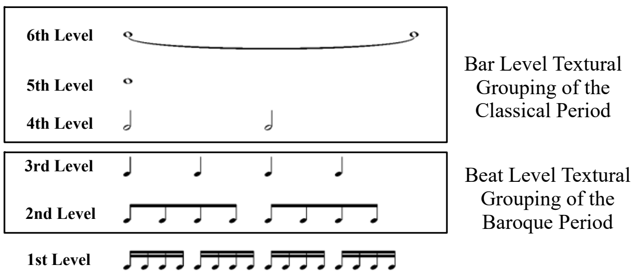

Figure 7. A well-formed metrical hierarchy.

Metrical well-formedness is also construed as a type of entrainment where patterns of 'attentional invariance' are generated (London, 2004, p. 84). However, in the often irregular metrical profiles of Western music the concept of well-formedness rules has limited applicability, especially at higher levels of metrical structure. While a well-formed hierarchy is the prevalent conception of metre, it is an essentialist one because many cultures depart from this schema. For example, metre is irregular in many non-Western cultures (Clayton, 1997). Considering the irregular nature of some metrical profiles in Western music – which can be ill-formed and polymetrical – entrainment to a single metrical structure in these cases also seems unlikely.

Lerdahl and Jackendoff (1983, p. 347) note that MWFRs 3 and 4 are idiom-specific (to tonal music), yet the contrapuntal styles of the Renaissance and Baroque periods arguably do not strictly conform to these rules. While Lerdahl (2001, pp. 32–34) and Temperley (2001, pp. 85–114) point out that contrapuntal textures can be unified through combining the note onsets of voices in the texture to form an overall metre, this is problematic because the inference of (regular) metre from texture is not possible if the onsets of individual voices (cf. Lerdahl and Jackendoff's (1983, p. 76) Metrical Preference Rule 2 (MPR 2) (Strong Beat Early)) cue contradictory metrical structures. These approaches straightjacket texture, compromising contrapuntal structure in favour of a top-down homogeneous mould. A single voice can imply the multiple layers of metre in its note values and contours (Benjamin 1984, pp. 371–372). Metrical noncongruence or 'dissonance' is thus possible between voices in a texture (Mirka, 2009, pp. 133–164, McKee, 2004, Rothstein, 1989).

When describing various manifestations of metre in cultures, the term 'metrical profiles' (Lester, 1986) is perhaps more appropriate than 'metre'. Metre might be viewed as a universal constraint for regular textural accentuation throughout its hierarchical levels, whereas a metrical profile is the instantiation of accentual patterns with various layers of regularity and irregularity in the hierarchy, or various patterns of congruence and noncongruence. Metrical profiles observe metrical well-formedness to a greater or lesser extent, manifesting congruence or noncongruence in various layers.

The interaction between metrical levels closely relates to musical style (Lester, 1986, p. 127). In the Classical style the various voices of the texture are generally highly congruent at the bar level of metrical structure (Cone 1968, p. 72) (i.e., the 4th, 5th, and 6th level of (hyper)metre in Figure 7). Furthermore, Classical music has congruence at the beat level, but this can change during the course of a movement (Cone, 1968, p. 72). In contrast, in Baroque music it is the beat that is the primary metrical unit (i.e., the 2nd and 3rd level of metre) (Cone, 1968, 66). Cone (1968, pp. 79–82) points out that Romantic metrical structures are similar to those of Classical music, but more regularly include hypermetrical units (i.e., approximate level 6 and higher of metre). This view of Romantic music, however, does not consider the highly irregular (hyper)metrical profiles of the style. While 'light' music of this period might have UC at (hyper)metrical levels (such as dance-style compositions), art music, especially towards the late Romantic period, is often relatively noncongruent at these levels. The pervasiveness of (hyper)metrical conflict in the Romantic period is noted in Berry (1976) and Krebs (1999), among others. However, the UC in these layers of the metrical structure in music of the Romantic period is arguably more regular than music of the Baroque period, but perhaps not as regular as music of the Classical period. The noncongruence at these levels is possibly a contributing factor for the hypothesised paucity of butterfly schemas in the Romantic period.

Textural grouping at (hyper)metrical levels is a necessary UC parametric feature of butterfly schemas. The late-Classical style has highly UC textural grouping at most levels of metre (conforming to the MWFRs 3 and 4 of GTTM). Figure 8 demonstrates the primacy of textural grouping in the late-Classical style in the opening of Mozart's Symphony in G Minor, K. 550, I, bb. 1–8 (1788), which is a butterfly schema. The textural grouping is MC with the metrical structure and harmonic rhythm, but the melody grouping is out of phase with the other features of the schema. The noncongruent melodic grouping suggests that textural grouping is more significant for creating MC than melody in this grammar, which conflicts with the significance placed on melodic structures in Gjerdingen's (1988) model.

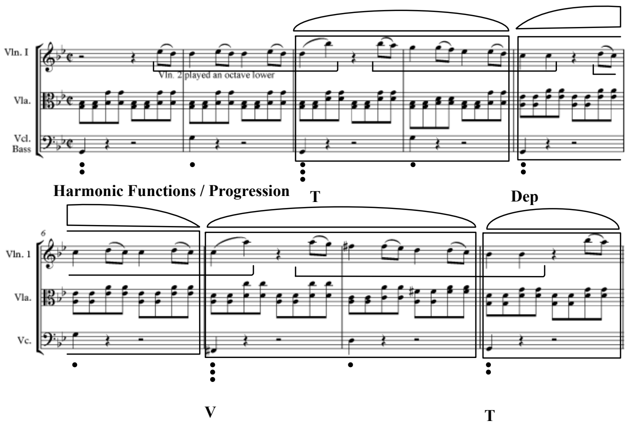

Figure 8. Textural grouping in a butterfly schema in Mozart's Symphony in G minor, K. 550, I, bb. 1–9 (1788). The textural grouping is shown with hemispheres, the melody grouping with square brackets, and the harmonic functions with boxes for each region.

McKee (2004), Rothstein (1995), Lester (1986), and Berry (1976) stress the importance of texture in grammatical relationships. McKee's (2004, p. 5) 'rule of texture' prefers to construe accompaniments as metrically stronger than melodies when they begin before the accompaniment. Lester's (1986) interpretation of this passage reinforces the significance of textural grouping, but places the main hypermetrical downbeat on the beginning of bar 2, at the onset of the melodic grouping. This reading is consistent with Lerdahl and Jackendoff's (1983, p. 76) MPR2 (Strong Beat Early) rule, which prefers phrase-grouping onsets at strong beats of the metrical structure. McKee's interpretation of this passage differs to Lester's, locating the main hypermetrical beat at bar 3, which is not only congruent with textural grouping, but also congruent with the 2-bar harmonic rhythm, a significant cue for metre in this grammar.

C. Harmonic-Rhythm Ratios

Harmonic change is one of the strongest influences on metre (Lester, 1986, p. 58, pp. 66–68), perhaps most acutely in the late-Classical style. Indeed, harmonic change is arguably a more significant cue for metre in late-Classical music than in early-Romantic music. In the latter period, harmonic change is often less aligned with metre, which is another possible reason for the scarcity of butterfly schemas in this time. Rothstein's (1995, p. 173) 'rule of harmony' posits that changes of harmony preferably occur on the inception of strong beats in the metrical structure. Yet the significance of harmonic rhythm (Piston 1941, pp. 189–203) as a feature is as yet unacknowledged in schema theory. Simple harmonic-rhythm ratios (1:1, 2:1, and 3:1) are UC features of butterfly schemas, informing regular metrical and hypermetrical profiles, i.e., enabling MC in this grammar.

The 1:1, 2:1, and 3:1 ratios inform metrical profiles with hierarchical depth (Lerdahl 2001, p. 286) and parallelism, and permit MC. The simplest ratio, 1:1, is a maximally UC ratio for MC, whereas the ratios 3:1 and 2:1 are minimally UC for MC. The 3:1 ratio permits duple metrical structuring, but with less hierarchical depth than the 1:1 ratio because it is uneven. The 2:1 ratio has an underlying triple structuring which is less UC than 1:1 and 3:1. Figure 9 illustrates a butterfly schema with a 1:1 ratio and Figure 10 shows one with a 3:1 ratio. These ratios are represented by boxes in each region.

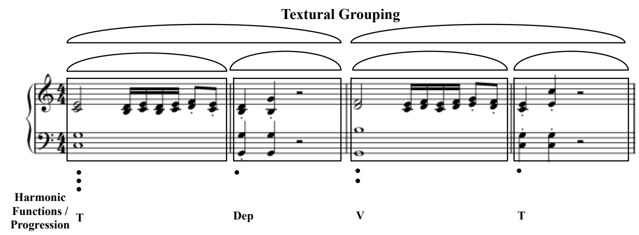

Figure 9. A butterfly schema with a 1:1 harmonic-rhythm ratio in Beethoven's Piano Sonata Op. 2 No. 3, I, bb. 1–4 (1796).

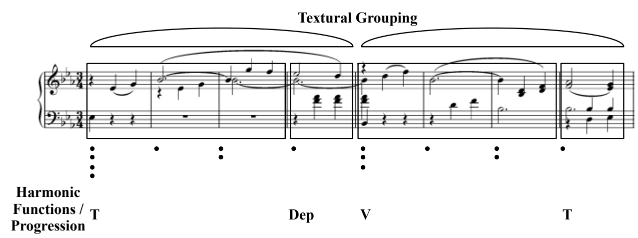

Figure 10. A butterfly schema with a 3:1 harmonic-rhythm ratio in Mozart's Symphony No. 39, I, bb 1–8 (1788).

D. The Combined Variable Features of Butterfly Schemas.

The described features of schemas can now be combined into a variable model of butterfly schemas. Harmonic progression and harmonic-rhythm ratio are of variable UC, and interact with UC textural grouping to produce variably MC forms of butterfly schemas, shown in Figure 11. The harmonic-rhythm ratios are 1:1, 2:1, and 3:1; the harmonic functions are encompassed by boxes in each region; the hemispheres show the main textural groupings; and the dots show the metrical structures. The minimally UC features are 3:1 or 2:1 ratios and T–Dep…Ret–T harmonic functions and progressions. The maximally UC features are a 1:1 ratio and T–Dep…V–T harmonic functions and progressions.

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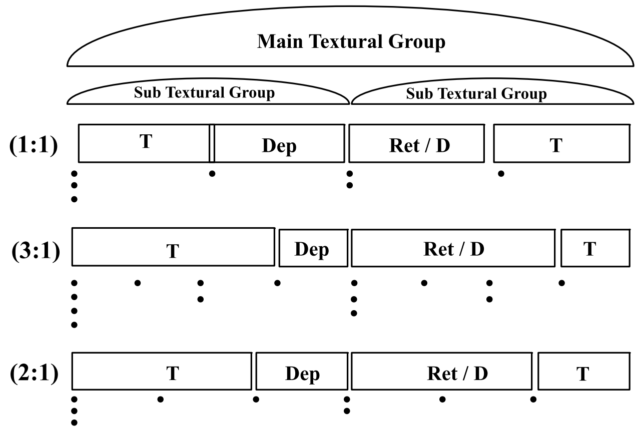

Figure 11. A model of variable MC butterfly schemas.

IV. A SURVEY OF BUTTERFLY SCHEMAS (*c.* 1750 – *c.* 1850)

In order to test the hypothesis outlined in the introduction, that butterfly schemas are more common in the late-Classical period than the early-Romantic period a survey was undertaken. Using a sample of 1,078 movements and single-movement works, in ten genres by five composers of European instrumental music between *c.* 1750 – *c.* 1800, the incidence of butterfly schemas was recorded. The ten genres chosen represent significant outputs by salient composers across the time period. They are: Haydn string quartets and piano sonatas; Mozart symphonies and string quartets; Beethoven string quartets and piano sonatas; Schubert string quartets and piano sonatas; and Chopin mazurkas and nocturnes. The survey records the number of movements and single-movement works where butterfly schemas are present, and those where butterfly schemas are absent. The number of schemas counted in a movement or single-movement piece is limited to one to avoid recording exact and inexact repetition of schemas. Minimally UC features (and mixtures of minimally and maximally UC features) are shown in grey and maximally UC features (MC schemas) are shown in black on the graphs below.

The results of the survey are illustrated in Figures 12–21. These show that, on the data surveyed, butterfly schemas are indeed more prevalent during the late-Classical period than the early-Romantic period. In the late-Classical period, butterfly schemas were found in only 17% of Haydn's movements, 24% of Mozart's movements, and 25% of Beethoven's pre-1800 movements. In the early-Romantic period, by contrast, butterfly schemas were found in 11% of Beethoven's post-1800 movements, 9% of Schubert's movements, and 4% of Chopin's one-movement works. Overall, in the late-Classical period 19% of movements contain butterfly schemas, whereas in the early-Romantic period only 8% of movements and single-movement works contain them. On this metric, butterfly schemas are therefore more than twice as prevalent in the late-Classical period than in the early-Romantic period.

Butterfly schemas were also claimed to have more maximally UC features than minimally UC features across the whole sample. This was confirmed as butterfly schemas with maximal UC features (1:1 / T–Dep…V–T) are more common than those with minimal UC features (3:1 / 2:1/ T–Dep…Ret–T) and schemas with a mixture of maximally UC and minimally UC features. Of the butterfly schemas recorded in both the late-Classical and early-Romantic periods, 82% had features that were all maximally UC (and thus maximally MC) and 12% were minimally UC or had a mixture of minimally and maximally UC features. That is, maximally UC features in butterfly schemas are considerably more prevalent than minimally UC features.

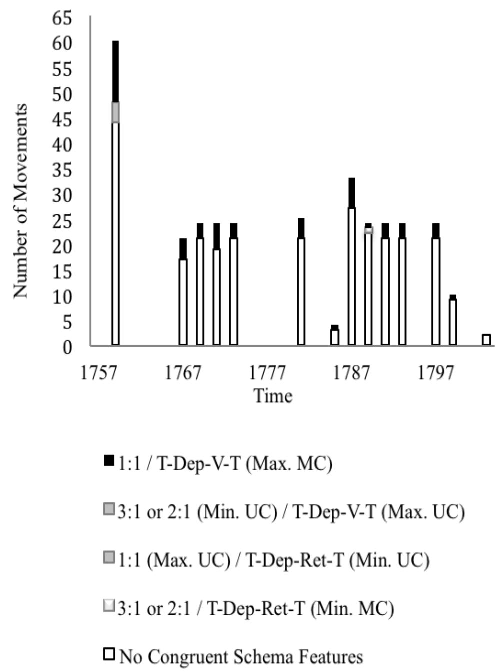

Figure 12. Butterfly schemas in Haydn string quartets.

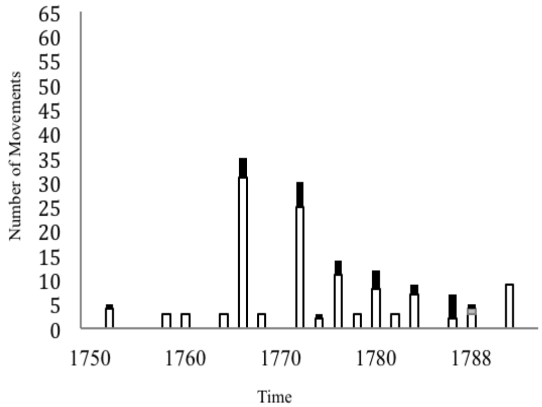

Figure 13. Butterfly schemas in Haydn piano sonatas.

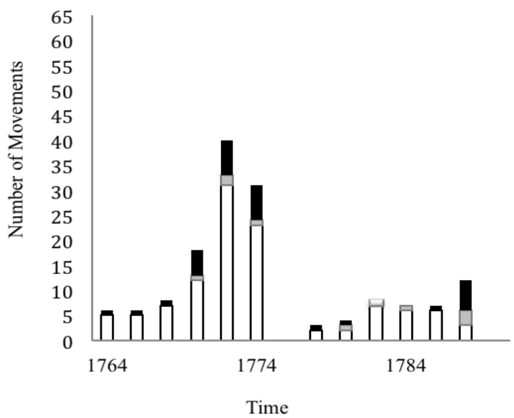

Figure 14. Butterfly schemas in Mozart symphonies.

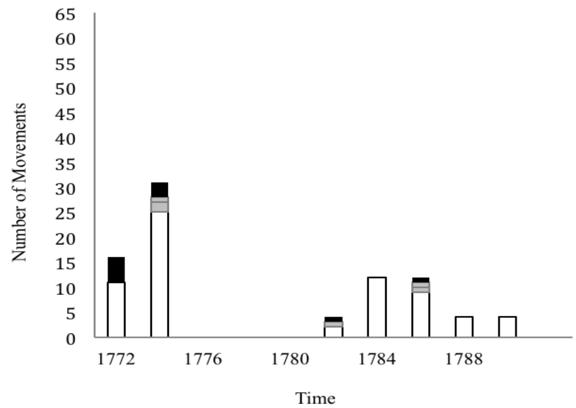

Figure 15. Butterfly schemas in Mozart string quartets.

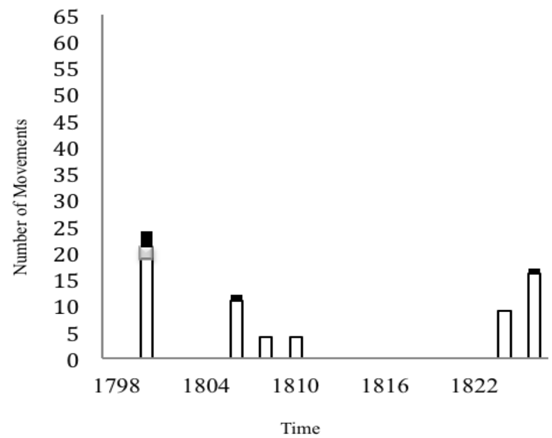

Figure 16. Butterfly schemas in Beethoven string quartets.

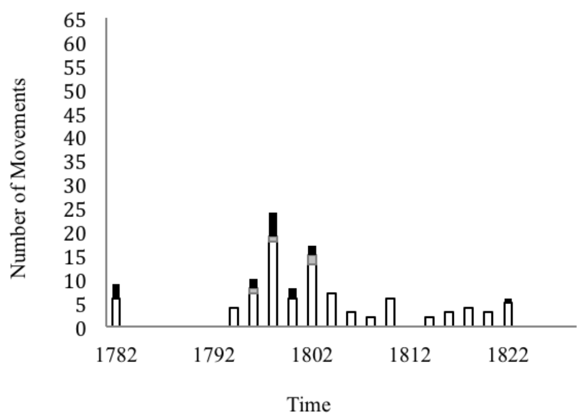

Figure 17. Butterfly schemas in Beethoven piano sonatas.

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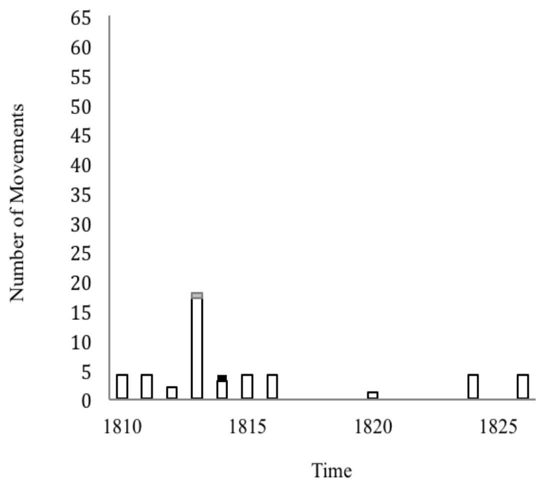

Figure 18. Butterfly schemas in Schubert string quartets.

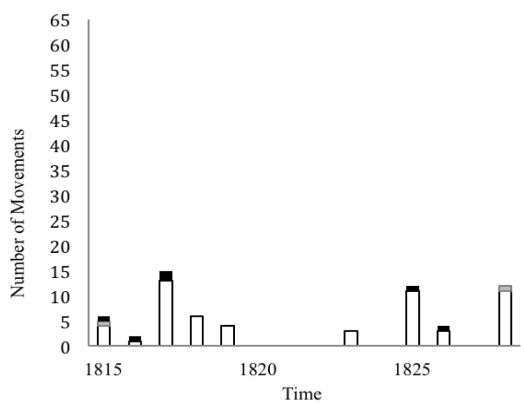

Figure 19. Butterfly schemas in Schubert piano sonatas.

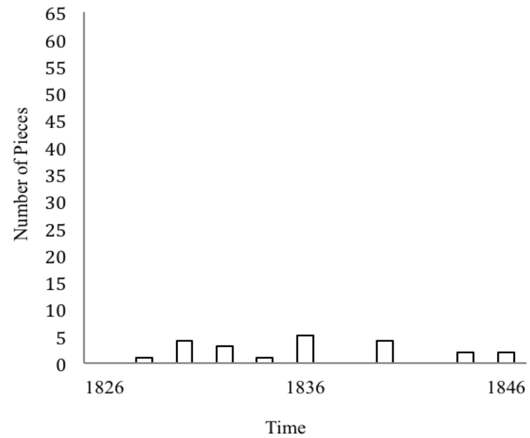

Figure 20. Butterfly schemas in Chopin nocturnes.

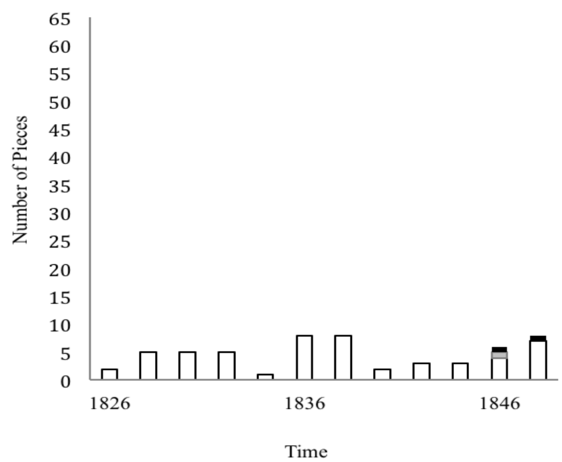

Figure 21. Butterfly schemas in Chopin mazurkas.

V. CONCLUSIONS

The statistical survey shows that butterfly schemas are more than twice as common in the late-Classical period than the early-Romantic period. Since grammars tend to have particular features that are commonly MC (the rule of MC), the prevalence of MC butterfly schemas in the late-Classical style suggests that the underlying cause of these schemas is the rule of MC. The survey also indicates that maximally UC features (a 1:1 harmonic rhythm ratio and a T–Dep–V–T harmonic progression) are more common than minimally UC features (a 3:1/2:1 harmonic-rhythm ratio and a T–Dep–Ret–T harmonic progression). The predominance of maximally MC schemas over minimally MC schemas is a consequence of the rule of MC

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that constrains schemas in both the late-Classical and the early-Romantic periods. These two aspects examined in the survey provide strong evidence that butterfly schemas are formed by a particular manifestation of the rule of MC that is more prevalent in the late-Classical period than the early-Romantic period.

This study redresses the limitation of some earlier theories of grammars (GTTM, Lerdahl, 2001, Temperley, 2001) that do not model the particular rules of distinct histories and geographies. The grammar of the late-Classical style, while broadly modelled by GTTM, is arguably finer grained than GTTM's generalised system of well-formedness and preference rules. The framework of UC, MC, and the rule of MC enable explanation of the particular relationships between features of butterfly schemas of the late-Classical style. This framework is lacking in Gjerdingen (1988) and Byros (2009a), which do not consider universal and tonal grammatical relationships in their schema theories. The butterfly schema, which is the parent class of many of Gjerdingen's schemas, has been shown to be conditional upon particular MC grammatical features outlined in this paper. The 'associative-statistical' model of Gjerdingen arguably does not consider the grammatical co-ordination of butterfly schema features, a deficit which the present study attempts to rectify, but construes them as commonly psychologically associated features that are simply present in the Classical style. Butterfly schemas, in our model, are by contrast, defined by the complex MC relationships of the particular time and place that rely not exclusively on psychological processes but on the rich interplay between the physical world, culture, and psychology. Schemas are first and foremost generated by grammars, and are then available to perception. Their perceptibility as schemas can be viewed as a symptom of this deeper cause.

The hypothesis that the rule of MC explains schemas might conflict with some contributions by other theorists. While MC is a necessary condition for butterfly schemas, it might be argued that it is not necessary for other schemas. It is possible for certain schemas to form in similar grammars which might have one (or more) feature that is not UC. This is because cultural forces can override the constraints of grammar, as evidenced by the use of various noncongruent, or richly differentiated, harmonic schemas in specific tonal contexts, such as in eighteenth-century schemas and schemas in Western popular music (Byros, 2009a, Huron, 2006). Due to the important role of culture in shaping style, it is possible that grammars similar to the late-Classical style in Western music (e.g., contemporary dance music and popular music) might generate non-MC schemas if particular noncongruent features are commonly transmitted through the culture. However, non-MC schemas are thought to be much rarer than MC schemas.

The rule of MC might appear to be an elusive constraint on musical structure. It is likely to be a cognitive universal, but further investigation is required to test its validity in other grammars. It provides an approach for future research based on the relationships between particular grammars and schemas of various geographies and histories. In the late-Classical style, further work is necessary on the interaction between texture and other parametric features and their corresponding effect on schemas. Similar to harmonic progressions and harmonic-rhythm ratios, texture might have variable schematic instantiations, but variance in this parameter was not quantifiable in the present study because butterfly schemas require maximal MC with other features to be identified as such. Further work could show how variability between texture and other parameters might result in various different types of schemas.

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Interdisciplinary process for collaborative artists: A proposed theoretical model

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ABSTRACT

The purpose of this paper is to provide a detailed breakdown of an exploratory process that was developed to facilitate collaboration between artists of multiple disciplines. This process places a strong emphasis on collaborative engagement, communication, and play in order to foster an environment where interdisciplinary work is created organically and synchronously among collaborators. In order to test initial viability of this theoretical approach, 11 artists from varying backgrounds were asked to follow this collaborative model for a period of 8 months, during which an original work was to be developed, rehearsed, and performed. This paper will present the preliminary findings following this 8-month implementation, and will substantiate the original theoretical framework with practical implications and suggestions. The ideas put forth in this paper are exploratory in nature and are intended to be viewed as avenues for further investigation and creative inquiry.

I. INTRODUCTION

Collaboration, as defined by John-Steiner and Moran (2004), provides us with the ability to extend our understanding of creativity beyond the individual. This definition suggests that the act of collaborating holds much more significance than simply working alongside another person towards a common goal. Instead, collaboration becomes a vehicle through which disparate ideas, skills, and interests from multiple people are aggregated to produce a result that would be otherwise unachievable by one person alone.

In my continuously evolving practice as a musician, I have become particularly interested in this approach to collaboration and how it can be applied to the creation of live interdisciplinary performance. Moreover, I am interested in investigating how to facilitate this higher level of collaboration between artists spanning multiple disciplines. In the field of collaborative performance, there is an important distinction to be made between interdisciplinary performance and interdisciplinary process. On a fundamental level, the former refers to any type of staged event in which multiple artistic disciplines are simultaneously present, such as dance and live music, or theatre with video projection (Bryon, 2014). Interdisciplinary process, however, falls closer in line with John-Steiner and Moran's (2004) definition of collaboration, and refers to an involved process that has the potential to not only deepen our sense of creativity beyond the individual, but also beyond the individual's artistic medium or practice.

This paper will elaborate upon a recently devised model for interdisciplinary process in which collaborative engagement, communication, and play are fundamental components (Reid, 2015). Furthermore, this paper will document the findings and insights of the model's trial implementation, including practical implications of each stage, preliminary successes or failures, as well as any resulting modifications or developments. The motivation behind designing this approach to collaboration stemmed from a desire to facilitate the integrated and cohesive development of work among artists of all disciplines. Structurally, this process was largely inspired by the concept of "flocking". This term, when applied in the context of dance and movement, describes a practice in which numerous people mimic one another's gestures and move through space as an intuitive and collective mass without ever establishing a leader (Pomer, 2002). It is my hope that this process will encourage artists to venture away from traditional methods of creative development—even briefly—to explore the range of possibilities made available by a more integrated approach to concept and content generation.

II. METHODOLOGY

In order to better understand the practical implications of this theoretical process, I assembled a team of artists to participate in a creative trial. The group consisted of three musicians/composers, three dancers, a choreographer, a video designer, a lighting designer, a costume designer, and a scenic designer, making a total of 11 collaborators. Over the course of an 8-month period, we conceptualized, developed, rehearsed, and performed an entirely original interdisciplinary work while adhering to the parameters of this new collaborative model. No material was generated prior to our first meeting, and each participant was given one absolute requirement: to be present at regular meetings throughout the entire lifecycle of the project, regardless of their artistic discipline.

It has been suggested that embedding oneself as both a creative contributor and a researcher into a project has the potential to result in a deeper level of understanding and insight surrounding the social and personal practices of collaboration (John-Steiner and Moran, 2004). Similarly, I believe that being critically aware of the underlying process and thought structure in a creative work will greatly enhance a performer's interpretation of it. I found that being present in a creative capacity as one of the three musicians/composers helped to establish a stronger sense of commitment and confidence from the team as they agreed to adopt this experimental approach.

My original outline for this interdisciplinary model cited collaborative engagement, communication, and play as components comprising the first stage in a three part process. However, following the initial implementation of this approach, I have come to realize that these components are integral not only to the first stage, but to the entire process.

The revised model still takes the form of a three part approach, which can be broken down into: i. foundation; ii. content generation; and iii. application. The first of these stages is crucial to the overall success of the project. By

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establishing a strong collaborative foundation, the group will be able to progress through the remaining stages efficiently and effectively. Present throughout the entire process are the themes of collaborative engagement, communication, and play. These factors are integral for maintaining an environment in which collaborators feel comfortable enough to articulate ideas freely, take creative risks, and develop work spontaneously.

As detailed in the original documentation of this process, collaborative engagement refers to both the mental and physical engagement of the participants, and is fostered early on in the collaboration through a series of blue-sky and brainstorming sessions. The notion of communication is further broken down into "green light dialogue", a practice adapted from a philosophical approach to mindful communication (Chapman, 2012); and "semantics", in which a common language tool kit is established to facilitate the exchange of ideas and knowledge across multiple areas of expertise and artistic backgrounds. Play is introduced as a means of instilling a sense of sharing and trust among the group members, which research shows are two vital ingredients for a successful collaboration (John-Steiner, 2000).

III. FOUNDATION

The first stage of this process is time intensive, yet tremendously valuable. During this stage, the collaborative and conceptual foundation for the later work is established. A further goal for this stage is to dissolve boundaries between the various artistic disciplines as much as possible, and to establish a sense of trust among the collaborators.

A.Blue-Sky and Brainstorming

At the very beginning of this process, all collaborators come together for a series of blue-sky sessions. These initial sessions are kept exclusively dialogue based, so that everyone has the opportunity to contribute and share ideas before any media is introduced. By restricting the group to verbal discussion as opposed to allowing visual assets, sound clips, or movement, everyone enters the collaboration on equal footing, and the value of communication is highlighted early on. A blue-sky approach is adopted for the initial sessions, in which all ideas, no matter how large, small, or complex, are encouraged and listened to. After these initial sessions, the group's focus transitions to brainstorming.

Although these two concepts are commonly assumed to be synonymous with one another, blue-sky is more appropriately used as a pre-cursor to brainstorming—an opportunity to let imaginations run wild and creative juices flow (Todd, 2007). Blue-sky means that you begin with every door wide open and a palette of limitless possibility before you. Instead of getting bogged down with concerns of logistics and feasibility at the beginning of a project, blue-sky encourages collaborators to jump in creatively and get inspired. Brainstorming is then the process by which all of these ideas become filtered and distilled for eventual application.

B.Discussion

In this context, discussion simply functions as an extension of brainstorming, but with specific prompts for a more focused dialogue. These prompts can be anything. However, it is useful to consider questions that may help the collaborators develop a personal relationship with the project in order to encourage a stronger sense of mental engagement. I prompted each participant to share two things with the group: something they have always wanted to try or experiment with, either on or off stage, and something that they feel artistically challenged or frightened by. By coupling this more personal prompt-based dialogue with the blue-sky mentality, I was hoping to encourage collaborators to open up on a more emotional level while also establishing a sense of confidence in the process of sharing and exchanging ideas. After the blue-sky and discussion sessions, there was a noticeable increase in emotional and cognitive investment from the team members toward the work they were developing.

C.Semantics

It is very important in this first stage to establish a common baseline for communication among the group members. Even simple words such as "texture" or "color" can mean very different things to a musician than they do to a scenic designer, and dialogue that is centered around media-specific language can easily lead to confusion or feelings of being left out. Given how large and diverse our team of artists was, it was challenging for us to find a semantic tool kit that worked well for everyone. The ultimate solution was a combination of teaching one another key words for each discipline, as well as making a concentrated effort to use more generic, colloquial language whenever possible.

D.Sharing and Discovery of Practice

Toward the end of this stage, each collaborator is given the opportunity to share an aspect of their art-making practice or discipline with the group members. This could take the form of an informal demonstration, a group exercise, or a game. The motivation behind this is simply to alleviate some of the mystery and barriers surrounding each collaborator's respective métier. Something as simple as teaching everyone in the group how to hold a trumpet or offering a quick tutorial on basic lighting techniques is enough to instill a sense of understanding and connectedness between disciplines.

The most important consideration for this step is that the exchange of information must remain lighthearted and nonjudgmental. It is not important for people to acquire a certain amount of new skill or even to "do it right". Rather than a traditional teacher–student interaction, this experience should function more as an invitation to discover and explore different art forms and practices, and an opportunity to gain knowledge of each other's craft through discovery and playfulness. This approach helps to create a sense of unity and cohesion, allowing each collaborator to become familiar with each other's discipline in order to begin to notice the inherent similarities between them.

The foundation stage can last anywhere from 4–12 weeks, depending on the number of collaborators, the project scope, and the overall timeframe. It may be tempting to skim through this stage in order to jump into content generation, but it is

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important to resist the urge to do so. As we progressed through this stage, our group discussions naturally began to focus themselves toward a common set of interests and an underlying concept for the piece began to emerge.

IV. CONTENT GENERATION

The second stage of this approach is dedicated to content generation. By this point in the process a collaborative foundation has been established, and the group has arrived at a concept or set of ideas that they find mutually inspiring.

A.Improvisation

The original collaborative model proposed that the primary method for content generation would be a series of improvisation sessions. Improvisation has been said to give collaborators the opportunity to begin working on an even playing field (De Spain, 2014), and to instill a sense of liberation as well as creative freedom (Rodosthenous, 2012). In our process, each improvisation session would be recorded and subsequently reviewed by the group. Upon reviewing the footage, collaborators are asked to look for moments or events that resonate with them or jump out as being particularly interesting. This process is very open ended and subjective: decisions can be made based on aesthetic, personal, or intellectual reasoning. Participants are not confined to commenting on their own contributions to the improvisation, but are encouraged to consider the entire group.

In practice, this method was an interesting ice breaker, and worked well as a transition out of pure discussion. However, it quickly became evident that not all of the collaborators shared the same comfort level or experience with improvisation. Certain individuals tended to dominate these sessions while others would default to a following or reactive role, ultimately leading to an imbalance between the collaborators and their contributions. Much like language and discussion, group improvisation is a method of communication that has an internal structure and vocabulary (Steinman, 1986). While this is certainly a set of tools that can be learned and developed, it is not something that everyone inherently shares.

B.Games

An unexpected change of course occurred when it became evident that improvisation was not working for everyone in the way that I had anticipated it would. In lieu of improvisation, we tried using a series of simple games and playful exercises as a means of initial content generation. Some of these games were introduced by group members during the foundation stage of this process, and others were invented on the spot as a need or curiosity arose. It is particularly interesting to note that many of the games we played were, in fact, largely improvisation-based. However, they did not seem to result in the same imbalance of participation as the straight improvisation sessions did. Perhaps the slight presence of rules and structure was enough to get people to stop thinking and to simply focus on playing. (Spolin, 1999). Of all the games we came up with, the following three had the most positive impact, both in terms of content generation and overall group morale.

1) *What is it?* In this game, one or two people act as the subject. Their task is to listen to a series of open-ended questions posed by the rest of the group and to respond to them—physically, musically, or visually—without answering verbally. The job of the group is to carefully watch and listen to the subjects and to ask questions that might help reveal what the subject is or isn't. The question asking process is entirely personal, and can include questions such as "is it weightless?", "is it rigid?", "is it stubborn?", and so on. This game was enjoyed so much by the group that it ended up being directly imported into one of the sections of the final piece.

2) *Move Together, Still Together.* Variations on this simple game can be frequently found in theatre and dance contexts. The goal is to intuitively find moments of collective motion and stillness without providing verbal directions or obvious gestural cues. Everyone begins by slowly walking around the room, taking note of their presence in the space and the objects and bodies that surround them. Each participant focuses on trying to stop and start their movement at the exact same time as everyone else in the room. Much like the concept of flocking, the goal of this exercise is to make it imperceptible even to the collaborators themselves who is initiating the starting and stopping of movement. This game challenges everyone to extend their awareness of their surroundings and of their bodies in space, and to try to become as in tune with their fellow group members as possible. Although this is traditionally a movement-based game, we had very interesting results exploring it with sound and visuals as well.

3) *Alternative Uses*. This began as a very playful exercise and ended up being a tremendous tool to help broaden individual comfort zones, break performative habits and defaults, and discover unique ways of integrating movement, sound, and physical space. The exercise is simply to challenge yourself to interact with the the space, the objects within it, each other, and your own bodies in ways that are new and unfamiliar. Examples of this could include using musical instruments to produce movement instead of sound; using the underside of a marimba as an entryway onto the stage; or programming light and projector cues as a means of composing music for sound of fans and motors.

As content began to be developed and larger sections started to take form, we did our best to assign each one a name that was inspired by how the content should feel, rather than what it should look or sound like. Once again, colloquial language was used as much as possible. Instead of describing a section as having rapid 16th note passages with strobe effect lighting, for example, it might be referred to as the "chaotic frenzy" section. The goal behind this was to avoid an accidental placement of hierarchy by giving everyone an emotional/language-based launching point as opposed to one driven sound or lighting.

V. APPLICATION

For a full-length performance such as this one, the application stage begins approximately 5–6 months into the process. At this point, the collaborators break apart to rehearse and/or develop their individual portions of the project. A costume designer may require time to buy material or sew a costume, dancers may need time to memorize and rehearse their choreography, and so on. This does not replace group meetings and rehearsals, but rather serves to supplement them. It is natural for there to be somewhat of an overlap between the content generation and application stages, as material begins to be rehearsed and solidified.

Even though we allotted ourselves the time to rehearse independently of one another, the group still craved collective rehearsals. This is likely due, in part, to the fact that each individual's role relied on the presence of all of the other components in order to properly function, or to be properly implemented. It was very exciting to see how everything had become completely interwoven during the development stages as a result of having all the collaborators present throughout the entire process.

VI. CONCLUSION

This paper discusses the practical implications and findings from the first implementation of a new model for interdisciplinary collaboration. The findings of this initial implementation led to a restructuring of the theoretical process to include collaborative engagement, communication, and play as underlying components throughout the entire process as opposed to solely in the first stage.

It was found that improvisation was not the ideal tool for content generation in this particular context due to varying degrees of experience and comfort among the collaborators. On the other hand, games and game-like exercises proved to be very useful both for creating material and for facilitating a cohesive and comfortable working environment. In the development of any interdisciplinary work, it is important to consider not only the difference between language used for each discipline, but also any differences in fundamental expectations and practices. The performing artists in the group were more immediately inclined to commit to a long term rehearsal schedule, whereas the designers were accustomed to a shorter and more intensive development period in the few weeks prior to the performance. These differences were by no means unsurpassable, however, and the overall experience was rewarding both personally and collaboratively.

VI. FUTURE WORK

This exploratory process is part of an evolving body of work surrounding creative collaboration and interdisciplinary art-making. Tremendous insight was gained throughout the eight-month period during which this process was applied, but there is still a lot more to learn. The use of games and playful exercises to generate content was an unexpected development which warrants further investigation, especially when considered in tandem or opposition with improvisation. Future applications in varying artistic contexts and timeframes will provide a deeper understanding of the practical implications and full potential of this collaborative model.

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Enhancement of numeric cognition in children diagnosed with Developmental Dyscalculia by an Auditory Musical Training

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ABSTRACT

Background

Studies have suggested that musical training (MT) enhances spatial-temporal reasoning leading to greater learning of mathematical concepts, in particular proportions and fractions (Graziano, Peterson, & Shaw, 1999), by producing long-term modifications in neural circuitry in regions not primarily concerned with music (Rauscher et al., 1997). Furthermore, the combination of melodic symbols helps children to remember random digits and multiplication tables, because the ability to distinguish distinct melodies requires temporal sequencing (Anvari et al., 2002). Therefore, MT has been shown to improve Numerical Cognition skills in children with typical development, the effects of MT in children with Developmental Dyscalculia (DD) remains unknown. According to that, in this study we examined the following assumption, whether MT could work as a form of rehabilitation in primary school-aged children within a longitudinal study design.

Aims

The purpose of the present study was to determine the efficacy of using an Auditory Musical Training (AMT) during 3 months, as a remedial strategy to enhance the Numeric Cognition skills of children who have been identified as having DD, and compare their performance in two different occasions (Pretest- before the AMT and Posttest – after the end of AMT). Moreover, we examine if DD group would be grouped in the same cluster after 3 months of AMT in Zareki-R (Neuropsychological Tests Battery for Number Processing and Mental Calculation in children).

Method

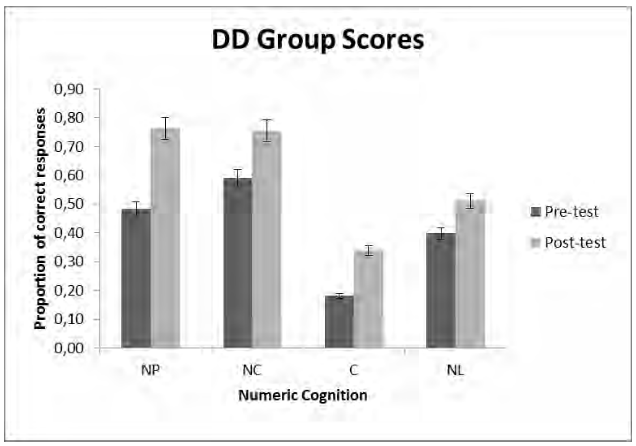
Sample: Participants were children from primary school, aged 8 years old, divided in two groups: DD; (N=24), confirmed by the cut-off point in Arithmetical task <9 (School Achievement Test; Stein,1994), and Typical Development (TD); (N=24).

The pre- and post-test assessment was carried out with instruments to estimate school achievement, Numeric Cognition, and working memory. The post-test was taken 7 weeks after the pre-test. The AMT program had a perceptual methodology running for 60 minutes weekly, during 7 weeks.

Instruments: RCPM. Raven's coloured progressive matrices (Angelini, et al., 1999); Zareki-R. Battery of neuropsychological tests for number processing and calculation in children, (Revised; von Aster & Dellatolas, 2006).

Results

First of all, were made a comparison between groups and were observed significant differences for almost all components of Numeric Cognition, where DD group had worst scores, except in Number Sense. Comparisons within groups revealed showed different scores on Post-test compared to Pre-test only for DD group to: Number Reproduction, Comprehension, Mental calculation and Number Line (Figure 1). It is important to point it out that TD group scored in agreement to age, according to Zareki-R standardization. Furthermore, TD group was not at ceiling on Pre-test, so the DD group results cannot be justified because they had more room to improve as a result of the intervention. Additionally, hierarchical cluster analysis was conducted with the 48 participants, regardless of their diagnosis. Findings support the presence of 2 subgroups marked by different results in Zareki-R, the cut-off point in pretest for cluster 1 was 129,10 (N=28) and for cluster 2 was 86,00 (N=20), for posttest; cluster 1 was 144,00 (N=33) and cluster 2 was 98,90 (N=15). Despite the decrease of the number of children in DD group, some of them still had the calculation skills clinically compromised.



Note: NP= Number Processing; NC= Number Comprehension; C=Mental calculation; NL= Number Line.

Figure 1. Proportion of correct responses for Numeric Cognition.

Conclusions

This result demonstrates the effect of AMT in Numeric Cognition, which cannot be attributed to developmental factors, as only DD group had higher scores compared to themselves.

These Data was also observed in cluster analysis. The AMT seems to be a useful tool for rehabilitation of DD.

Keywords

Auditory Musical Training; Developmental Dyscalculia; Numeric Cognition.

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General subjects display cross-modal responses to musical stimuli

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ABSTRACT

Background

Our study explores evidence of cross-modal cognitive perception in non synaesthetic individuals. Although "cross wired" [Cytowitz] synaesthetic neural networks are thought to be vastly different from non syntesthetes, the results of our cognitive pycho-musicology study with 40 synaesthetes and 40 non-synaesthetes reveal a spectrum rather than a divide. FMRI experiments have revealed that the cross-modal associations to sounds in synaesthetes are less pronounced, yet still present in the general population. Our research probes theories regarding recruitment of brain pathways for processing sound and initiates the exploration of a quasi-synaesthetic spectrum extending to general listeners, similar to culturally founded synaesthesia [Kohler].

Aims

Our research seeks to identify a facet of sound-related associative patterns informed by a cognitive psycho-musicology study. The portions of the brain which enable hearing and sound processing are vastly interconnected and far-reaching, thus, music induces specific affects in humans. Our study seeks to demonstrate that findings in FMRI studies revealing interconnectivity between auditory and cross-modal brain pathways in response to sound, transfer to a behavioral level in general listeners.

The linguistic "Kiki, Boulba Effect" [Köhler, 1929] reveals that individuals are indeed capable of consistent sound-to-pictorial/ shape associations. In more recent variations of the Kiki-Boulba experiment, over 90 percent of all subjects identified the spiked shape with the name Kiki, and the rounder shape as Boulba [Köhler, 1929] even when modified and applied cross-culturally [Sievers, Wheatley, Casey et al 2012]. These experiments support the hypothesis that non-synaesthetic individuals recruit universal cross-sensory associations.

On the music-processing frontier, the Kiki-Boulba experiment has not been verified. Furthermore the Kiki-Boulba phenomena has been critiqued by various scholars for the forced-choice format in which the experiment was originally presented prior to current adaptations. Based upon this, it was our aim to create an open-ended cross-modal experiment that could collate the range of responses (if present) to sound and music stimuli from 40 general subjects.

Method

The responses collected from the 40 non-synaesthetic subjects were placed alongside the 40 subject synaesthetic control group in a test informed by the Synaesthesia Battery [Novich, Cheng, and Eagleman] which successfully detected 20,000+ synaesthetes in a behavioural study. The Synaesthesia Battery testing protocol allows subjects screening for sound-triggered synaesthesia to select a color after hearing a sound/timbre. Participants who identify the initially chosen color association when the sound/timbre repeats, will have a high accuracy. Results for note>colour and timbre>colour synaesthesia with an accuracy above 85% indicate synaesthesia. We extended the Synaesthesia Battery testing protocol by adopting repetition accuracy procedures while allowing for more varied association responses beyond sound>color. 20 sound stimuli [Table 1] were presented to both subject groups in repeated trials wherein subjects had the opportunity to provide any association that occurred (or did not occur) during listening.

Table 1. Chart featuring order of repetition in sound files and songs/music clips.

#1	Sound Clip 1	#11	Clip 1	#21	Sound Clip 1	#31	Sound Clip 6
#2	Sound Clip 2	#12	Music Clip 2	#22	Music Clip 1	#32	Music Clip 4
#3	Sound Clip 3	#13	Music Clip 3	#23	Sound Clip 3	#33	Sound Clip 5
#4	Sound Clip 4	#14	Music Clip 4	#24	Music Clip 3	#34	Music Clip 5
#5	Sound Clip 5	#15	Music Clip 5	#25	Sound Clip 6	#35	Sound Clip 10
#6	Sound Clip 6	#16	Music Clip 6	#26	Music Clip 8	#36	Music Clip 7
#7	Sound Clip 7	#17	Music Clip 7	#27	Sound Clip 9	#37	Sound Clip 2
#8	Sound Clip 8	#18	Music Clip 8	#28	Music Clip 6	#38	Music Clip 10
#9	Sound Clip 9	#19	Music Clip 9	#29	Sound Clip 8	#39	Sound Clip 4
#10	Sound Clip 10	#20	Music Clip 10	#30	Music Clip 2	#40	Music Clip 9

Results

The given answers of the non-syntesthetes were placed alongside synaesthetic answers to examine whether they could be distinguished from one another in a blind review. There were many similarities aside from three distinguishing factors: 1) The synaesthete responses exhibited more consistency, 2) The synaesthetic group had a near 100% sound clip response level, higher than the that of the general group, 3) There was a greater level of agreement amongst the non-synaesthetic test responses regarding associative imagery. Surprisingly however, when presented with music clips, almost 90% percent of the general group provided idea/concept/image based associations. (Figure 1) Some of the associations named by general listeners were culturally based such as associating a droning tone to nautical elements: ships, barges (65%), while others seemed to be innate; such as, a music clip associated with warmth, light or the sun by the majority of this subject group (75%). These preliminary findings reveal a form of innate, learned or culturally founded synaesthesia [Kohler, 1929]. Some sounds impact general participant associations in a similar manner. In some cases, as many as 75 percent [Fig. 2]

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of participants presented like responses to the featured sound files.

Conclusions

Human adoption of music related metaphors, symbolism and innate readiness to relate sound to various concepts is a social replication of brain images seen in FMRI scans and confirmed on a cognitive-behavioral level in our experiment.

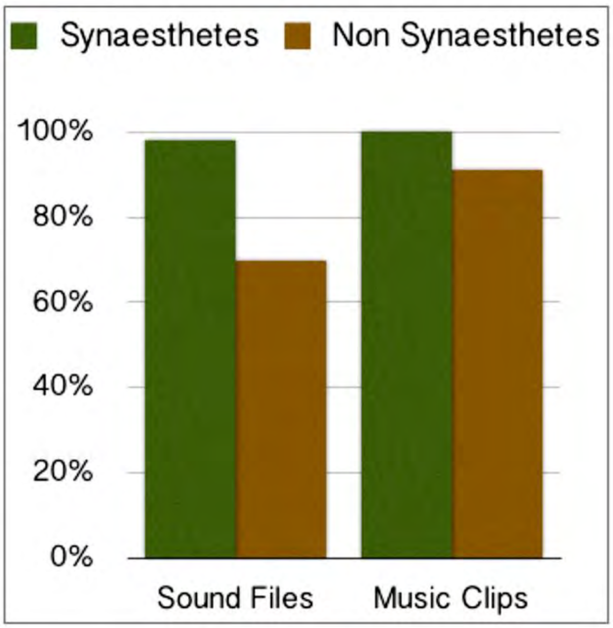

Figure 1. Percentage of Synaesthete and Non Synaesthete responses to sound files and music clips that included idea, concept or image based associations.

General human desire for cross-modal perspectives is strongly interrelated with the neurological condition of synaesthesia posing the question: "how is cultural or acquired (learned) synaesthesia different from organic synaesthesia?" While the vast differences are clear, studying similarities in sound-cognition will allow for a greater understanding of how our brains learn, adapt, process information and rehabilitate.

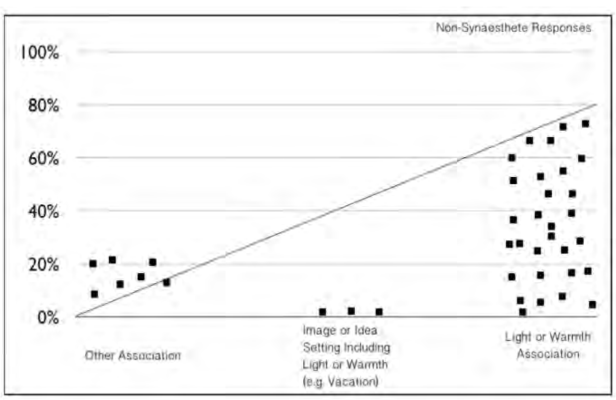

Figure 2. Scatter plot of general listener response to music clip featuring a non-recognizable guitar interlude.

Neuroscientist Gottfried Schlaug has made great strides in cognitive rehabilitation by engaging other portions of the brain to process that which the damaged area is unable to. "Music is a strong multimodal stimulus that simultaneously transmits visual, auditory, and motoric information to a specialized brain network consisting of fronto-temporo-parietal regions whose components are also part of the putative human mirror neuron system." (Gottfried, Thaut 2010) In both acquired and organic synaesthesia, aspects of the brain establish a cross-modal "leap" to an arbitrary or related concept. Based upon our research findings which probe cognitive facets of multi-modal sound associations, we conclude that there is a synaesthetic spectrum in general listeners which can spur theories of brain pathway recruitment, rehabilitation and reassignment through sound studies.

Keywords

Synaesthesia, Cultural-Synaesthesia, Cross-modal Sound Processing, Sound Associations, Sound Study, Cognitive Musicology, Behavioral Study, Aesthetic perception and response

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Novel compositional devices in *Presto* by twelve year old Sergei Prokofiev

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ABSTRACT

Background

It is well known that compositional abilities by Sergei Prokofiev (born 1891) appeared rather early, and perhaps it is not an exaggeration to call him a musical Wunderkind. After 1903 when Reinhold Glière was invited to teach him music, Prokofiev started to compose the so-called ditties (pesenka), i.e. short piano pieces. *Presto* is the fourth ditty of the third series of such works. It was composed in St. Petersburg on 20 March 1904 (according to the orthodox calendar), and first published—as far as I know—in 1987 in Italy by Ricordi in a collection of Prokofiev's works for piano called Manoscritti infantili. *Presto* has no opus number and therefore it is not included in the main list of the composer's works. Its performance by Frederic Chiu (HMX 2907301.10) has been used as the auditory source for analysis.

Aims

This paper is aimed at analyzing *Presto* in an attempt to detect novel expressive devices in a composition by the teenage composer.

Method

More or less traditional methods of analyzing form, harmony, tonality, rhythm and meter, and compositional devices have been used against the background of aesthetical norms of fin de siècle. Alongside, elements from the well-known theories, firstly, of musical expectancy by Leonard B. Meyer and, secondly, of generative grammar of tonal music by Fred Lerdahl and Ray Jackendoff are paralleled for explanation of some musical solutions in *Presto*.

Results

The duration of *Presto* is about two minutes. The piece has a form ABA preceded by a short introduction. The section A has a ternary structure in its turn. *Presto* exhibits the stylistic traits which later became overtly characteristic to Prokofiev's music. They are first of all related to the use of scale and tonality: the latter may remain ambivalent as switching between major and minor, and virtually every chord, how distant ever, may occur within its framework. Prokofiev's modulations are also rather unorthodox in their nature.

Conclusions

Elements of novel and talented compositional devices may be detected already in the oeuvre of teenage Sergei Prokofiev.

Keywords

Prokofiev, works for piano, musical structure, childhood manuscripts, *Presto*

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Assessment and modelling of latent and overt absolute pitch

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ABSTRACT

Background

Absolute pitch (AP) research typically focuses on one manifestation of the ability; for instance, overt pitch labelling is a demonstrably dichotomous ability (Athos et al., 2007), but such tests preclude investigation of individuals without musical training. Additionally, a latent form of AP involving veridical pitch memory for music exists in a substantial proportion of the general population (Levitin, 1994; Frieler et al., 2013) suggesting that such abilities may lie on a continuum. Therefore, a comprehensive approach is needed to investigate the structure and nature of both AP abilities in musicians and non-musicians.

Aims

This study constitutes the first step in creating a standardised test battery for absolute pitch. Test design is intended to capture both overt and latent abilities in musicians and non-musicians by including tasks with and without explicit pitch-naming. We aimed to discover whether latent AP (lAP) and overt AP (oAP) are continuous or discrete abilities and to identify which tests discriminate maximally between possessors and non-possessors.

Method

Sixty-three participants including 22 self-reported oAP possessors completed eight pitch perception and production tasks adapted from existing literature. Overt AP tests consisted of two decay-rate (e.g. Jakubowski & Müllensiefen, 2013) and three traditional pitch labelling tasks (e.g. Athos et al., 2007). Latent AP tests comprised two song production (e.g. Levitin, 1994) and one tune recognition task (Schellenberg & Trehub, 2003).

Results

Preliminary analysis indicates that oAP and lAP are bimodally distributed, with cluster analysis indicating two-component models as the best fit for data on all tests. This result persists for lAP when self-reported oAP possessors were removed. Variable selection algorithms reveal pitch production as providing the greatest discrimination between oAP clusters and song recognition between lAP clusters when self-reported oAP possessors were excluded.

Conclusions

These results support previous findings that oAP is an all-or-none ability (e.g. Athos et al., 2007) but, interestingly, they also suggest that lAP is dichotomous. Based on current data, production of named pitches and song recognition comprise the optimal tests for oAP and lAP respectively. On-going testing will provide deeper analysis of the structure and association of these abilities and enable further optimisation of the test battery.

Keywords

Absolute pitch, pitch memory, music memory, psychometrics.

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The piano accompanist portrayed through the eyes of a soloist

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ABSTRACT

Background

The pianist has been researched in various capacities including that of a soloist (e.g. Miklaswski, 1989; Davidson, 2012), duettist (e.g. Appleton et al., 1997; Blank & Davidson, 2007), chamber musician (e.g. Kokotsaki, 2007; Roussou, 2013) and accompanist (e.g. Lippmann, 1979; Rose, 1981; Goodman, 2000; Ginsborg & King, 2012). The musical, technical and social qualities of accompanists have been documented (e.g. Moore, 1943; Adler, 1965; Cranmer, 1970; Katz, 2009), while recent studies have investigated live accompaniment practices using digital and computer solutions (e.g. Dannenberg & Raphael, 2006; Jordanous & Smaill, 2009). To-date, there is no existing systematic research on the views of soloists about the different qualities of piano accompanists.

Aims

The aim of this study was to investigate the views of experienced soloists about the functional and socio-emotional qualities of piano accompanists in the Western duo chamber ensemble.

Method

As part of a large-scale interview study, 10 professional instrumental and vocal soloists were interviewed about their views on piano accompanists and accompanying. The interview questions concentrated on: a) accompaniment techniques, b) expectations, c) achieving ensemble, d) communication, and e) the accompanist's role in Western duo chamber ensembles. The data were analysed using conventional directed thematic analysis (Hseih and Shannon, 2005).

Results

Most soloists identified listening as the primary accompaniment technique, with other key skills including adaptability, flexibility, sensitivity to balance, rhythmic precision and technical control. Soloists expected their accompanists to know their music, be easy to work with and sensitive towards the soloist's strengths and weaknesses. To achieve ensemble, soloists expected the accompanist to both follow and lead where appropriate, and communicate visually and aurally. They perceived the accompanist's role in terms of support and understanding.

Conclusions

This study highlights a range of qualities and expectations about accompanists in the eyes of soloists, both functional (e.g. listening; rhythm; adaptability) and socio-emotional (e.g. support; sensitivity; understanding). The soloists acknowledged that accompanying is a specialist skill and that the piano accompanist is an integral part of the duo chamber ensemble partnership.

Keywords

Ensemble performance; piano accompaniment; accompaniment skills; duo partnership.

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"TV's Got Talent". On reception and economic aspects of German music talent shows

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ABSTRACT

Background

The music industry has been in crisis for at least a decade. Although music consumption is higher than ever, sales figures are at an all-time low. Music talent shows have proven to be a salvation for the music industry. Debuting in the 1990s, music talent shows have become one of the most successful television formats in recent years. This has been especially true in relation to the high demand for reality TV shows (Pendzich, 2005). The most popular German examples of this genre are *Popstars* (since 2000), *Deutschland sucht den Superstar* (*DSDS*; since 2002), and *The Voice of Germany* (*The Voice*; since 2011). These shows are broadcasted during prime time slots, each reaching four to six million viewers. They obtain a market share of about 40% for the 14–49 year-old target group.

Aims

While there has been considerable research on talent shows, it is not comprehensive. Most empirical studies investigate the reasons why people – especially children and young adults – watch talent shows (Götz & Gather, 2012) and how they perceive the jury and the stars-to-be (Hackenberg & Hajok, 2012). Consequently, we focus on the reception of music talent shows and the perceived differences between the show formats. Additionally, we examine the economic aspects of these formats and compare which dispositions lead to better purchasing behavior of talent show products.

Method

Therefore an experimental online survey (N= 230, M = 25.48, 75.7% female) was launched comparing the reception of two different formats, namely *The Voice of Germany* and *DSDS*. Only people who watched both formats recruited as participants for this study. The questionnaire aims on user behavior towards the talent shows, parasocial relationship (8 items, $\alpha = .91$), received authenticity of the show (7 items, $\alpha = .88$), jury (7 items, $\alpha = .80$) and the show participants (12 items, $\alpha = .92$) and received musicality of the jury (8 items, $\alpha = .91$) and the show participants (8 items, $\alpha = .82$) as outcome variables.

Results

Our results show that there are differences in the reception. In this case *The Voice of Germany* (M = 3.6, SD = .78) is regarded throughout as the more authentic format in comparison to *Deutschland sucht den Superstar* (M = 2.09, SD = 0.64, $t(229) = 23.18$, $p < .05$). But both formats are successful in stimulating the recipients in buying talent show products like CDs the more often they watch the shows (*The Voice:* $r = .25$, $p < .01$; *DSDS:* $r = .27$, $p < .01$). We found that the crucial factor responsible for the consumer acceptance of the recipients for buying talent show products are parasocial relationships (*The Voice:* $R^2 = .25$, $b = .35$, $p < .01$; *DSDS:* $R^2 = .21$, $b = .27$, $p < .01$).

Conclusions

The recipients definitely experience differences between the two formats: The concept of the show *The Voice* is received as more authentic as the concept of *DSDS* over all. Especially the participants and jury members of *The Voice* are received as more authentic. The jury members of *The Voice* (like Nena, The BossHoss, Rea Garvey or Samu Haber from the band Sunrise Avenue) are received as more musically than the "pop titan" and his jury crew from *DSDS*. The participants of *The Voice* are received as more musically talented and experienced than the participants of *DSDS* which could be the central explanation for the received authenticity.

The results are consistent with the observations by media criticists. While formats like *DSDS* and *Popstars* are criticized as musically and authentically modest because the participants, that are largely very young, do not perform original songs but only cover versions and their performances and personality changes to a very mainstream-like appearance (Jacke, 2005; Schramm, 2010), the newest format *The Voice* does receive very positive critics (Schramm und Ruth, 2014).

Finally, the results indicate that the most important factor for buying products of the music talent shows is the parasocial relationship between the recipients and the participants.

Keywords

music television, performance, talent show, parasocial relationship, authenticity, musicality, purchasing behavior

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A model of music-related emotional competence

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ABSTRACT

Background

This paper presents a theoretical model of a music-related emotional competence. Music is unquestionably a language of emotion: it accurately conveys emotions between performers and listeners (Gabrielsson & Lindström, 2010; Juslin & Timmers, 2010), and activates the core evolutionarily adaptive neuroaffective mechanisms (Blood & Zatorre, 2001; Koelsch, 2014). As a result, in daily life, it is actively and efficiently used for the induction (Juslin & Laukka, 2004; Zentner et al., 2008), self-regulatory modification (Saarikallio & Erkkilä, 2007; VanGoethem & Sloboda 2011), and interpersonal communication (Clayton 2009; Cross, 2014; Dissanayake, 2008, Trehub et al 1993; Malloch, 1999) of a variety of emotional states. Yet, current literature is lacking elaboration of the mechanisms that explain the emotion-related relevance of music and the connections of music to general emotionality and emotional health. Indeed, research on music and emotion is still an emerging field with a lack of comprehensive theoretical models to guide research designs and empirical investigation.

Aims

This paper presents a theoretical model of the core elements that constitute the concept of music-related emotional competence. General emotion research and theories of emotional intelligence were used as a foundation for constructing the model. The paper will elaborate on how the specific aspects of music-related emotional competence have their distinctive relationships with various aspects of general emotional competence and how they play their distinctive roles also in connecting musical behavior to emotional health and wellbeing.

Main Contribution

General emotional competence, or emotional intelligence, consists of a variety of interrelated abilities such as the perception and self-awareness of emotions, self-regulation of emotions, interpersonal communication of emotions, and the utilization of emotional understanding to guide thought and behavior (Goleman, 1995; Gross, 1998; Mayer & Salovey, 1997; Swinkels & Giuliano, 1995). Pioneering studies have demonstrated some connections between this general emotional competence and some emotion-related skills in music (Resnicow, Salovey & Repp, 2004; Saarikallio, Vuoskoski, & Luck, 2014; Thompson, Schellenberg, & Husain 2004; Wöllner, 2012). However, this paper will discuss some of these findings particularly as an illustration of the challenges of the field: the results are typically limited to particular sub-features of the studied phenomena (e.g. empathy, emotion recognition, expression of anger through musical timbre and loudness) and the studies greatly differ in terms of which sub-features are studied and how they are being operationalized.

In order to understand how music relates to general emotional competence and further to emotional health, we must detail the particular aspects that our studies focus on. A comprehensive model for conceptualizing the elements of music-related emotional competence is therefore presented. The model that I propose consists of four fundamental components: 1) Emotion recognition and awareness 2) Emotional self-regulation and induction, 3) Emotional expression and communication, and 4) Emotional self-agency and self-control of thought and behavior. The first component – the ability of identifying and being aware of emotions in self, others, and in music – serves as the fundament for the next two abilities that divide between the internal emotion processing and the external emotion communication. Finally, the last component is a feedback loop of meta-emotional understanding of acknowledging one's (music-related) emotional behavior and taking self-agency in acting upon its outcomes. Practical research examples of these sub-components will be presented.

Implications

The proposed model conceptualizes music-related emotional competence, and provides a comprehensive framework for future studies in the field of music and emotion. The model does not only serve as a groundwork for scientific and empirical testing of the connections between musical and general emotional competencies, or the mechanisms that link music to emotional health, but also provides a framework for practitioners who wish to embrace musical practice as a forum for training, recovering, and excelling in the different aspects of emotional competence. Implications for practitioners working in music education, music therapy, and community health are also discussed.

Keywords

music, emotional competence, emotional intelligence, music-related emotional competence, theory development

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The pleasures of sad music: A systematic review

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ABSTRACT

Background

Humans have long devoted effort and attention to the making and consuming of art that portrays and conveys sadness. Sadness in everyday life, however, is hardly pleasant, and is induced in response to distressing and adverse situations. If in most circumstances sadness is unpleasant, how then can it be associated with pleasure in an aesthetic context? Herein lies the so-called "tragedy paradox:" the seemingly contradictory idea that humans work to minimize sadness in their lives, yet find it pleasurable in an aesthetic context.

There are several proposed theories regarding how sad music can become pleasurable. Schubert (1996) proposed that negative-valence music is perceived as sad, but that this perception does not produce displeasure because the stimuli are considered to be aesthetic in nature and thus not actually harmful. Huron (2011) suggested that the hormone prolactin is responsible for enabling the enjoyment of sad music, which is released normally in the body to induce feelings of comfort and closeness after the experience of a negative emotion. A third proposal comes from Juslin's BRECVEMA model, which describes eight distinct mechanisms by which music can induce emotions (Juslin, 2013). A mixed emotion, such as pleasurable sadness, can be understood as the result of two different mechanisms generating different affective responses simultaneously.

Still other's have attempted explain the human attraction to sad music in terms of the psychological rewards that are associated with it. In large-scale surveys, people report listening to sad music for its ability to purge negative emotions, to improve understanding of emotions, to experience and express intense emotions and feelings, to regulate emotions and feelings, to feel connected to others, and to trigger specific memories (Taruffi & Koelsch, 2014)

Personality, mood, and the surrounding social context also appear to be important factors in determining whether or not sad music is enjoyed. Measures of the personality traits absorption, empathy, and openness to experience are all correlated with the liking of sad music (Garrido & Schubert, 2011; Vuoskoski, Thompson, McIlwain, & Eerola, 2012). People report choosing to listen to sad music more often when they are alone, when they are in emotional distress or feeling lonely, or when they are in reflective or introspective moods (Taruffi & Koelsch, 2014). The role of mood is a bit more complex. Whether or not a person selects mood-congruent (i.e. selecting sad music when they are sad) or mood-incongruent (i.e. selecting happy music when they are sad) depends on personality and social context (Taruffi & Koelsch, 2014).

The recent emergence of new tools in neuroscience provides an additional lens with which to investigate the relationship between perceived sadness in music and positive affect. The results from the neuroimaging experiments suggest that pleasurable sadness can be seen as a consequence of several coordinated neural processes: emotional perception and reaction, which occurs primarily in the brainstem and auditory cortices and subsequently in the hippocampus, amygdala, and insula (Juslin, 2013), aesthetic judgment which is coordinated mainly in the frontal lobes, including the superior frontal gyrus, the middle frontal gyrus, the orbitofrontal cortex, and the anterior cingulate cortex (Jacobsen, Schubotz, Höfel, & Cramon, 2006), and pleasurable response, which is correlated with activity in the ventral striatum, specifically the nucleus accumbens, the caudate nucleus, and the orbitofrontal cortex (Berridge & Kringelbach, 2008).

Aims

We review the facts and interpretations of why and how sad music can become pleasurable. We attempt to bring together the findings from philosophy, psychology, and neuroscience in order to arrive at a framework for how sad music becomes pleasurable. We also propose ways of possibly assessing the validity of this framework using neuroimaging and suggest how the available facts may be applicable to mental health interventions.

Main Contribution

Pleasure in response to sad music occurs when a combination of the following factors occurs concurrently: realization that the stimuli have no immediate real world implications, recognition that the stimuli have aesthetic value, and promotion of certain psychological benefits, which depend on personality profiles, social context, certain mood, and the learned associations.

The way in which these various factors interact to produce pleasure when listening to sad music can be understood in the perspective of homeostatic regulation. Feelings of pleasure can be thought of a reward for achieving homeostatic balance, encouraging the organism, under certain conditions, to seek out behaviors and stimuli that are adaptive and should be repeated.

The pleasurable response as a result of listening to sad music can be interpreted as an indication that, in the past, engaging with such music lead to a restoration of homeostatic balance. Given that various psychological and emotional rewards (e.g. emotional expression, emotional resolution, catharsis) are shown to be associated to a higher degree with sad music than happy music (Taruffi & Koelsch, 2014), it may be that sad music, in particular, is preferentially suited for regulating homeostasis. This notion is further supported by the fact that listening to sad music engages the same network of structures in

the brain (i.e. the OFC, the nucleus accumbens, insula, and cingulate) that are known to be involved in processing other stimuli with homeostatic value, such as those associated with food, sex, and attachment (Zatorre, 2005). We believe that pleasurable responses to negative-valence music stimuli are thus best understood through this ability to promote homeostasis.

There are many ways in which a homeostatic imbalance can arise and there are equally numerous ways via which sad music can correct such imbalances. For example, a person who is currently experiencing emotional distress and has an absorptive personality will be able to listen to sad music and gain psychological benefits associated with it without the negative feelings. In this case, listening to sad music would correct the homeostatic imbalance caused by emotional distress and therefore the experience would be pleasurable. On the other hand, a person who is in a low affective state but who is highly open to experience and thus prefers a variety and intensity of feelings, may feel pleasure when listening to sad music because the music is able to change mood and induce feelings which places the person in a preferred state of being given his or her personality

Implications

Viewing the tragedy paradox in terms of humanity's deeply rooted biological need to maintain a variety of basic psychological and physiological balances and stability over time, should allow researchers to focus less on the individual and situational factors associated with enjoying sad music and more on how these factors interact with each other. We believe that this comprehensive focus will ultimately permit a better understanding of the questions that persist on this issue.

This framework proposed will help guide the direction of future research onto the psychological and neurobiological underpinning of complex emotions. Such studies should attempt to elucidate the contribution that different parts of the brain may make to pleasurable response induced by music by exploring three lines of research: (1) directly comparing music that is perceived as sad but not found pleasurable with music that is perceived as sad and found pleasurable; (2) exploring how the emotional response to sad music compares to the emotional response to other types of sadness, such as sadness due to the loss of a loved one or being ostracized; and (3) considering specifically how the interaction between mood and personality alters preference for sad music.

The review also has implications for music-based therapeutic intervention, specifically with regards to mental disorders that are characterized by deficits in emotional regulation and pleasurable response. Given the psychological benefits associated with it, sad music might be helpful in the treatment of depression in particular. As it stands, the currently available music therapies for depression do not use the unique components of music that make it so conducive to cognitive and emotional repair. A new type of music therapy, centered on listening to sad music in conjunction with psychopharmacological and psychotherapeutic treatment, could provide a novel way of combating the emotional disruptions associated with depression. By actively exploring, with the guidance of the therapist, the thoughts, feelings, and memories associated with experiencing a sad piece of music, patients could gain a better understanding and be more equipped to deal with their intensified response to negative stimuli in life, find new ways of connecting with others and coping with sadness, and realize that finding pleasure and meaning in life is still possible.

Keywords

sad, music, neuroimaging, music therapy, depression

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Heuristic models for decision making in rule-based compositions

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ABSTRACT

Scores that require participants to negotiate inter-personal relationships during performance encourage the development of individual and collective strategies for decision-making as part of the performance practice. Such strategies might be codified through rules specified in the score or developed more informally through the preferences of the performers. In both cases, models drawn from decision-making theory can be usefully applied to help explain the ways in which composers initiate these processes and how performers respond to them. In particular, heuristics suggest possible explanations for the ways in which such pieces operate in practice. A heuristic is a useful decision-making strategy that "ignores part of the information, with the goal of making decisions more quickly, frugally, and/or accurately than more complex methods" (Gigerenzer & Gaissmaier, 2011, p. 454). By reducing the amount of information to be considered, there is a corresponding reduction in the cognitive effort required to make a decision.

This paper considers the creative potential for heuristics as a compositional strategy. It explores implicit uses of heuristics in work by Christian Wolff and Joseph Kudirka, as well as my own recent music. It examines how performer decisions in such pieces create different modes of interaction between individuals and rules. The practice presented in the paper provides possible models for embodying heuristics, and decision-making theories more generally, as a compositional strategy. I contend that defined heuristics are present in existing compositions where performers are required to make judgments based on available information, and that composers have deployed such heuristics intuitively. By making links between current heuristics theory and compositional practice, as well as showing how such theory might actively inform the creation of new work, the paper suggests future possibilities for creative practice.

I. INTRODUCTION

Scores that require participants to negotiate inter-personal relationships during performance encourage the development of individual and collective strategies for decision-making as part of the performance practice. Such strategies might be codified through rules specified in the score or developed more informally through the preferences of the performers. In both cases, models drawn from decision-making theory can be usefully applied to help explain the ways in which composers initiate these processes and how performers respond to them. In particular, heuristics suggest possible explanations for the ways in which such pieces operate in practice. A heuristic is a useful decision-making strategy that "ignores part of the information, with the goal of making decisions more quickly, frugally, and/or accurately than more complex methods" (Gigerenzer & Gaissmaier, 2011, p. 454). By reducing the amount of information to be considered, there is a corresponding reduction in the cognitive effort required to make a decision. While some previous research has posited that heuristics produce more errors in comparison with logical and statistical models as a result of the "accuracy-effort trade-off" (Gilovich, Griffin, & Kahneman, 2009; Kahneman, Slovic, & Tversky, 1982), recent studies have shown that heuristics outperform such rational methods in environments to which they are "ecologically rational" (Gigerenzer & Gaissmaier, 2011). In particular, heuristics are suited to environments where some relevant information is unknown, contrasting the use of rational methods in the bounded laboratory conditions of "small worlds" with the need to find ways to address the complexity of "large worlds" (Binmore, 2007).

This paper considers the creative potential for heuristics as a compositional strategy. It explores implicit uses of heuristics in work by Christian Wolff and Joseph Kudirka, as well as my own recent music. It examines how performer decisions in such pieces create different modes of interaction between individuals and rules. The practice presented here provides possible models for embodying heuristics, and decision-making theories more generally, as a compositional strategy. I contend that defined heuristics are present in existing compositions where performers are required to make judgments based on available information, and that composers have deployed such heuristics intuitively. By making links between current heuristics theory and compositional practice, as well as showing how such theory might actively inform the creation of new work, this paper suggests future possibilities for creative practice.

II. HEURISTICS

According to Gerd Gigerenzer, heuristics are composed of three building blocks that have specific functions in decision-making: search rules, stopping rules, and decision rules (Gigerenzer, 2002, p. 43). Gigerenzer splits search rules into two categories: the search for alternatives, and the search for cues. The search for alternatives derives from Herbert Simon's concept of *satisficing* (1956, p. 136) in which the "search process goes on until a satisfactory alternative is found that reaches or surpasses the aspiration levels on the goal variables, and then this alternative is taken" (Selten, 2002, p. 14). In this model, a search continues until an option is presented which will suffice: it may not be the perfect option, but it is satisfactory. The alternatives are not known in advance, but the criteria for their recognition allow them to be found. The search for cues operates within an environment where the alternatives are known in advance, and their recognition terminates the search. Stopping rules are the conditions that terminate each search and "involve simple criteria that are easily ascertained" (Gigerenzer, 2002, p. 44) and decision rules determine what happens when the search is stopped. The different ways in which these building blocks are configured defines individual heuristics.

As an example, in the *take-the-best heuristic* cues are compared in a ranked sequence until such a comparison can

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discriminate between available options. In a study of which of two residential properties was more likely to be burgled on the basis of eight cues (Garcia-Retamero & Dhami, 2009), professional burglars judged the presence of an alarm system to be the most important factor. If one property had an alarm and the other did not, then the non-alarmed property would be selected. If both or neither property had an alarm then discrimination using that cue was not possible, so the second ranked cue (location of the property on the corner or in the middle of the street) was used, and so on. The search rule here is cue-based (does one property have an alarm? is one property on the corner?), the stopping rule is activated when the search rule can discriminate between a pair of properties, and the decision rule indicates the action to be undertaken on termination of the search (burgling the property, or not).

Gigerenzer also introduces the notion of *ecological rationality* as a way to assess "the match between a strategy and an environment" (Gigerenzer, 2002, p. 46). He notes that such a match results in "adaptive decisions that combine accuracy with speed and frugality" and that heuristics are more robust "when environments are noisy and information is scarce." In particular, where a heuristic is ecologically rational it produces results that match or exceed those of more computationally-intensive and time-consuming methods (Gigerenzer et al., 2002). Shah and Oppenheimer (2008, p. 209) propose five distinct methods used by heuristics to increase the efficiency of decision-making in this way:

1. Examining fewer cues.
2. Reducing the difficulty associated with retrieving and storing cue values.
3. Simplifying the weighting principles for cues.
4. Integrating less information.
5. Examining fewer alternatives.

In summary, heuristics reduce the amount of information, or simplify the structuring of that information, that is minimally necessary to make decisions in order to "employ a minimum of time, knowledge and computation to make adaptive choices in real environments" (Gigerenzer & Todd, 2001, p. 14).

III. RULE-BASED COMPOSITIONS

One such real environment is found in compositions that require performers to make decisions based on cues in live performance. Typically such pieces use verbally-expressed rules which tend to be internalized by the performers during rehearsal and preparation, and then activated in the performance, often from memory. The rules might govern the way performers respond to the events that unfold during the performance, controlling anything from individual moments through to entire pieces. Given the possible complexity of musical performance as an environment, heuristics are useful because they enable performers to focus on critical information while ignoring other features.

A clear example can be seen in Christian Wolff's *For Pianist* (1959). In one passage the performer is asked to make a sound which is "as soft as possible", and then determine whether the sound was "inaudible", "as soft as possible" or "louder than as soft as possible" (see ***Figure 1***). The result of this assessment routes the next part of the music to three different sequences of material. Given the comparative nature of this decision, a good model is the *similarity heuristic* which Read and Grushka-Cockayne (2011, p. 25) note

> can be used whenever a classification decision is to be made, when the object or event can be placed into one of two or more categories, and it is possible to assess the similarity of the object or event to members of each category.

So here the pianist must assess the similarity of the amplitude of their resultant sound to the three specified categories. The decision is a simple one in that it isolates one parameter as a basis for the judgment. It is however somewhat indefinite as a criterion and it relies on the subjective judgment of the pianist. The range of amplitudes that might qualify as "as soft as possible" may vary between pianists and pianos, and may be altered by the immediate context. Here the event occurs approximately 1.5 seconds after a loud sound which is left to decay and a subsequent constellation of seven other sounds, any of which might alter the perception of amplitude for the cue

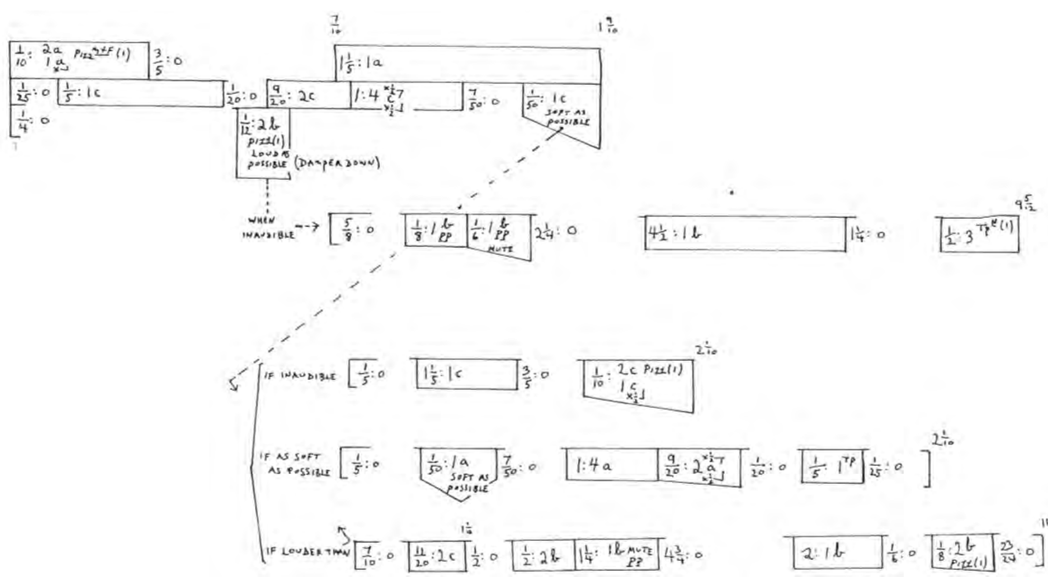

Figure 1: Christian Wolff - *For Pianist* (1959), excerpt

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sound. The heuristic building blocks here are quite straightforward though: the search rule looks for an amplitude cue in the sound; the stopping rule is activated by the assessment of the sound after its production (the search is complete); and the decision rule evaluates the amplitude and triggers the consequent sequence of sounds. The decision is therefore contingent on the perception of the sound and subsequent interpretation of the criterion by the pianist.

In contrast, in Joseph Kudirka's *harmony* (2007) the cues are more explicit (see **Figure 2**). Three tones are sounded, with one tone periodically dropping out. A new tone replaces it, and the rules specify the placing of the tone in relation to the remaining two: either above, between, or below them. Whereas in the Wolff the search rule looks for the relative amplitude of the sound with the consequent subjectivity that creates, in Kudirka's piece it assesses whether the tone that has just stopped was the highest, middle, or lowest of the three that were sounding. While subtle microtonal differentiation in the played pitches or a poor sense of relative pitch might make this task difficult, it is nonetheless more quantifiable than that presented in the Wolff. Kudirka's piece also has a more open decision rule. In the Wolff, the decision is based on the assessment of similarity to the three categories, requiring comparison in order to reach a decision. In *harmony* the player is presented with two options for the new tone and must make a straight choice. So if the stopped tone was the highest, then the new tone should either be the middle or lowest tone. There is no information given as to how this choice should be made however. This reveals a more covert use of decision making where a heuristic is not explicitly encoded in the rules, but rather where one must be employed in order to make the required decision. The player must first "decide how to decide" (Goldstein et al., 2002, p. 183). So in this example the player must choose whether to play a pitch that is between the two that are sounding, or below them. There are two possibilities, and heuristics such as *take-the-first*, the *fluency heuristic* or the *recognition heuristic* may be employed here. Each of these heuristics is a method for selecting between two options. In the recognition heuristic, "if one of two alternatives is recognized and the other is not, then infer that the recognized alternative has the higher value with respect to the criterion" (Gigerenzer & Gaissmaier, 2011, p. 460). Here, if a difficult judgment needs to be made regarding placing a tone between two others–they may be very close together for instance–then it may be that the lower option is selected as it is only this one that is recognized. In take-the-first, the first or only option that comes to mind is selected. Take-the-first is useful in this respect as "part of recognizing or categorizing a situation as typical is to recall what to do in that situation", such that options may "come to mind in order of quality" (Goldstein et al., 2002, p. 177). Here, the ease of playing a lower tone may be thought of first, and therefore selected. With the fluency heuristic "If two objects, a and b, are recognized, and one of two objects is more fluently retrieved, then infer that this object has the higher value with respect to the criterion" (Hertwig, Herzog, Schooler, & Reimer, 2008, p. 1192). This may apply if the possibility of playing either the middle or lower tone is recognized, but that it is potentially easier (more fluent) to play the lower tone, hence more value is attached to that option. In this example, there is no significant sense of utility attached to the decision however. The effectiveness of take-the-first is limited where there are "low costs for making errors" (Goldstein et al., 2002, p. 177). Being caught in the middle of a burglary is not at stake here. Equally, the use of the recognition heuristic may also vary over time and affect the choices of other players as by continuously prioritizing one of the choices it might "assure [it] a place in the recognition memory of others" (Goldstein et al., 2002, p. 178). Success is measured here in relation to the rules of the piece. There are two correct responses in this situation: play the middle or lowest tone, not the highest tone. Players may consider their chance of success is therefore more likely if the lower pitch is played.

harmony

for any number of players

Three tones of differing pitch enter and sound together.
One of these tones drops out, and a new tone enters.

If the tone that stopped was the highest of the three sounding tones, the new tone should either be in between (in regards to pitch) the two remaining tones, or the lowest tone.
If the tone that stopped was the middle tone, the new tone should be either the highest or the lowest of the three tones.
If the tone that stopped was the lowest, the new tone should be the highest, or middle pitch.
Then one of these three tones may drop out, etc.

This process may continue for as long as the players desire.

2007

Figure 2: Joseph Kudirka - *harmony* (2007)

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all voices are heard (2015)

Each player needs a large number of instruments and/or objects capable of producing sustained sounds. Every player should have an identical collection of instruments and/or objects.

The aim is to reach group *consensus*.
Consensus is achieved by all contributing players playing a *statement* in unison such that they are in agreement as to its uniformity.
Players must determine if the similarity is sufficient to constitute consensus.
When consensus is reached, the *sequence* is complete.
A performance may comprise any number of such sequences.

A sequence comprises a series of statements.
One player cues the beginning of each statement.
At the first cue, all players play their opening *material*.
At the second cue, and on each subsequent cue until consensus is reached, players may do one of the following:

1. play the same material as that which they played at the previous cue
2. play material that matches what another player played at the previous cue
3. play something new
4. remain silent

The material comprises any configuration of short sounds played on the available instruments and/or objects. The material may comprise one or more sounds.

If a player chooses to remain silent for a statement, that player takes no further part in that sequence, but may join in for the next sequence.

James Saunders
April-May, 2015

Figure 3: James Saunders - *all voices are heard* (2015)

This question of utility is central to the use of decision-making processes in rule-based compositions. While the outcomes of decisions in performance will not determine anything as significant as, for example, whether someone has had a heart attack or if it is advisable to get married (Gigerenzer & Todd, 2001, pp. 3-8), they are important within the context of the piece. By not following the rules, the piece is not realized according to the composer's intent, however open the result might be. This is a common problem in realizations of open scores, where flexibility can lead to ambivalence for the outcome where errors may not be noticeable. One way to counteract this is to give value to the outcome of the decision in a way that is apparent to observers.

I attempt to do this in my piece *all voices are heard* (2015), where the results of players' decisions become apparent to listeners (see **Figure 3**). The piece models consensus decision-making, best known as the means through which Quaker meetings are conducted. In the piece, players simultaneously play a sequence of sounds chosen from a limited set of sources to which all have access. This event repeats, with players electing each time to undertake one of four actions:

1. play the same material as that which they played on the previous downbeat
2. play material that matches what another player played on the previous downbeat
3. play something new
4. remain silent

The aim is to achieve consensus, defined here as all players playing the same sound "in unison such that they are in agreement as to its uniformity" (or remaining silent). The degree of similarity is negotiable however, opening up the process to different levels of rigour in the application of this criterion. So two whistle sounds might be acceptable for one player, whereas two C sharp whistle sounds might be required by another, while the C sharp whistles with matched duration, envelope and timbral distortion might be necessary for a third player. This criterion is negotiated non-verbally by the players.

The building blocks in *all voices are heard* focus on developing the best strategy to achieve group consensus in a future state of the piece. The search rule requires players to assess what the other players are doing. The stopping rule activates once this assessment has been made, and the decision rule articulates the response by each player in the next event that is most likely to promote consensus. There is however more autonomy here as a number of different strategies are valid, and players may exert more agency in the decision-making process. So for example, one player might decide that they want all other players to conform to their sound and only play option 1. Conversely another player might always try to conform to the majority sound, aiming to reinforce that to achieve consensus and play only option 2. In both cases the players are trying to achieve the same aim, but their strategies differ and are evidenced by the decisions they make. This may derive from an application of the take-the-best heuristic. Searching through the current texture and checking each of the four decisions in order until a satisfactory match is made would present a workable strategy. A rank ordering of these decisions might be: 1. remain silent; 2. play matching material; 3. play the same material; 4. play something new. These will promote consensus with decreasing likelihood. In *all voices are heard* players' decisions must, therefore, take into account both the stated aim of the process and the likely responses of the other players. This suggests a game situation, given the presence of an interactive goal-directed challenge with conflicting competitors that creates meaning (Costikyan, 2002; Crawford, 2003). Both utility, with its consequent potential for analysis, and playfulness may emerge.

IV. CONCLUSION

The examples presented here suggest some possibilities for embodying heuristics in rule-based compositions. In the Wolff a subjective assessment of similarity forces a choice from three possibilities. In the Kudirka there is a free choice from two options, inflected by the complexity of the context. In my piece the decision is governed by the strategy that, in each player's view, is most likely to attain the stated goal. These examples show some of the possible ways in which heuristics and decision-making processes more generally are embodied within some rule-based compositions. There seems to be two principal approaches: either to encode a specific heuristic in the rules themselves, or to present decision-making scenarios that require performers to establish a way to make decisions. While there are perhaps no explicit examples of the former as interdisciplinary collaboration between composers and heuristics researchers is currently under-developed, examples such as the Wolff demonstrate that such approaches have been used intuitively in the past. The second approach is more common, with many rule-based compositions presenting a series of decisions that performers must make, such as in the Kudirka and my piece. Here there is great scope for further consideration of the ways performers might make these decisions, generating a better understanding of such behaviours as a means to inform creative practice.

ACKNOWLEDGMENTS

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Improving pitch memory in congenital amusia with transcranial alternating current stimulation

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ABSTRACT

Background

In order to process and understand music, it is essential to be able to perceive and memorize musical material such as musical pitches. Though, about four per cent of the population lack these abilities and have a congenital perception disorder, known as tone-deafness or congenital amusia (Kalmus and Fry, 1980; Peretz et al., 2003).

Brain imaging studies have highlighted structural differences in congenital amusia, that are associated with pitch perception and memory deficits (Hyde et al., 2006, 2007, 2011; Loui et al., 2009). Additionally, a functional anomaly of decreased low gamma oscillations (30-40 Hz range) in the right dorsolateral prefrontal cortex (DLPFC) during pitch memory in amusics has been revealed (Albouy et al., 2013).

Aims

The aim of the present study was to investigate whether applying transcranial alternating current stimulation (tACS) at 35 Hz to the right DLPFC would improve pitch memory abilities in individuals with congenital amusia. TACS was used as previous studies have shown the potential use of tACS to modulate perception and cognitive performances (Herrmann et al., 2013 for a recent review).

Method

Nine amusics (7female) took part in two tACS sessions and completed a pitch memory and visual memory task before and during tACS with a target frequency of 35 Hz or a control frequency of 90 Hz. Additionally, matched controls also completed the pitch and visual memory task without stimulation to compare performances. To measure pitch memory, the pitch span task (Williamson & Stewart, 2010) was used. Participants heard two tone sequences with a short pause between them and should decide whether they were the same or different. The task started with two tones per sequence and then followed an adaptive staircase procedure and the participants' pitch memory span was calculated. Additionally, a visual span task was composed which followed the same experimental parameters as the pitch span task, only that the stimuli were visual symbols (letters from Hindi alphabet Devanagari).

Results

The results reveal that 35 Hz stimulation facilitated pitch memory in amusics significantly. No modulation effects were found with 90 Hz stimulation or on the visual control task. Furthermore, the analysis revealed that before stimulation amusics showed a selective impairment of pitch memory compared to controls, whereas the visual memory performances were comparable. Interestingly, the amusics' pitch memory performance during 35 Hz stimulation was not significantly different to pitch memory in healthy controls.

Conclusions

Taken together, the study shows that modulating the right DLPFC with 35 Hz tACS in congenital amusia leads to an improvement of pitch memory performance supporting the hypothesis that alterations of gamma oscillations within the DLPFC are causally involved in disturbed pitch memory. In addition, the study adds to the growing literature that non-invasive brain stimulation is a useful tool for therapeutic interventions.

Keywords

congenital amusia, pitch memory, transcranial alternating current stimulation, right dorsolateral prefrontal cortex, gamma oscillations

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Useful music is favoured music – The effect of musical functions on musical preferences

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ABSTRACT

Background

Musical preferences are hard to explain and predict. While some individual variables, such as age, gender, and personality traits, are suitable to explain a part of the variance the lion's share remains unexplained. During the last two decades, the psychology of music has focused on the functionality of music in people's everyday life. Some scholars have suggested that musical preferences should be interpreted in the light the functions that are served through music (e.g., Arnett, 1995; Behne, 1997; Larson, 1995; Lehmann, 1994). Although this approach is compelling and promising, only a handful of empirical studies have investigated the functional aspect of music listening and its influence on musical preferences (see Chamorro-Premuzic, Swami, & Cermakova, 2012, for an example). It is, at least, well known that the degree of functionality and the strength of musical preferences are correlated (e.g., Schäfer & Sedlmeier, 2009).

Aims

Since correlation does not yet equal causation the aim of the present study was to clarify experimentally if the degree of functionality really determines the strength of musical preferences.

Method

'Social relatedness' was selected as one of the most important functions of music. It is not only the most prominent candidate for the potential evolutionary root of music (see Huron, 2001) but was also identified to be one of the three fundamental functions of music listening in an empirical study (Schäfer, Sedlmeier, Städtler & Huron, 2013).

Social relatedness as a function of music was manipulated in an experimental study. Participants should indicate their favourite musical style and one of their favourite pieces of music that they deemed suitable to create a strong social bonding among the devotees of that style. They were told that other devotees of the same style would subsequently be asked to rate—based on that piece—how much they would like to get to know and take to the person who had named that piece. False feedback was manipulated in two randomized groups. One group received very positive feedback from the other fans (suggesting high functionality of the piece of music they had named); the other group received rather negative feedback (suggesting low functionality). At the end of the study, participants should indicate how much they like the piece they had named.

Results

As expected, participants in the high functionality group gave higher preference ratings for their selected piece (M = 91.7; SD = 7.11; on a scale from 1 to 100) than participants in the low functionality group (M = 87.3; SD = 12.56); $F(1,128)$ = 14.90, p = .001, d = .43.

Conclusions

The experiment demonstrates that the degree of music's functionality in everyday life is a significant determinant of musical preferences. Thus, the functionality of music should be incorporated in modelling musical preferences.

As musical preferences are seen as traits—something that is enduring and stable by nature—a sudden and significant change due to receiving social feedback is a remarkable finding. Although former research suggests that, compared to other functions of music listening, social relatedness might not be the most salient one (Schäfer et al., 2013) the present study shows that it is unarguably essential when reasoning about the influence of music's functionality on the strength of music preference. To complete the picture, future studies should examine whether the other two fundamental functions of music listening—self-awareness and arousal/mood regulation—are also significant determinants of music preference.

Keywords

musical preferences, functions, social relatedness, false feedback, favourite music

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The Musical Foregrounding Hypothesis: How music influences the perception of sung language

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ABSTRACT

The question how music influences the perception of lyrics is rather complicated. There are indications that music enhances the perception, comprehension and memorization of sung language, but also that it obstructs language perception and comprehension by withdrawing attention from the words, or undermining their meaning. The linguistic concept of foregrounding, might be helpful to understand the paradoxical way in which music seems to affect lyric perception. Foregrounding (the use of stylistic features such as metaphors and parallelisms, etcetera) is supposed to obstruct normal understanding, but, by doing so, to draw attention to the language too. Foregrounding, for example, both slows down reading and increases strikingness and affects ratings. The Musical Foregrounding Hypothesis (MFH) states that matching music to words has a similar effect to language perception as linguistic foregrounding. However, music is far more complex than any stylistic feature. Music consists of components such as rhythm, pitch, harmony, song structure, etcetera, all of which might affect lyric perception independently. This leads to several sub-hypotheses. An MFH-based model for lyric perception explains the relations between the MFH and these sub-hypotheses. Support for some of these sub-hypotheses is found in the existing literature, others should be tested. The MFH offers an interdisciplinary approach to song and to the relationship between language and music, that might be beneficial to science, education, music, advertising and literature.

I. INTRODUCTION

Music seems to have quite contradictory effects on the perception of song lyrics. In everyday life, many people report to be deeply moved by the words of a certain song, while others do not even notice them. And when researchers test the effect of music on, for example, verbal memory, small differences in the design of their studies lead to opposite results (Moussard et al., 2014, among others). It is a problem that we do not fully understand these contradictory effects yet, because now it remains unclear when and how the use of song is beneficial for advertising, education, or therapy, although there are strong indications that it is (Patel, 2011; Lim, 2010; Graekjaer & Jantzen, 2009; Msila, 2013, among others). Furthermore, since it is still unclear what song lyrics are and how they work under the influence of music, literary study lacks a proper approach to writing, studying, 'reading' and valuing song lyrics (Buelens, 2011; Pence, 2012). Although, in the last few decades, several scholars and writing-coaches have sought and advocated for new approaches to song and song lyrics, and progress has been made (Kramer, 1984, 2002; Rubin, 1995; Spyropoulou Leclanche, 1998; Eckstein, 2004; Schotanus, 2007; Pattison,1991, 2005), most assumptions and hypotheses remain untested and they are often contradictory, as illustrated by the striking differences of approach between the contributors to Pence's book (2012).

To understand the paradoxical ways in which music affects lyric perception the linguistic notion of foregrounding might be helpful. Stylistic features essential to literature, have long been thought to de-automize language perception to make the words more effective, or striking, or give them new meanings. Miall and Kuiken (1994) have shown that stylistic features indeed cause not only defamiliarization, but also an increase of reaction time, and of strikingness and affect ratings. Furthermore, Kuijpers & Miall (2011) have shown that there is a connection between foregrounding and reader-reported bodily reactions (such as changes in heart beat and respiration), and Miall (2011) has connected foregrounding to the ERP's measured in several studies on language processing, stating that these ERP's might explain both the sense of strangeness and the emotions caused by foregrounding. However, the effects of foregrounding are limited. It works if, and only if, the alienation is somehow resolved by an explanation for the use of those estranging features, causing insight and perhaps also a mesolimbic reward for resolving a problem. Therefore, too much foregrounding, will make a text incomprehensible, and will cause a decrease of strikingness and affect ratings (Shen, 2007). As a result, the effect of an increase of foregrounding on strikingness and affect ratings, follows an inverted-U-shaped curve.

Thus, linguistic foregrounding, like music, seems to have a paradoxical effect on language perception. It seems to support it by obstructing it, as long as the obstruction is not too heavy. And because singing is obviously less familiar than speaking, I would like to suggest the idea that music in song defamiliarizes language in a way similar to linguistic foregrounding. However, since music is far more complicated than any linguistic feature, this hypothesis, the Musical Foregrounding Hypothesis (MFH), cannot go without a model mapping the process it supposes. Figure 1 shows such a model.

II. LYRIC PERCEPTION, AN MFH-BASED MODEL

As Figure 1 shows, the MFH considers song to be composed of two complex constituents (lyrics and music) unfolding in time. Both lyrics and music consist of various components each raising expectancies about what will come, based on conventions learned and general experience stored in memory. Processing musical events requires attention, and, depending on the complexity of these events, might distract from new textual events in the continuating song, especially when musical expectancies are violated. Music processing in general, violated musical expectancies, and synchronicities and

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misalignments between lyrics and music function as foregrounding in lyric-perception, alienating language and affecting meaning and emotional colour.

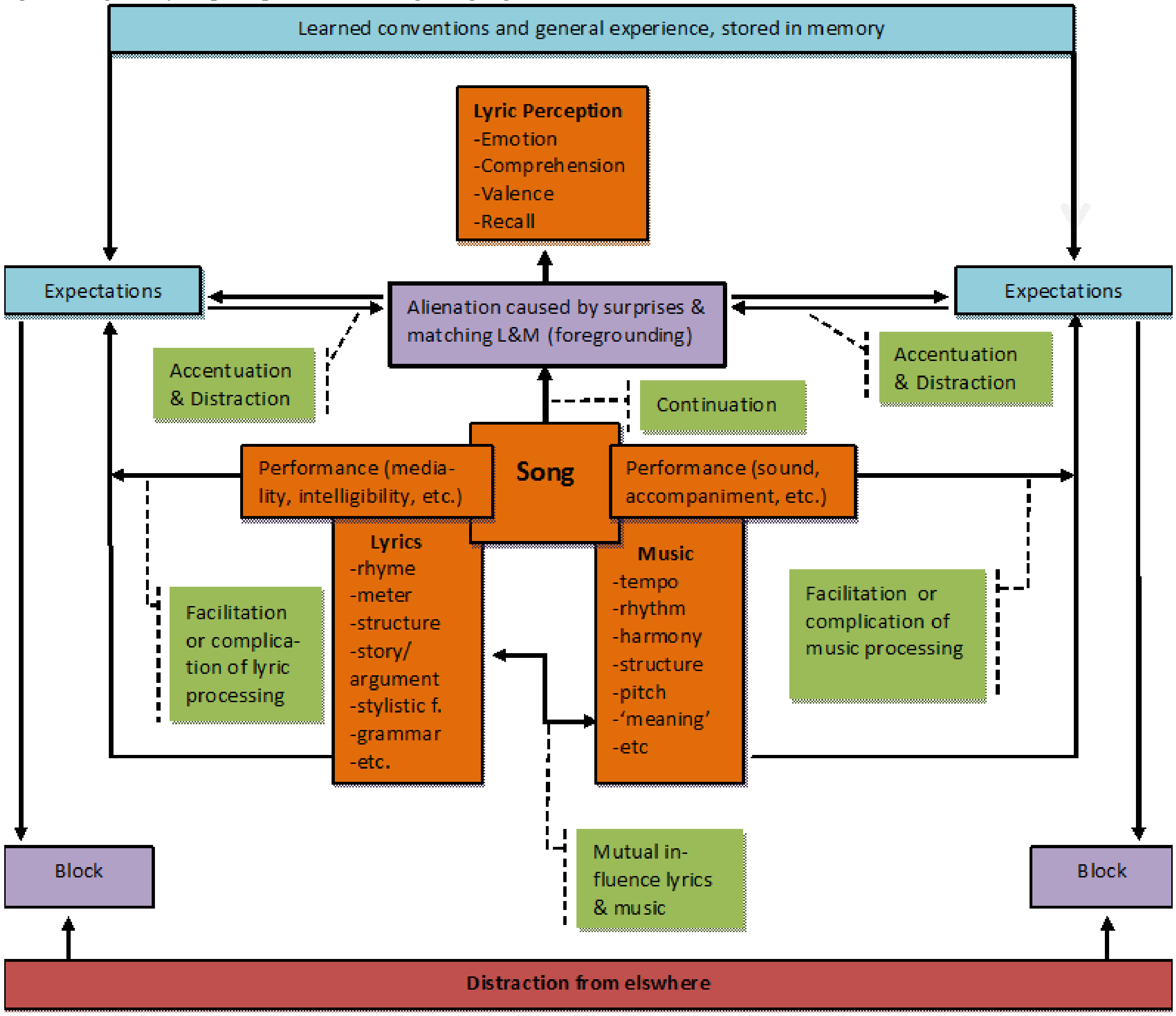

Figure 1. Lyric Perception according to the Musical Foregrounding Hypothesis

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Furthermore, there is an inverted-U-shaped relationship between the amount of foregrounding, and comprehension, valence, recall, and intensity of emotions. Such an inverted-U-shaped relationship is known to exist between complexity and aesthetic valence, also in popular song (North et al., 1995). The exact curve differs from individual to individual, due to poetic and musical experience, taste, interest, etcetera.

The cognitive activities involved in song processing block distraction from the world outside, creating focus on the song. Thus, music processing distracts from the lyrics and puts focus on them at the same time.

During creation, not only composers influence Musical Foregrounding (MF), lyricists can do so too, if only they anticipate the effect of song structure on MF, or carefully construct synchronicities or misalignments between an existing melody and the lyrics. Performance and medialization (Eckstein, 2004) influence foregrounding by facilitating or complicating the processing of music and lyrics.

As the model shows, the processing of textual events, might be distracting too, even to lyric perception. However, that would be the result of linguistic foregrounding not MF. Incidentally, it is important to note that MF has to be distinguished from Foregrounding in Music (FiM). With FiM I mean violations of musical expectations that defamiliarize the music in itself, an effect some composers create deliberately (Kramer ,2002). FiM often causes MF, but not always, and music without FiM does so too.

Please note that in this paper, a song might be any piece of sung language, no matter which genre this 'song' might belong to, although every genre causes specific expectations, and some features (such as harmony) do not play a substantial role in every genre. A piece of language is considered sung when a human voice (or a mechanical imitation of that voice) matches words to music in a non-accidental way.

III. Sub-hypotheses and Support

The idea that music in song obstructs language perception and, at the same time, is a benefit to it, is not new. As early as 1984 Lawrence Kramer wrote about the way Schumann treated poetry in his song cycle *Dichterliebe*: 'The result […] is to defamiliarize utterance; to give it a stylized, even a ritual, quality in which the vocal line becomes an image of speech in much the way a mimed movement is the image of an action. The most immediate impact of song is to convert this dissociated speech-image into an occasion of expressive intimacy.' (Kramer, 1984, 131) According to Kramer this defamiliarization is universal: 'The dissociative, agonic quality of song is inherent in the fusion of words and music – so much so that vocal styles are perhaps best described by the ways in which they attack the text.' (*ibid*, 129) Kramer distinguishes at least two ways in which music impairs lyric perception: decreasing intelligibility, and 'songfulness'. Music is 'songful' when it gets the listener too involved to attend the lyrics, although the music itself is not difficult and the words are perfectly intelligible. I think this phenomenon is a result of Backgrounding in Music (BiM). Backgrounding is the opposite of foregrounding, it is: making familiar (Jacobs, 2015). Nevertheless, BiM might still work as MF in language.

Although Kramer's ideas have inspired several scholars in their approach to song (Eckstein, 2004; Ramazani, 2009), their writings only serve rhetorical evidence for the MFH. Fortunately, several sub-hypotheses derived from the MFH are supported by experimental evidence too.

A. Music Processing Influences Language Processing in a Disturbing Way

In the past decades a growing body of evidence has shown that music processing influences language processing. In several behavioral and EEG studies participants listened to short chord or melody sequences while reading short sentences, or listened to sung sentences. Especially when musical unexpectancies of a syntactic kind (out-of-scale chords or notes, for example), coincide with syntactical unexpectancies in language Event Related Potentials (ERP's) invoked by the music turn out to influence those invoked by the language (Fedorenko et al, 2009; Slevc et al., 2009; Carrus et al., 2012; Kunert et al. 2013, 2014, among others). Furthermore, in these cases reaction time increases and understanding gets impaired, compared to when these unexpectancies occur separately.

An explanation might be the Shared Syntactic Integration Resource Hypothesis (SSIRH) proposed by Patel (2003) and supported by Menon & Levitin's (2003) discovery that (what is called) musical syntax is processed in Broca's area, the same brain region where linguistic syntax is processed. When both language and music compete for the capacity of this brain region it gets overloaded, Patel suggests. An fMRI-study, Kunert et al. (2014), indeed shows interaction in Broca's area.

Another explanation, presented by Perruchet & Poulin-Charronnat (2013), is the hypothesis of a shared general attention resource (SGAR). Although Kunert et al. (2013, 2014) supplie very strong evidence for the SSIRH, an 'SGAR' might exist too. Actually, an SSIR does not account for all the evidence Perruchet & Poulin-Charronnat measured. However, whether there is an SGAR or not, focusing on the language leads to an impaired perception of the music and vice versa (Besson & Schön, 2007; Koelsch, 2011).

In the mean time, more shared resources are detected or indicated. Sammler et al. (2010) showed interactions in several brain regions, associated with, for example, prelexical phoneme-analysis. Lidji et al. (2009) measured interactions between pre-attentive vocal processing and pitch processing. Finally, several researchers found indications for a shared, or related, semantic integration resource (see Koelsch (2011) for a review) (see also section D). It is not clear yet, whether the interactions between language and music shown, should be considered obstructive or beneficial.

Incidentally, the ERP's invoked by musical unexpectancies of any kind (including changes in timbre, timing, tune or intensity, etcetera), always involve 'early negativities', preconscious reactions of surprise, similar to those that Miall (2011) pinpointed as a highly probable cause for the alienation effect of literary language. Since these reactions are preconscious, it is very unlikely that listeners are able to

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distinguish between sources, so the alienation effect of music-invoked surprises, will probably attribute to the de-familiarization of language too. Moreover, repeated exposure will not decrease these alienation effects severely, because at least harmonic surprises are less sensitive to habituation than linguistic or visual ones (Bigand et al., 2005).

A clear detrimental effect of music on lyric perception was measured when strong misalignments occur between musical beat and prosodic stress (Gingold & Abravanel, 1987; Gerard & Auxiette, 1981). An explanation for this is offered by the Dynamic Attending Theory (DAT), developed by Jones (1976; Jones & Boltz, 1989; Large & Jones, 1999). DAT suggests that attention pulses rhythmically in such a way that it is maximal when we expect the most important events (like beats in music), implying that attention is minimal off beat. Thus, major linguistic events (like stressed syllables or phrase boundaries) occurring off beat, might remain relatively unnoticed or create confusion. Nevertheless, misunderstandings through misalignments might be partially explained by linguistics too. In the first place, prosodic stress is, at least in English, more important for word recognition than phonemic accuracy (Field, 2005), and in the second place accents are important for syntactic structure and semantics too, at least in German and Dutch (Schmidt-Kassow et al., 2011; Burholt Kristensen et al., 2013).

Experimental support for Kramer's claim that singing, especially melismatic singing, decreases intelligibility is found by Johnston et al. (2014) and Collister & Huron (2008).

Finally, in lyrics the singer determines 'reading' pace, and the listener cannot look back or forward, unless a printed copy is at hand. Thus, according to Bakker (2006) lyrics are perceived as sequences of almost isolated phrases, not as a fluent whole. Such a constrained moment-by-moment perception is often supposed to impose constraints to the perception of narrative and rhetoric structures in lyrics, and to the processing of complex poetic language too (Bakker 2006; Rubin, 1995). Several studies indeed indicate that listeners respond to local features in music, not to structural ones, and are less sensitive of the bigger structure (see Rolison and Edworthy (2013) for a review). Moreover, Johnston et al. (2014) found an unexpected decrease in the intelligibility of sung rhyming words when presented outside a context, and attributed this to an increased call upon working memory. So it seems to be more demanding to connect and compare consecutive events when their succession is delayed through singing. However, to what extent this really imposes constraints (or opportunities) to language in lyrics is unclear.

B. Music Processing Influences Language Processing in a Beneficial Way

Often, the same studies and theories that support the hypothesis that music processing obstructs language processing, support the hypothesis that music benefits from it too, although not always in the clear causal way the MFH predicts.

1) Dynamic Attending. In the first place, DAT supposes that linguistic events that coincide with strong beats, get a maximum of attention and, thus, will be perceived optimally. Several studies support this hypothesis (Poulin-Charronnat et al., 2005a; Brochard et al., 2013; Gordon et al., 2011; Carrus et al., 2012; Gingold & Abravanel, 1987, among others). Therefore, it is quite confusing that some researchers in these papers refer to their musical stimuli as background music. I think it is very important to distinguish between real 'background music' and carefully 'matched music' sounding in the background.

Although it might seem that there is no alienation involved when dynamic attention benefits the perception of on-beat events, I think there is. Matching language to a beat, always causes a way of patterning that is strange to normal prosody; every-day language is simply not isochronous. Even non-musicians might create roughly the same text settings for various sentences to a given beat, but several sentences force them to violate at least one of the hierarchical set of rules they appear to follow (Hayes, 2009). Furtherrmore, even if musical stress is matched perfectly with lexical stress, text setting might have changed relative stress significantly, because syllable length and note length, might differ completely, causing a distribution of stressed syllables over stronger and less strong beats that accentuates other syllables than speech does, and so do melodic, harmonic and durational accents. This is illustrated very well by the difference between the proposed text setting of the well-known song, *Moon of Alabama*, by lyricist Brecht, and the final text setting by composer Kurt Weill (Weill, 1990, 66-67), stretched over several extra measures and scale tones. It is an example of the way both authors tried to both alienate their art and stay true to the prosodic gesture of the text. Eventually, I think, evidence of enhanced language perception in on-beat syllables is evidence for the plausibility of the MFH.

Of course stronger support for the MFH would be found if major events occurring off-beat would turn out to impair and benefit language perception at the same time. Fortunately, some of the DAT-related studies show enhanced processing of off-beat linguistic events that violate the rules of language, such as invalid word segmentations (wo/rse) or syntactically or semantically incongruent words (Brochard et al., 2011; Carrus et al., 2012). Similar results were found by Curtis & Bharrucha (2003) although they did not create a beat to recruit dynamic attending. Instead, they only used one single chord to set up harmonic expectations for a next chord to come. If the next chord came up to these expectations it was hypothesized to require a minimum of attention and thus benefit language processing, if it was unexpected, it was hypothesized to be distractive (see also, Poulin-Charronnat et al., 2005). In the end, expected chords indeed enhanced word recognition, but unexpected chords enhanced non-word recognition.

Possibly, the musical surprises Ting & Thompson (2012) created, also functioned as off-beat surprises that both impair and enhance language processing at the same time. Ting & Thompson worked with short melodies with only one accent and no clear beat, so the accents where totally unexpected, and words presented along with those accents lack the benefits of dynamic attending. Thus, contrary to the authors' expectations, these words turned out to be remembered badly. On the other hand, words preceding or following the accent were remembered very well and led to the overall conclusion that

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music benefits recall. Possibly, these outcomes are indebted to the increased arousal and attention music is supposed to evoke; however, the researchers think that they are the result of forward and backward priming caused by the accents. Alas, because of lack of control measures, the evidence is not decisive enough for this conclusion.

DAT seems to support several mechanisms suggested by lyric-writing coaches too, or at least the related concept of Dynamic Expectation (DE) (Huron, 2006) does. In the first place, Bakker (1998, 2006), Pattisson (1991, 2009) and I (Schotanus 2007), in line with Huron (2006, p227), suggest that rhyme serves online-processing of song lyrics because it marks line endings (not visible in song) and it creates expectations about what and when to come, thus grabbing attention, enhancing intelligibility, structuring information, and opening up the opportunities to create surprises. Moreover, like Pattison, I think, these surprises accentuate the deviant words, lines and sections. Hoorn (1996) indeed detected an increased cortical activation (an N400) when a non-rhyme occurred where a rhyme was expected. However, I do not agree with him that these results indicate that only non-rhymes affect semantics. To conclude anything like that, non-rhymes in rhyming poems have to be compared not only with rhymes in rhyming poems, as Hoorn did, but also with both rhymes and non-rhymes in non-rhyming poems, and with surprising rhymes (early, extra, or delayed ones) in rhyming poems. Moreover, all line-endings in rhyming lyrics should be compared with those in non-rhyming ones. Anyhow, McGlone & Tofighbakhsh (2000) already found that, at least in aphorisms, rhyme really affects semantics, making the aphorisms more convincing.

According to both Pattison and me, line lengths, stanza forms and overall song-structures, also cause dynamic expectations. We think that these expectations enhance online-processing and foreground certain words and lines within the created pattern, but also create the opportunity to be violated, and foreground surprising words and lines even stronger. Because of the singer-paced moment-to-moment perception of lyrics, I think the effects of DE will be much stronger in song than in reading, because reading short texts such as lyrics hardly takes any time, and the reader can take in the whole text at a glance, at least the formal aspects of it. Moreover, the effects of DE will be stronger in song than in recitation, since singing is slower than speaking, and music, by being isochronous, facilitates DAT.

The key concept in Pattison's writing is balance. Song, in his view, is basically binary, so every set up asks for an equally shaped continuation. The expectations, thus risen, function in a similar way as music, comparing 'deceptive rhyme schemes' to deceptive cadences and the resolution strength of various rhyme types to the resolution strength of different chords. At least Western songs and metrical poems indeed seem to be dominated by hierarchical binary forms (Aroui, 2009; Spyropoulou Leclanche, 1998).

In my own writing the basic idea is that music is a game of repetition and surprise, and that sung lyrics are part of that game. The combination of text and music leads to a set of wellformedness rules, governed by listeners' expectations, that are in line with Ollen & Huron (2004) and Huron (2013), but in addition explain why listeners do expect ABAB-patterns in songs (Rolison & Edworthy, 2013, Tsai et al., 2013), whereas they do not expect these kinds of patterns in instrumental music (Ollen & Huron 2004, among others). I do not think these expectations are only a matter of cognitive knowledge about popular songs, that would not explain the actual variation in song forms (Schotanus 2007). In line with Huron (2013), I think that song forms, like all music, are ruled by strategies to create patterns of repetition that take advantage of the positive effects of repetition while minimizing boredom. Differences occur because language is more sensible to habituation as music (Margulis, 2014), and the sections created by combinations of text and music are quite big, and bigger patterns tend to be repeated less often than smaller ones (Huron 2013). Presumably, because of the fact that repeated exposure decreases repetition recognition in small patterns, but increases repetition recognition in bigger ones (Margulis 2014, 8-9).

Thus, my Repetition and Surprise Hypothesis (RAS) leads to the following set of rules, governing tension, surprise and boredom in songs:

1 New text-language combinations raise tension, and lead to a need for repetition (predicting AAAA forms).

2 Repetition of a text-language combination leads to a need for surprise (predicting AAB and AAAAAB forms),

3 A surprise leads to a need for repetition (predicting AABA and AABABC(A)B forms).

4 If a surprise does not come up soon enough, it will not be expected anymore (predicting that AAAAB leads to a bigger surprise than AAB)

5 Repetition is more likely to occur in the beginning of a song, surprises tend to succeed each other more quickly toward the end of a song (predicting that ABCABABB, and ABAAA are less likely than AABABCAB and AAABA, as measured by Ollen & Huron, 2004)

6 In AAA forms, longer A sections tend to consist of two contrastive parts (predicting medieval Bar form (AAB))

7 Repetitions and surprises, especially deviant ones, have to be motivated by song content (a rule derived from the MFH, see also section D).

According to Bakker (2006) repetition in song benefits on-line lyric processing not only by serving expectations about what to come, but also by strengthening short-term memory. Rhyme, or any other repetition, brings back in mind the word, the line, or the stanza it refers to. This would alleviate the effects of the constrained moment-to-moment processing in song. Incidentally, although this line-isolating process might impair the processing of a text as a whole, according to Bakker it empowers individual lines, making banal phrases sounding new. This might also partly explain the power of strong verbal hooks and refrains, even if the rest of the lyrics are weak.

2) Harmonic interaction. It is difficult to say whether the interaction between linguistic and musical syntax might benefit language processing in certain cases. Most studies just show detrimental effects, and measure no changes in the N400, an ERP associated with semantic activity. However, according to the MFH, distracting musical events should be able to make sense, at least in situations where, in speech, prosodic stress

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makes the difference. This would be the case in ambiguous sentences (like those used in Speer et al. 1993), in broken sentences such as ‘I would like a - That’s my apple!’, or in sentences like those created and validated for SSIRH-related studies by Featherstone et al. (2012). Alas, the majority of SSIRH-related studies do not use this kind of sentences.

The garden path sentences several researchers use, might show beneficial interaction too, if only the target combinations of music and words were chosen earlier in the sentence. Researchers normally choose the word that first indicates the need for syntactic or semantic reinterpretation. For example, in the sentence ‘After the trial the attorney advised the defendant was likely to commit more crimes’, Slevc et al. (2009) chose ‘was’ as their target. But by then the wrong path has been taken already. What if the word that set up the garden path, ‘advised’, was accompanied by an unexpected chord? Maybe the reader would have been alarmed, and would not have been misled. Sentences with an object-extracted relative clause such as the ones Fedorenko et al. (2009) use to avoid garden path effects, cause more or less the same problems. The authors compared sentences such as ‘The boy that the girl helped got an A on the test’ with syntactically easier ones like ‘The boy that helped the girl got an A on the test’ (containing a subject-extracted relative clause). They had them both sung on the same melodies, once with an in-key note on the sixth word, once with an out-of-key note on it. This design creates strong misalignments between prosodic stress and musical stress, with the weaker syllables ‘the’ and ‘helped’ in on-beat position, and ‘helped’ getting an extra ‘out-of-key’ accent, whilst a strong accent on ‘girl’ is an important prosodic cue to be able to make sense of this sentence. No wonder the comprehension of this kind of phrases is impaired. What if ‘girl’ was given the ‘out-of-key’ accent? I think, some of the misalignment effects would have been alleviated, and comprehension would have been improved. Incidentally, relying on the graphs in the study, the out-of-key accent on ‘girl’ in the easier sentences did result in a an increased comprehension accuracy, although it might not be significant – the authors did not mention it.

Curtis et al. (2005) did report significant interaction between musical manipulations and comprehension. In sentences such as ‘As the child ate the cake baked in the oven’, they chose ‘baked’ as their ERP-target, but they manipulated the music matched with ‘ate’ and ‘the’. They coupled these words to either a subdominant and a dominant, creating motion, or to two tonic chords, creating a sense of closure and new beginning. The MFH would predict that such a break, in the accompaniment of an ongoing sentence, would function as a pause in speech, or a comma in writing; in this case preventing the garden path. The double-tonic condition indeed turned out to benefit interpretation and to suppress the EEG-amplitude on ‘baked’.

3) Rhythmic interaction. The interaction between rhythmic manipulations and language processing ought to be investigated too. Honing et al. (2009) detected a mismatch negativity in so called ‘loud rests’ (on-beat silences). Since several singers are famous for their timing, it would be very interesting whether this mismatch negativity influences language processing or is influenced by it in a delayed or accelerated, thus syncopated, syllable onset, or a within-phrasal loud rest.

4) Auditory Processing. A completely different way in which music might support language is enhancing auditory processing. As Patel hypothesized in his OPERA hypothesis (Patel, 2011, 2014), music might cause beneficial changes in speech processing networks in the brain, if:

‘1 A sensory or cognitive process used by both speech and music is mediated by overlapping brain networks.

2 Music places higher demands on that process than speech

3 Music engages that process with emotion, repetition and attention.’ (Patel, 2014)

Growing evidence for such music-invoked changes in neuroplasticity, beneficial for linguistic processing, is supplied by studies concerning the perception of plosives and syllable-onsets. In the first place musical training seems to increase the neural representation of these phonemic phenomena, and in the second place dyslexic children and adults show impaired mental representations of them (Huss et al., 2014, among others). Of course, changes in neuroplasticity are long-term effects, so they have nothing to do with MF; moreover, Patel (2014) hypothesizes that even non-verbal musical training might benefit dyslexic children. Nevertheless, several studies, including the two mentioned above, support the idea that music might also evoke short-time effects on linguistic skills, by enhancing auditory processing, especially in the shape of song (Ludke et al., 2013; Lim, 2010; Schön et al., 2008; Zumbansen et al., 2014a, among others). These studies, concerning literacy education, foreign language learning, and music therapy for people suffering from aphasia or autism spectrum disorder (ASD), do indicate MF.

Music in song paces tempo (sung language is, on average, much slower than spoken language), supports expectations concerning syllable onset (timing), and lets vocals sound to a steady pitch, whereas, in speech, pitch changes continuously (Patel, 2014). These three qualities make it easier to perceive the different sounds relevant to a language. Thus, music supports word detection in, and pronunciation of a foreign language (Schön et al., 2008; Karimer, 1984, among others), just as the musical language called motherese supports native language learning in neonates (Thiessen et al., 2005). How can this be consistent with the fact that singing impairs intelligibility? The explanation might be that this impairment is due to performance not to perception, or to distraction by the music, or that intelligibility might be impaired but that acoustic processing on a deeper level is enhanced, for example because of the activation of certain brain areas.

Music, just as motherese, also exaggerates prosodic cues, such as pitch range, and singers, like all musicians, tend to deviate from a prescribed score in a way similar to acoustic enhancement in speech (Sundberg, 2012). They accentuate dynamic, harmonic, melodic, and especially grouping accents (phrase boundaries) (Drake & Palmer, 1993), by singing them louder, lengthening and shortening prescribed note lengths, or adding small breaks. So if linguistic prosody fits in with musical prosody, musicians will automatically accentuate it.

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Moreover, singers tend to correct misalignment by manipulating note-lengths (Palmer & Kelly, 1993).

Furthermore, songs often contain repetition and rhyme, accentuating sound, and supplying a kind of natural practice (Patel, 2014). Incidentally, because singing relies on vocals (Kolinsky et al., 2009), and rhyme is mainly vocalic, I think, rhyme will be accentuated by music too. An effect that will even be amplified by dynamic attending, because rhyme mainly occurs in stressed syllables.

Of course, musical prosody not always supports language perception. A lot of singers accentuate musical features by transforming vocals, or creating unnatural accents in language; for example, a pitch leap on a phrase-ending weak syllable, is very difficult to sing as subdued as required. Furthermore, the emphasis on the sound of language, might sometimes distract from the meaning of it, leading to songfulness. But still, because MF accentuates all kinds of auditory aspects of language, I think song is, under certain conditions, very useful in education: for example, for the introduction of rhyme, the improvement of spelling, prosody and pronunciation in foreign languages, and for the introduction of difficult new words to children with dyslexia in first language classes.

5) *Melodic Therapies.* The very close relationship between musical patterning and linguistic prosody seems to support language learning in children with ASD too. Children with ASD often reproduce melodic and rhythmic patterns very easily, even when they do not speak. Lim (2010) uses this talent in a speech-therapy for those children. Especially severely impaired children improved better when phrases with target words to be learned where presented with music than without. Tindell (2010) reported similar results for a related therapy: *Precision Songs.* These successes are partly based on the fact that the human brain almost perfectly represents left-out parts in familiar musical stimuli (Kraemer, 2005), as if they actually sound. However, music not only served as a mnemonic. The participants could not only fill in left-out words, they could even use them in functional speech. So, the music seems to accentuate important linguistic cues. Another explanation for the effect of this kind of therapies on natural speech, might be that music activates mirror neurons in Broca's area better than speech does (Wan, 2010).

In Melodic Intonation Therapy (MIT) and related therapies for people suffering of Broca's Aphasia, music is used to teach the right hemisphere to adopt left-hemisphere speech skills, although several therapists seem to have dropped the right-hemisphere directed parts of the therapy. Whether the successes of these therapies might be due to musical accentuation of linguistic features, or just to the activation of other neural networks is not clear yet. However, both rhythm and music can account for the beneficial effect of MIT on speech in Broca's Aphasia (Zumbansen, 2014).

C. Music Benefits Memory for Song Lyrics

A huge amount of studies in various disciplines concern the supposed benefits of music for verbal memory. Studies concerning the effect of musical training or background music on verbal memory; and studies concerning the effect of rhythm, melody, rhythmic grouping, matched background music, song or song structure on verbal memory or digit memory. For evidence supporting the MFH only the last group of studies is of interest.

All of these studies show that a matched rhythm benefits memory. Jingles work (Yalch, 1991); recall of curricular information improves significantly when worked up in songs (Powhida, 2008; Chazin & Neuschatz, 1990, among others); recall of (seemingly) unrelated items such as the letters of the alphabet, the words of a foreign language, or the digits of a telephone number, improves when presented in rhythmic groups, in a song, or just grouped by a regularly returning beep (Medina, 1994; Rainey & Larsen, 2002; Dowling, 1973); and recall of song lyrics improves when the rhythmic patterning fits in with the rhythmic patterning of the music (Gingold & Abravanel, 1987; Gerard & Auxiette, 1981). Several factors seem to be involved: DAT, rhythmic grouping, and a prosodic fit, all of which are in favour of the MFH. The rhythmic structure that music adds to language supports chunking, and DAT supports an enhanced perception of the main events. Since positive emotions are known to increase memorization, the strong effects of rhythm on recall is further explained by the fact that rhythm processing evokes pleasure and a dopamine reward (Menon & Levitin, 2005).

The role of melody in memory is less clear. Wallace (1994) was long thought to have found strong evidence for a memory-supporting role of melody, until participants in an experiment of Kilgour et al. (2000) gained similar results with slowly spoken texts. However, Ludke et al. (2013) and Thiessen & Saffran (2009) checked for tempo and found a significant advantage for melody. Ludke et al (2013) checked for rhythmic speech too.

Still, several studies show contradictory effects of melody on memory. The outcomes of Wallace's (1994) experiments, for example, suggested a beneficial effect of familiar melodies and a detrimental effect of new ones. However, Purnell Webb & Speelman (2008) could not replicate Wallace's findings. They found a beneficial effect of music, with or without melodies, both familiar and new. Other studies supported the hypothesis that learning new melodies and words at the same time would impair immediate recall, but would support long-term memorization. Moussard et al. (2014) indeed showed that an unfamiliar melody improved long-term retention, especially in patients suffering from Alzheimer's Disease.

These findings are consistent with the observation that verbatim recall for melodies improves in time, while recall for language decreases (Dowling & Tillman, 2014). On the other hand: lyrics are easier recognized than melodies (Peretz et al., 2004), due to the fact that words are more unique than pitches, and linguistic rules are very restrictive. So it might not come as a surprise that lyrics are reported to support musicians and dancers dealing with very difficult melodies. The medieval monk Notker Balbulus wrote syllabic texts as a mnemonic for difficult melismatic melodies (Winn, 1981, 59), and Bavarian Zwiefach dancers use the lyrics of the songs to anticipate the irregular rhythm changes in this complicated folk dance

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(Hanna & Veterle, 2009). Peretz et all. (2004) indeed found a mutual priming effect of melody and text in memory for songs.

It would be interesting to investigate how melodic and rhythmic phrasing and linguistic prosody interact in chunking, and how musical and linguistic link chunks to one another. The MFH would predict that the better linguistic prosody is accentuated by musical prosody, the better a song will be remembered. The experiments Purnell & Speelman (2008) conducted indeed indicate something like that. However, even in 'lyrics' that only contain random numbers, melody not only supports memory for lyrics, but lyrics support memory for language too (Thiessen & Saffran, 2009).

Sometimes melody and lyrics seem to be stored in memory as a unity, in which language is just a meaningless stream of sounds (Serafine et al., 1986). However, studies such as those performed by Besson et al. (2008) and Peretz et al. (2004) showed independent processing. Furthermore, the experimental results found by Peretz et al. (2004), Ludke et al. (2013), Lim et al. (2010) and Powhida (2008), among others, indicate recall of at least semantic and prosodic information too. In education music sometimes is supposed to enhance recall of conceptual or narrative information too, or even to prime recall of a whole lesson. Msila et al. (2013) indeed seem to serve evidence for that, but in the successful history lessons they observed, the songs were used to inspire such different teaching formats, that it is very difficult to distinguish between the effects of songs and teaching formats.

Ultimately, the MFH supposes that songs might be initially stored as meaningless sound streams, but are thus always accessible for attended 'listening', and that once attended, valenced and interpreted, the alienated language of song lyrics will be stored separately too, and memorized even better.

Several findings indicate that, apart from rhythm and melody, song structure affects memory too. This concerns textual structure as well as musical structure. In the first place there is rhyme. Rhyme is long thought to serve as a mnemonic device for singers and for story tellers in the oral tradition (Rubin 1995), and for music industry to benefit sales, because rhyme would support retention in people's minds (Yalch, 1991). Tillman & Dowling (2007) indeed proved the positive effect of rhyming poetry on recall for texts, which they attribute to the rhythmic, musical aspects of those texts (rhyme and meter). However, the fact that these aspects limit lexical freedom of choice anywhere in a song supports recall too (Manin 2013; Rubin 1995).

Song structure also benefits memory because of the working of genre-specific schemas (Rubin, 1995), the amount of repetition and the division in contrastive sections. Repetition is well-known to enhance memory (Patel, 2014), and might even benefit recall if only the melody is repeated and te words are new (Wallace, 1994). Although Wallace's findings are not replicated yet, and a first verse is usually recalled better than a second or a third (Neath & Brown, 2006), it might still be easier to remember a second verse on the same melody than a second verse on a new one.

The division of songs in contrastive sections might enhance memory because it enhances chunking, thus enhancing memory for first and last lines. Furthermore the division in contrastive sections facilitates real repetition without boredom, in the shape of a chorus alternated with verses.

D. Musical Meaning Affects the Meaning of Words

During the last two centuries the mere existence of musical meaning is often debated. However, in the last decades several studies have shown that musical meaning really does exist. (see Koelsch (2011) for a review). Words primed by unrelated short musical excerpts or single chords elicit an increased N400 compared to related chords and excerpts, and vice versa. Huron (2006) shows that musical tension, stability and surprise evoke meaning. Paquette et al. (2013) created a validated set of musical stimuli evoking different emotions. Experiments such as Fritz et al. (2013) indicate that the association between certain musical features and basic emotions such as happiness, sadness and fear are universal. And advertisers successfully use music to express brand characteristics and product features (Brodsky, 2011).

Repetition is known to create emotion and meaning too. Repetition in language does, but repetition in music does so in a very special way, although it might distract from verbal meaning at the same time (Margulis, 2014).

Of course, musical meaning originates partly from associations (with artists, scenes, countries, personal memories, advertisements, etcetera) but nevertheless it is undeniable. Musical meaning often is prosodic like motherese. Therefore, scholars suppose consider popular music adolescent motherese supporting foreign language learning (Eng, 2013).

The MFH states, in line with interpretation practice (Kramer 1984, for example), that musical meaning affects the interpretation of lyrics through binding by synchrony (Large and Jones, 1989). Furthermore, in line with Pattison (1995, 2009) and Spyropoulou Leclanche (1998), the MFH states that musical structure will facilitate the processing of narrative and associative leaps on section boundaries, and will activate or empower the poetic function of language (Jacobson, 1980) emphasizing parallels and contrasts through melody.

Of course, lyrical content affects musical meaning too (Graekjaer & Jantzen, 2009). However, in these cases also the meaning of the words changes.

E. Music supports attention to song-lyrics

Although music processing distracts from lyric processing, it aids lyric processing at the same time, because it induces attention, arousal and emotion (Menon & Levitin, 2005), and blocks distraction from the world outside, creating focus. For many scholars the supposed attention-raising effect of music is one of the main reasons to use song in a class room (Engh, 2013; Goering & Burenheide, 2010). However, although song might indeed raise attention, the content still might get lost. Nevertheless, Wolfe & Noguchi (2009), among others, really measured a positive effect of song on attention and learning.

F. Performance and mediality affect lyric processing

The MFH states that where, when and how a song is played affects lyric perception. Sound quality, the availability of printed lyrics, the listeners' mood, and the context all influence intelligibility, listeners' expectations, listeners' attention, etcetera, thus facilitating or disturbing lyric perception. Therefore, dance music allows (or demands) more repetition than a theatre song, and an album track of a progressive-rock band allows more complex language than a teen-star hit single. The accompaniment also influences both perception and production of music. According to Byrne (2012) the emergence of rap, for example, with its relatively complex lyrics, was facilitated by the fact that the pitch range of the accompaniment of hip hop music does not interfere with the pitch range of the human voice.

The MFH predicts that, in principle, accompaniment that defines rhythm and harmony, and empowers the melody with a certain sonority, will enhance musical processing and reduces musical foregrounding effects. Hence, the lyrics of a song sung a cappella by a single voice might be more difficult to perceive than the same lyrics sung by the same voice, but accompanied by a piano or a guitar. The results of an experiment conducted by Silvermann & Schwartzberg (2014) point in another direction, but their stimuli where very short and did not contain loud rests, or harmonic ambiguities, so music processing was not difficult anyway. However, sonority did matter it seems, because a male voice and a piano induced better perception than a female voice and a guitar.

The idea that a harmony defining accompaniment will enhance music processing suggests that a melody implies a certain harmony, which is shown to be the case at least in Western tonal music (Kim 2014). The results of an experiment conducted by Poulin-Charronnat et al. (2005) indicate that accompaniments indeed influences harmonic processing.

For education it might be important to investigate what kind of presentation supports learning best. Presenting a fully printed text while the song is played, might enhance conscious attention to the lyrics, but on the other hand might distract from the singing, and might damage the benefits of dynamic expectation. Would a lyric video be better, viewing just a few words or lines at once, or do you have to play the song first and present the full text afterwards?

IV. CONCLUSION

In this paper I have presented the Musical Foregrounding Hypothesis (MFH), and an MFH-based model for lyric perception. The MFH states that music, like stylistic features, both obstructs and enhances lyric perception at the same time. The MFH tries to explain, for example, why music sometimes seems to amplify the strikingness of certain lyrics, but often reduces them to mere sound.

Evidence and theories from various disciplines support the MFH. In return the MFH sheds new light on several academic and practical topics such as the shared-resources debate, the use of song in therapy, advertisement and education, song structure, and the poetics of song lyrics.

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Reconsidering expectancy and implication in music: The Veridical Chaining hypothesis

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ABSTRACT

Background

Expectation and implication (EI) are related phenomena that have important applications for how we process music. They allow us to understand how we listen to music and how music is organised in terms of predicting one musical piece of information based on (usually the previous but in more general terms) another piece of musical information. Among the most influential theories of these phenomena are (A) the implication-realisation models, driven by gestalt principles in a bottom up manner, drawing on the way the perceptual system generates meaning from patterns and (B) emergent principles as a result of exposure to regularities in music that can be thought of as style or schemata, and which impose EI in a top-down manner.

Aims

This paper aims to present an alternative approach, which takes a step back from general rules/principles outlined above. Instead, this paper proposes the idea that the most expected event to happen in a piece of music is what actually happens for the particular piece of music under scrutiny—that is, the veridical expectation—regardless of the extent to which it satisfies gestalt or schemata driven likelihoods. Of course, this means that the listener must be familiar with the music, and so it does not in an obvious way explain how new music is processed.

Main Contribution

The solution proposed is that the new incoming music is segmented and matched with existing representations where possible. In parallel distributed processing parlance, upon which this hypothesis is based, it is similar to the 'nearest neighbour' solution. When no reasonable match can be found, the piece requires additional coding, such as further exposure, to allow new mental representations to become established. When segments are established in mental space they are then linked together to form new representations of the piece, but the connection with the earlier source-match is also retained (shared). The linking of the different segments that leads to the representation of the new piece is referred to as veridical segment cross chaining, of 'veridical chaining'. As one is exposed to more and more music, the network becomes more intricate and complex. However, the simple principle of matching segments provides the unifying thread of the hypothesis.

Implications

The hypothesis has several implications, three of which are: (1) Music analysis could focus on tracing the origins of a musical information unit – e.g. a melodic fragment, a particular rhythm pattern, a particular timbre – for a typical or specific individual, rather than assuming that all listeners enact the currently adopted rules of music theory and generalised psychological principles of top down and bottom up processing. (2) The long and/or complex lists of rules/principles of existing EI theories can be replaced by the single, simple principle of Veridical Chaining which then weaves itself into a vastly complex network, but fundamentally based on the single principle. (3) Veridical Chaining does not need to be in operation at the exclusion of other theories. It is quite likely that the developing network will lead to similar emergent top down principles found in those theories (B, above), although bottom up gestalt principles do present some incongruity.

Other possible limitations of the hypothesis are discussed, and examples are provided that argue for its utility.

Keywords

Expectancy; implication-realisation; parallel distributed processing; mental organisation of music; music theory; music perception

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The effect of microtiming on body movement behavior when listening to swing or funk music

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ABSTRACT

Background

The *Theory of Participatory Discrepancies* (PD theory) claims that minute timing discrepancies (PDs) arising in music performance are relevant for triggering the groove phenomenon (Keil, 1987, 1995, 2010). Groove is said to have a positive effect on the emotions of listeners and to enhance their bodily entrainment with the music (Doffman, 2008; Pfleiderer, 2010). Previous empirical research does not offer any evidence to support PD theory. Butterfield (2010) and Madison et al. (2011) reported that different PD magnitudes had no impact on listener reactions. Frühauf et al. (2013) und Davies et al. (2013) found that music with PDs received lower groove ratings compared to music with perfectly quantized timing.

Aims

The present study tested the effects of the scaling of PDs on the body movement behavior of listeners. It tested whether listeners reacted differently when listening to Swing or to Funk music. It also tested whether expert listeners reacted differently than non-expert listeners.

Method

Two internationally renowned music professionals, a bassist and a drummer, recorded a Swing (150 bpm) and a Funk (100 bpm) pattern during several minutes. Both musicians heard a metronome click as a timing reference over headphones. From the recordings, they chose the passages that they considered to have the best groove. From these passages, the experimenters selected a clip of 20 seconds' duration for each style.

The onset timing of the drum events was extracted with sub-millisecond precision using the *Massey Drum Replacement Tool*. Then the drum tracks were recreated on a sample basis, so that the timing could be manipulated without audible artifacts. The bass line was manipulated using the stretching algorithm of *Avid ProTools*.

Two series of six music clips were created for each style. In one series, the PD magnitudes of all recorded events were reduced (scaled down) by 0%, 20%, 40%, 60%, 80% and 100%. The clip with a PD reduction of 100% had perfectly quantized timing: all event onsets occurred exactly on the metronomic grid. In the second series, the PD magnitudes were expanded (scaled up) by 0%, 20%, 40%, 60%, 80% and 100%. In the clip with a PD expansion of 100%, the timing difference between every event onset and the metronomic grid was doubled.

160 participants (mean age = 24 years; 75 female, 85 male) were divided into two groups according to musical expertise: 80 participants were considered to be music experts because they were either professional musicians or students enrolled in professional music training. The remaining 80 participants were considered non-experts.

Participants were randomly assigned to listen to either the Swing or the Funk clips. Random processes were used to establish whether the participant would first hear the series with reduced or with expanded PD magnitudes. The sequence of the six stimuli within each series was also randomized.

Participants took the test one at a time in a quiet office. They were guided through the test by a *Neurobs Presentation* script on a computer screen. They triggered the playback of the stimuli themselves by clicking the mouse. Between series, the participants filled the PANAS questionnaire.

The participants heard the music clips over studio headphones. A yellow ping-pong ball was mounted on top of the headphones' frame. Two cameras, located frontally at angles of $-45°$ and $+45°$, filmed the participants during the listening task. The *Mikromak WinAnalyze* motion tracking software was used to determine the trajectory of the ball in space with a precision of 2 mm and with a time resolution of 40 ms. The first and last 2 seconds of the 20 seconds of motion data were systematically cropped in order to remove data noise (many participants shifted their upper body backwards after triggering the playback, and they leaned forwards to grasp the mouse at the end).

For each listening event, the periodic head movement intensity on the double-beat frequency (Swing: 1.25 Hz; Funk: 0.83 Hz) was retrieved from the cropped motion data, using the *FFTW* fast Fourier transform library. The data of 159 participants (1908 cases) were valid. The motion data became approximately normal after a log-transformation; Levene's test and Mauchly's test were non-significant.

Results

A four-factor mixed-design ANOVA was performed. DV was the *Periodic Head Movement* intensity on the double beat frequency. There were two between-subjects IVs: *Expertise* (expert, non-expert) and *Style* (Swing, Funk). And there were two within-subjects IVs: *Direction* of PD manipulation (reduction, expansion) and *Δ-Magnitude* of PD manipulation (0%, 20%, 40%, 60%, 80%, 100%).

The omnibus ANOVA showed a significant *Expertise* × *Direction* × *Δ-Magnitude* interaction ($p = .001$). When the dataset was split according to the *Expertise* groups, the expert listeners (see Fig. 1) showed a significant *Direction* × *Δ-Magnitude* interaction ($p < .001$). No significant effect was measured in the non-expert group.

When the data of the expert listeners was split according to the levels of *Direction*, the reduction subset showed a significant effect for *Δ-Magnitude* ($p = .005$). Tukey HSD reported a significant effect between the 60% ($M = 3.34$) and

80% ($M = 2.97$) reduction levels ($p = .012$, $d = 0.39$). Another significant difference was measured between the 60% ($M = 3.34$) and 100% ($M = 2.93$) reduction levels ($p = .004$, $d = 0.42$). The music clips with fully quantized timing triggered significantly less periodic head movement in expert listeners than the music clips with the original PDs reduced by 60%. No significant effect was measured within the expert listeners' expansion subset.

When the data of the expert listeners was split according to the six levels of *Δ-Magnitude*, three subsets showed significant effects between the two *Direction* levels: the 60% reduction level ($M = 3.34$) had a significantly higher mean than the 60% expansion level ($M = 3.01$, $p = .011$, $d = 0.33$). Conversely, the 80% reduction level ($M = 2.97$) had a significantly lower mean than the 80% expansion level ($M = 3.29$, $p = .004$, $d = 0.38$). Also, the 100% reduction level ($M = 2.93$) had a significantly lower mean than the 100% expansion level ($M = 3.32$, $p = .001$, $d = 0.41$). All significant effect sizes were small to medium ($0.33 \leq d \leq 0.42$).

Conclusions

The results of this study offer partial support for PD theory. The scaling of PDs had significant effects on the body movement behavior of listeners. But these effects were only measured for music experts, and they were rather small in size. Quantized or deadpan timing (PD reduction by 100%) had a smaller entrainment effect on the experts than performed timing that was "tighter than life" (PD reduction by 60%). This result is in opposition to the findings of Frühauf et al. (2013) and Davies et al. (2013) who reported that the quantized stimuli received the highest groove ratings by listeners.

The difference between large mean periodic head movement values on the 60% reduction level compared to the 60% expansion level can be interpreted as follows. For musicians, tight timing is a marker of musical competence (Berliner, 1994, p. 154). Accordingly, the expert listeners show more entrainment when listening to music with tight timing compared to music with loose timing.

The inverted situation on the 80% and 100% *Δ- Magnitude* levels is more difficult to interpret. What triggered the music experts to move their heads strongly with the least tight music? We hypothesize that the PD patterns on the 80% and 100% expansion levels create tempo oscillations which are consciously perceived by the expert listeners. The experts' head movements to these stimuli may thus not be an instance of entrainment instilled by groove, but rather a way of comprehending the tempo oscillations by mapping a bodily response to the unsteady beat.

Musical *Style* did not have a significant effect on the listeners' periodic head movement. The Swing PDs were more widely spread ($SD = 22.8$ ms) than the Funk PDs ($SD = 15.3$ ms, $p < .001$). But this difference did not trigger different reactions in listeners, regardless of the scaling. Hence we may assume that the absolute numeric PD magnitudes in milliseconds are not relevant on their own, but they depend on the stylistic context of the music.

In summary, this study offers support for PD theory insofar as tight musical timing triggers more periodic head movement in music experts than quantized or deadpan timing. No similar effect was found for the non-experts: they did not react to the PD variations tested in this study. It appears that the experts' musical training sharpens their perception of PDs. However, every day musical entrainment and groove are experienced by countless non-expert listeners, dancers, concert-goers, sports-people, workers, and others engaged with music-related body motion. This suggests that further factors must be taken into account for explaining the phenomenon of musical entrainment in non-experts and experts. Likely candidates have been proposed by Madison et al. (2011): "beat salience" and "event density," but their effects remain yet to be tested.

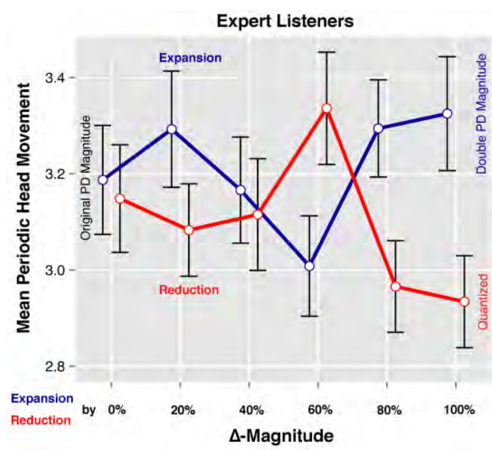

Figure. 1: Mean Periodic Head Movement for expert listeners; reduced PD magnitudes in blue, expanded PD magnitudes in red. The error bars represent the standard error of the mean.

Keywords

Groove, Body Motion, Microtiming, PD Theory.

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Neurodynamics of the human brain during listening to rock-music with modified frequency range

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ABSTRACT

Background

Neuroscience research of music is mainly related to music perception and brain mechanisms of music processing. Studies on emotions using different sound stimuli (nature sounds, single pitch and chords, variety kinds of musical compositions) comprise a large part of this research. Of particular interest is the perception of full music compositions as well as separate music component, like pitch, rhythm and timbre. It is also well known that music can be used as efficient treatment for cognitive, emotional and motor disorders. It has been shown that preferred music can reduce sulivary cortisol level, shift frontal EEG activation from relative right to relative left frontal activation in depressed adolescents (Field T, Martinez A, et al.) and enhance cognitive recovery after stroke (Särkämö T, Tervaniemi M, et al.). People listen to music due to its ability to elicit strong emotions and pleasure. And experienced musicians and sound engineers, while mixing and mastering, consider the fact that depending on signals level of certain frequencies music can elicit different emotions and affect on its strength.

Aims

The aim of our study was to investigate a neurodynamics of EEG features during perception of rock-music with native frequency range and with reduced low-frequency range.

Method

20 healthy volunteers (16 women and 4 men) - students aged 18 to 22 years with no prior musical education participated in this study. Four stimuli were presented: white noise (40 seconds), song of nightingales (60 sec), instrumental rock-composition (Blue Vapa – My love, 75 seconds) and the same rock-composition with reduced low-frequency level (60 Hz, 150Hz, 400Hz). Frequency range changes of the rock-composition were carried out using "GoldWave" audio editor. We estimated spectral power density (SP) of all subbands from 4 to 35 Hz. In order to estimate spectral power EEG changes we compared every audio session sample with preceding rest state sample. During EEG registration volunteers were sitting in a comfortable chair in a darkened, soundproof room with closed eyes. After EEG registration participants were asked to estimate audio stimulus using valence and arousal emotional scales from "-5" to "+5". The Wilcoxon test was carried out to compare the data of dependent samples.

Results

Listening to white noise caused frontal activation in theta1-, theta2-, alpha3-, beta1- and beta2-subbands basically in right hemisphere. Such frontal right hemisphere activation could represent reaction to stimulus novelty and negative emotional response. We detected decrease of SP in theta2-, alpha1-, alpha3- and beta1-subbands during listening to the song of birds, which could be related to relaxation, positive emotional response and external attention. Subjects also estimated this audio sample as pleasant and relaxing. There was an increase of SP in beta2-subband in temporal, parietal and occipital with left hemisphere lateralization during listening to the rock-composition with native frequency range. This left-lateralized reaction could be related to imagination processes, emotional activation and, probably, positive emotional response. During listening to the rock-composition with reduced low-frequency range, we observed an increase of SP in beta2-subband in right frontal hemisphere in frontal, temporal and parietal lobes. There was also observed a local increase of SP in right frontal lobe in beta1-subband. We suggest that such right-shifted frontal activation in frontal lobe in beta1- and beta2-subbands is related to processing of musical components and comparison of the rock composition with reduced low-frequency range with previous rock composition with native frequency range.

Conclusions

During listening to the sounds and music the most significant EEG changes were observed mainly in theta- and beta-bands, which related to emotional and cognitive processes. EEG dynamics during listening to the rock-music with native frequency range and reduced low-frequency range is different and characterized by clear lateralized activation in beta1 and beta2-subband.

Keywords

Audio perception, rock-music, nature sounds, white noise, EEG.

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Attention, density, and coherence in musical time estimation

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ABSTRACT

Background

Attention and expectations have been shown to play an important role in perceptions of time. Attending to time makes it seem to pass slowly (Brown, 1985), and attending to events makes it seem to pass quickly—the interference effect (Brown, 1997). Moreover, temporal intervals are judged as longer when filled with sine-wave tones (compared to silence)—the filled interval effect (Thomas & Brown, 1974); and musical melodies are judged as longer when they are structurally incoherent (as compared to structurally coherent)—a tenet of dynamic attending theory (Boltz, 1995; Jones & Boltz, 1989). It remains unknown, however, whether these effects depend on focused attention. That is, do the filled interval effect and the effects of dynamic attending require focused attention, or do they occur even in the absence of it?

Aims

The present study aimed to explore the role of attention on the temporal effects of density (the degree to which a temporal interval is filled with events) and coherence (the degree to which the events within the temporal interval cohere into a stable structure) in music.

Method

Participants were 110 psychology undergraduate students with normal hearing from the University of Arkansas (53 females; 18 to 24 years of age; M = 19.4; SD = 1.17). They participated in this experiment in exchange for research credit. They gave informed consent before participating in the experiment. The experiment was approved by the University of Arkansas IRB committee.

Materials: Participants wore Sennheisser HD 650 headphones while seated at a Dell computer in a 4’ x 4’ WhisperRoom sound isolation booth. The musical stimuli played at a comfortable listening level (65dB SPL). The experiment was run using Medialab (Jarvis, 2012).

Participants heard 45 musical clips altogether (Finale 2012; piano timbre). Each clip had either low, medium, or high density *and* either coherent, incoherent, or repeated structure. Density was crossed with structure, creating nine pairings (i.e., low-coherent, medium-coherent, high-coherent, low-incoherent, etc). Five clips with varying lengths (5.7s; 7.3s; 8.6s; 10.5s; 13.2s) were produced for each of these pairings.

Low density clips consisted of blocked chords, all of which were separated by rests; medium density clips consisted of arpeggiated chords, some of which were separated by rests; and high density clips consisted of arpeggiated chords filled with four times as many notes as the medium density clips, with no rests between them.

Coherent clips used progressions drawn from standard tonal harmony with conventional voice leading; incoherent clips used progressions not standard to tonal harmony with unconventional voice leading; repeated clips simply repeated the same harmony in the same position throughout the excerpt.

One group of participants, the single-task group, listened to the clips without performing a concurrent task. Another group, the dual-task group, completed a visual-search task while listening. They scanned for “C” symbols on a screen filled with “O” symbols. Between zero and three of these “C” symbols were randomly dispersed among 1281 “O” symbols. The symbols were printed in black font and displayed on a light-blue background.

Procedure: This experiment was run in one 30min session at the Music Cognition Lab at the University of Arkansas. All of the participants read and signed the consent form,answered a set of demographic questions, and completed three practice trials before proceeding to the experimental trials. The 45 experimental trials were presented in random order. For the trials, all of the participants verbally estimated and reproduced (start and stop a timer) the durations of the musical clips, however only the participants in the dual-task group scanned for “C” symbols while listening. Verbal estimates were always collected before reproductions to control for between-subjects timing variations, (following Brown, 1985).

For a given trial, participants in the single-task group were instructed “Attend to the amount of time that passes from the initial ‘click’ to the final ‘click;’” whereas participants in the dual-task group were instructed “Randomly scan for the ‘C’ symbol” and asked “How many ‘C’ symbols did you find in the last visual display?” Then, both groups were prompted “How many seconds passed from the initial ‘click’ to the final ‘click’ in the music you just hear.” Then, “Imagine through the music you just heard. Actually play it back in your head. Mark the initial ‘click’ with the Spacebar, then imagine through the music, then mark the final ‘click’ with the Spacebar.”

Results

To standardize the measures of perceived duration and control for response bias, we converted the VE and R data into ratio scores—values below and above one represented under- and overestimations of the clip’s actual durations, respectively. VE and R were significantly correlated ($r=.63$, $p<.001$). Verbal estimation (VE) and reproduction (R) were treated as repeated measures (following Brown, 1985); density and coherence were

treated as repeated measures; and attention was treated as a between-subjects factor.

An analysis of variance (ANOVA) was performed on these data. Overall, we found a strong interference effect: participants in the single-task group judged the clips as longer than participants in the dual-task group ($F[1,106]=1031.39$, $p<.0001$).

Furthermore, we found an effect of density in the single-task group, such that the high and medium density clips were judged as longer than the low density clips ($Fs[1,180]=25.18$ & 12.61, respectively, $ps<.001$, but not in the dual-task group.

Similarly, we found an effect of coherence in the single-task group, such that the repeated clips and the incoherent clips were judged as longer than the coherent clips ($F[1,60]=7.84$ & 9.40, respectively, $ps<.01$), but in the dual-task group, the repeated clips were judged as longer than the incoherent clips and the coherent clips ($F[1,48]=7.99$ & 5.28, respectively, $ps<.05$).

Conclusions

These results provide novel evidence for the interference effect (Brown, 1985), the filled interval effect (Thomas & Brown, 1974), and the effects of dynamic attending (Jones & Boltz, 1989). Also, they suggest that density and coherence's effect on musical time estimation depend on attention. Further, since musical expectancies operate automatically, without reliance on conscious attention, (Bharucha, 1994) the effects of density and coherence are likely due to retrospective, memory-based rather than prospective, expectation-based mechanisms—the more "chunks" of information that are stored in memory, the longer the perceived duration (Poynter, 1989).

Keywords

Musical expectancy, dynamic attending theory, filled interval effect, interference effect, time perception.

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Writings by internationally renowned flutists on breathing control in the orchestral excerpt from Debussy´s *Prélude à l´après-midi d´un faune*

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ABSTRACT

Background

The *Prélude à l´après midi d'un faune* by Claude Debussy is an important orchestral work from late 19th century. In addition to being very significant for the literature of the flute, this orchestral excerpt has become a standard audition piece worldwide. The performance of the opening four measures has been consistently considered one of the most demanding passages for the instrument. Renowned flutists such as Peter Lloyd, Michel Debost, Elizabeth Buck, Georges Barrère, Jeanne Baxtresser and Marcel Moyse have pointed out to breathing, intonation, sound color, vibrato, dynamics, articulation, timing phrasing, expressivity and style as the main technical and interpretative aspects requiring skillful resolutions on the part of the instrumentalist.

Aims

This article brings out discussions, suggestions, commentaries and solutions presented by internationally renowned musicians in order to shed light on their learning processes and strategies as well as on their experiences with this work.

Method

The methodology is based on writings compiled among internationally renowned flutists through the bibliographical investigation written by McCutchan (1994), Lord (1998), Debost (2002), Buck (2003), Toff (2005), Baxtresser (2008) and Toff (2012).

Results

Breathing appears as the number one aspect in the performance of this excerpt due to the fact that these initial four measures should be played in a single breath especially in audition situations. All other aspects seem to become subsumed under breath control. It is however intriguing that Baxtresser and Lloyd offer suggestions for intermediate breathing places while Buck discusses possible practice strategies related to the management of pacing.

Conclusions

Although the capacity of performing the four initial measures of Debussy´s *Prélude à l´après midi d'un faune* in single breath plays a crucial role, already in 1908 Marcel Moyse declared “When I played the first phrase in one breath, he [Debussy] didn´t even compliment me. He found that natural”. Based on this statement and other equally illuminating commentaries, it is our aim to discuss how expert flutists have found out individual solutions for this challenging orchestral excerpt.

Keywords

Breathing Control; Flute; Debussy, Orchestral Excerpt; Technical and Interpretative Aspects

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'Moved by the music': Affective arousal, body movement and musical features of electronic dance music

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ABSTRACT

Background

Night-after-night dance floors are bursting with people experiencing pleasurable dance and intense emotions related to electronic dance music (EDM). EDM is specifically produced for dance, thus the acts of music production and music perception are closely linked together.

These intense and pleasurable experiences of EDM have most commonly been investigated in the club context from a sociological and anthropological point of view. Few psychological and embodied contributions have yet been made within the EDM research field. The experiences of EDM have therefore most often been associated with some of the components of the club setting, such as many people dancing together, strong visual stimuli and the use of drugs. Consequently, thorough analysis of the musical features and production techniques of producers and DJs remain relatively unexplored. However, DJs and producers of EDM are highly aware of what production techniques and musical features that draw the dance floor into a heightened bodily and affective sensation.

EDM therefore provides an ideal case study for understanding the relationship between musical structures and affective and bodily experience. Despite few direct empirical studies of EDM, it is possible to infer from literature from the fields of musicology, music psychology and embodied music cognition that musical structures likely associate with such intense affective and bodily experiences.

The multisensory club setting obviously consists of several components that culminate in the club experience, but how crucial are the musical features in the shaping of intense and pleasurable experiences of EDM? Can the musical features of EDM still afford a sense of movement and pleasurable experiences when sitting sedentary and alone in a home listening setting?

Aims

This paper aims to investigate and compare the experience of pleasure, affective arousal, and the desire to move to EDM in two different settings and with contrasting bodily engagement; dancing in a club-like atmosphere and sitting still in a home listening-like context. An additional objective is therefore to explore the role of bodily engagement when perceiving EDM. The paper also provides a detailed account of musical features and structural conventions associated with intense and pleasurable experiences of EDM.

Method

Two experimental empirical studies were carried out to explore the experiences of pleasure, affective arousal, and the desire to move to EDM. The experiments comprised two different settings and bodily engagement; a club setting where the participants danced together and a home listening setting where the participants sat alone and sedentary.

Experiment 1 simulated the club setting and was carried out in a motion capture lab. An optical motion capture system tracked and recorded the body movements of a group of 16 subjects (11 women and 5 men (M = 30.3 years, SD = 8.6)). Each participant wore two reflective markers and the group danced together to a continuous DJ mix, which consisted of four EDM tracks. Two tracks comprised the EDM routines 'breakdown', 'build-up', and 'drop', while two tracks had flat structural development and functioned as control tracks. The group was instructed to dance and move to the music as they would in an actual club setting. A lot of effort was put into creating a club setting as ecologically valid as possible. Hence, the main light was switched off, rotating light effects were installed, and real dance music was played loud through a good sound system.

Experiment 2 simulated the home listening setting and was carried out in a small lab room. Three physiological responses – electro dermal activity, heart rate level and respiration – were measured on a different group of people, which consisted of 24 subjects (14 females and 10 men (M = 28.1 years, SD: 9.23)). Each participant sat alone and sedentary while they listened to five different excerpts of EDM using headphones. Four excerpts included the 'breakdown', 'build-up' and 'drop' routines and one track served as control with flat structural development. The order of presentation was based on the Latin Square formula to avoid carry-over effect. The participants were instructed to focus on the music and try to relax and not move.

Both studies included the same questionnaire, gathering information about the participants' self-reported pleasure and bodily and affective appraisal of the music. The participants rated the music examples according to pleasure and familiarity. Additionally, they described the specific musical characteristics causing affective arousal and a desire to move.

Music preference is important in the exploration of pleasurable experiences with music. Therefore, the criteria to participate in the studies were: (a) to be open-minded regarding electronic dance music, and (b) to preferably enjoy listening and dancing to this type of music together with others.

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Results

Preliminary results from Experiment 1 show correlations between specific features in the music, the intensity and amount of body movements, and the participants' self-reported affective experience. In Experiment 1 the quantity of motion was calculated; the total activity level of the whole group. A pronounced change in the degree of body movements happened during the 'breakdown', 'build-up' and 'drop' routines. A significant increase in the group's quantity of motion occurred at the moment of and right after the drop.

This coincides with preliminary results from Experiment 2, which indicate correlations between physiological arousal, self-reported affective experience, and the same structural conventions. In Experiment 2 the physiology data, and especially the levels of arousal in the skin conductance response, were higher around the moment of the drop.

Both the qualitative and quantitative results from Experiment 1 and Experiment 2 correlate with the music analysis. The same musical moments, namely the 'build-up' and 'drop', were reported as especially pleasurable and as causing a stronger desire to move by the participants. The tracks comprising these routines were rated as more pleasurable than the control tracks with flat structural development. Affective and bodily peaks were found for the following musical features: (a) extensive use of sounds and effects comprising upward pitch movements; (b) compression of rhythmical structures; (c) large changes in frequency spectrum and textural density; (d) removal and reintroduction of the bass and bass drum, and (e) new or changed element occurring after drop.

These features reinforced their dance or desire to move, and related to the large structural and dynamical changes in the music. Dance participants reported that moving together with others in a club-like atmosphere was also reinforcing their affective experience. Interestingly, the physiology study participants reported about intense pleasurable experiences and a wish to move despite sitting still and alone in a context similar to home listening.

Conclusions

Both studies indicate correspondences between musical features and participants' degree of movement or desire to dance, and the intensity of their affective arousal. Hence, pleasurable and intense experiences of EDM can occur regardless of listening setting and bodily engagement. This may suggest that the specific musical features and structural conventions of EDM involve the body to a large extent; the music itself affords pleasurable experiences even when not being present in a club setting and dancing together with others. It could be argued that a shared embodied understanding exists amongst EDM listeners of how to experience and perceive EDM – regardless of bodily engagement.

Nevertheless, actual bodily engagement, the presence of others and the specifics of the club setting are indeed important factors of the total club experience. Subjective feedback from both groups acknowledged the role of bodily engagement and the club setting. The participants in Experiment 1 reported that they would have a weaker experience of the music if they listened to this music still-sitting, while the participants in Experiment 2 said they would experience the music stronger if moving to it in a club setting.

Furthermore, it is possible to infer that capturing body movement and measuring physiological responses can both be interpreted to measure intensification of affective experience.

Keywords

Pleasure; electronic dance music; physiological responses; motion capture; dance; movements; emotions; affective arousal

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Influence of personal traits and musicality on flow experience during radio reception

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ABSTRACT

Background

Recent research has shown that the radio is still the most relevant device for everyday music listening (Krause, North & Hewitt, 2013). From an economic perspective, listeners are the most important factor in success for a radio station. The main goal for any Adult Contemporary (AC) or Contemporary Hit Radio (CHR) broadcasting company is therefore to get people to listen to their program, and then not to switch to another station or turn off the radio. The crucial factor that keeps listeners engaged is music, making the composition of music programs key to success (Schramm, 2008).

When people enjoy a radio program, and especially the music, they are more likely to stay with that radio station. One way to explain how radio stations provide enjoyment through their music programs is the concept of flow (Csikszentmihalyi, 1975, 1990; Sherry, 2004). This concept illustrates how the right balance between the challenge of completing a task and the skill of the executive person can lead to a particularly fulfilling mental state. Individuals have described the flow experience as feeling totally absorbed and comfortable, and losing track of time. This experience can be attained by listening to music; Cziksentmihalyi (1990) wrote that ‘Listening to music wards off boredom and anxiety, and […] it can induce flow experiences’ (p. 109). This was confirmed by Sherry (2004), who agreed that ‘many have experienced temporal distortion, losing track of time while reading a novel or listening to music’ (p. 333). In light of these statements, we would assume that experiencing flow during radio reception would encourage listeners to stay tuned to the program, the desired outcome for radio stations.

Aims

Besides the personal traits there are many factors that influence our reception of radio programs. Especially when listening to music on the radio musicality, music genre preferences and the personal listening modes are crucial for the enjoyment and a flow experience during reception. Therefore our research question is:

Which skills and personal traits are the best predictors for a flow experience during the reception of a music-based radio program?

Method

A laboratory experiment was conducted. 392 participants (50,5 % female, age: $M = 25.4$, $SD = 6.6$) listened to one of eight different radio programs (four Contemporary Hit Radio and four Adult Contemporary programs) with a music program that systematically varied in terms of complexity and publicity of the songs. The external validity of the mixes was guaranteed as the eight music mixes were compiled and produced by a professional music editor of a major German radio station. The music editor chose eight songs from the latest German airplay charts; these eight songs were used on all of the radio programs. The remaining four songs in each 12-song playlist—the third, sixth, ninth, and twelfth songs—were then different for each program in terms of familiarity and complexity.

Flow was measured with nine items ($\alpha = .89$) using the Flow Short Scale (Engeser & Rheinberg, 2008; Rheinberg, Vollmeyer, & Engeser, 2003). Music genre preferences were measured with 17 items. Listening Modes were measured using the Listening Modes Questionnaire of Behne (1986).

Results

A multiple regression (R2 = .09, $F(8,383) = 4.48$, $p < .01$) showed that the most important predictors for Flow experience are neuroticism ($\beta = -.13$, $p = .02$) and motoric listening ($\beta = .26$, $p < .01$).

Conclusions

The less neurotic listeners are and the more they have a motoric listening mode, the more they enjoy broadcasted music programs. We found the concept of flow to be a very useful one for music radio research. Flow fits the interests of radio broadcasting companies—as was confirmed by our cooperation partner—and helps to evaluate entire programs, as opposed to evaluating individual songs through the usual hook tests.

Keywords

radio, broadcasting, Flow, complexity, popular music

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Improvisation and change in music therapy sessions: Exploring individual difference

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ABSTRACT

Background

Music therapy has been suggested to help children with autism (e.g. Geretsegger, et al. 2014, Gold et al., 2006) and improvements in aspects associated with communicative behaviour and joint attention have been identified. Such findings are usually reached by focusing on subsections of sessions for detailed analysis or by looking at outcomes by comparing measures before and after therapy (e.g. Geretsegger et al., 2014; Kim et al., 2008).

Nordoff-Robbins music therapy – as a music-centred approach – is an improvised, interactive approach (Aigen, 2005, Nordoff & Robbins, 2007). During Nordoff-Robbins music therapy sessions the therapist monitors and regulates their own music making according to the client's music, gestures, vocalizing and movements, often with the initial aim of establishing, sustaining and developing a shared, flexible and negotiated regular pulse (Bruscia, 1987). In this approach, the "basic beat" is understood to be the foundation for developing a mutually negotiated musical relationship in music therapy (Nordoff and Robbins, 2007, p. 298, see also: Aigen, 2005, Ansdell 1996, Pavlicevic 2000, Wigram, 2004).

At the same time, studies in music perception and production have suggested that typically developing children entrain their pulse to another pulse from a young age (e.g. Kirschner and Tomasello, 2009). This does not seem to happen so readily for at least some children with ASD diagnoses and, though the studies available on the topic are limited and reasons for difficulty not clear, it seems that rhythmic co-ordination can be problematic for children with ASD (e.g. Isenhower et al., 2012). Such difficulties of regulation of one's own timing and synchrony with others have been suggested as important in the understanding social experiences of individuals with autism (e.g. Hardy and LaGasse, 2013).

Taken together with studies suggesting that entrainment can contribute to social affiliation (e.g. Hove and Risen, 2009), a detailed investigation of pulse characteristics of interaction in music therapy may provide insight into how such characteristics change over time in music therapy and, eventually the effect they have for clients beyond the therapy room. In particular, questions remain about the kinds of patterns that occur in music therapy sessions including: How do players' pulse characteristics change over time? What are the different relationships between the client's and therapist's pulses? In this study we investigate shared pulse within the context of other characteristics of the therapy sessions and in particular we compare patterns of shared pulse and where the therapist and client are facing during the sessions.

Aims

We compare the amount of shared pulse and where the players are facing between sessions and between client-therapist pairs.

Method

A. Participants

Two client-therapist pairs were included in this part of the study. Both clients, diagnosed with ASD were boys, aged 4 in the early session. The music therapist is female, trained at Nordoff Robbins.

B. Materials

All videos were filmed at the Nordoff Robbins London Centre. Clients and therapists in the sessions are free to move around the room. One early and one late session of client-therapist pairs were analysed.

For pair 1: Two videos, 26 min 36 s and 27 min 57 s in duration, were analysed. The early session is the initial music therapy session for this client-therapist pair, filmed in 05/2007. The later session features the same pair approximately one year later and was filmed in 06/2008. For pair 2: the early session was the second session for this client, filmed in 09/2009, the later session was from the end of this child's 1-to-1 music therapy and was filmed in 01/2011.

For both pairs, the client and therapist saw each other more or less weekly between these sessions. Ethical approval was granted by the NR and the Faculty of Music, University of Cambridge Research Ethics Committees.

The videos used in this study were from a previously existing collection that had been recorded during the usual clinical work. The videos were made by switching between two CCTV cameras and with one microphone for sound. Given the nature of the recordings, automatic analysis of the video and audio was not practical. Therefore, manual annotation, using a protocol, was carried out based on what can be seen and heard.

Once annotations of pulse characteristics had been assigned to the entire music therapy session, moments in which client and therapist were perceived to be playing in the same metrical framework were marked as 'shared pulse'. In addition, the direction in which participants were facing, including whether they were facing the other player, was annotated.. (For more information about the protocol see Spiro et al., 2014).

Manual annotation in ELAN

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(http://tla.mpi.nl/tools/tla-tools/elan/) was followed by analysis of absolute and relative durations of the players' behaviours, and relationships between the clients' and therapists' behaviors.

C. Inter-annotator reliability

A co-annotator analysed 10% of the video material using the same guidelines. Divergent annotations were noted and statistical analysis tests for correlation between annotators were applied. Pearson's Rank was used to test for correlation between durations of moments identified by annotator and co-annotator. Cohen's Kappa was used to test for consistency between annotators in labeling annotations that occurred at the same time. As reported previously, agreement between annotators was high (Spiro et al., 2014).

Results

Different patterns of the proportion of time during which the players shared pulse and faced each other were found for the two pairs. Here we give some examples of the broad patterns found.

For pair 1 the proportion of shared pulse in the session increased (from 4% in the early session to 20% in the later session). For pair 2 we see a steady proportion in both sessions (7% in the early and 6% in the later session). Conversely, in terms of the proportion of time spent facing each other, for pair 1, the proportion is very similar in both sessions (7% in the early session and 10% in the later session), while for pair 2 there is a tripling in the proportion of time they face each other (12% in the early session to 36% in the later session).

Conclusions

We find that the characteristics that show change are not the same for the two pairs studied. Charting the range of possibilities of what might or might not change in music therapy for different clients will help reach a more nuanced understanding of the nature of change and interaction in this context. For example, changes between the sessions that we observe might be related to reasons for referral. By having these representations of sessions, we may start identifying whether there are overall similarities in patterns across client - therapist pairs and the level at which it is helpful to compare clients. Moreover, having such representations of MT sessions may help contextualise aspects that are captured in other ways (music therapists' or parents' interpretations) and help make predictions about what we expect to change within and beyond the therapy room.

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Song singing: How children apply musico-linguistic rules or a grammar

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ABSTRACT

Songs are cultural rituals that are governed by rules in order to yield well-formed performances. Traditionally, parents and caretakers intuitively introduce infants and young children into this practice, for instance by lullabies and play songs. Provided that children are engaged in this practice, they start song singing around the end of the first year and during their second year. In order to study the teaching and learning of songs as a trans-generational cultural practice, the formal principles and rules of traditional children's songs have been extracted and initially sketched out as a grammar. This grammar of children's songs draws on music and language as generative systems, and it elucidates the rules how musical and linguistic elements are simultaneously combined into a coherent and well-formed unit. As each language has specific prosodic rules, this grammar so far is restricted to children's songs in a particular language, i.e., German. The application of the grammar is shown by microanalyses of children's song acquisition processes. In a quasi-experimental study, children were asked to learn newly composed songs that tacitly, yet deliberately violate the grammar. Case studies demonstrate the strategies children apply to cope with the violations and to create well-formed songs. Interestingly, children not only show implicit knowledge of the children's songs' grammar, but also exhibit an aesthetic sense of well-formedness. Since the grammar of children's songs encompasses musico-linguistic elements and rules, implications not only concern a structural approach to musical development, but also to language and to the synchronisation of movements.

I. MUSIC – A GENERATIVE SYSTEM

The idea is not new that music is a generative system. The main inspirations go back to Humboldt (1836, p. 70) who characterized language as a system, that makes infinite use of finite media, whereby the synthesis creates something that is not present per se in any of the constituents. Langer (1953) mentioned that music, like language, has discrete parts that can be combined in a variety of ways to make new expressive wholes. Merker (2002) elaborated the core principles of music as an open-ended self-diversifying (Abler, 1989) or generative system: Humans do not exploit the continua of frequency (pitch) – of their voice or of instruments – and time, but create limited sets of discrete categories and combine them into complex patterns. The rules of music systems have been a key issue, and researchers proposed various attempts for formalize them. For instance, Sundberg and Lindblom (1976) described Swedish nursery tunes in terms of a generative rule system; Lerdahl and Jackendoff (1983) published their Generative Theory of Tonal Music (GTTM), and Povel designed algorithms for generating melodies. So far, all these approaches focus *melodies* as hierarchically organized units and deal with tonality and musical time in terms of metrically based durations with proportional values. The present research investigates the question how humans learn to organize their sensorimotor activities – vocalization and motor movements – according to generative rules and create new patterns as expressive wholes. The elementary, yet first complex musical pattern is early song singing that may emerge around the end of the first year (Stadler Elmer, 2012a, 2012b). Let us therefore investigate the structural components of children's songs as a traditional cultural practice with and for children. Beforehand, we briefly mention some of the reasons human beings sing songs.

II. WHY DO WE SING SONGS?

To sing a song implies the memory and experience of the feelings how to create, to recreate, and to share it. The singer knows that a song is experiencing a structured time unit that can be repeated and even predicted because of its form and some implicit rules. Talking or using speech implies different intentions, contexts, and feelings. Singing parents make use of this device to convey and transmit cultural traditions to the young generations, and to create and share feelings by performing. They provide vocal models to the infant and young child and thereby stimulate vocal learning and playing according to some rules. Song singing is a cultural act and a vocal performance of formal rules for creating well-formed entities and positive affective states. As an integral part of a cultural tradition with ritual characteristics, song singing units feelings and form (Langer, 1953; Merker, 2009; Eckerdal & Merker, 2009; Stadler Elmer, 2015).

III. THE MAKING OF SONGS

What are the principles and rules of making up songs? Musicethnologist Nettl (2000) describes the features of simple, universal children's songs as consisting of short phrases, repeated with small variations, and covering three or four different pitch categories in the range of a fifth. Yet, children's songs (CS) are not only melodies, but are always a combination of two different, yet intertwined generative systems: music and language. Although there is much research on the comparison of music and language (e.g., Patel, 2008; Rebuschat, Rohrmeier, Hawkins, & Cross, 2012), but only rarely is the combination of the two addressed with respect to the traditional form of songs (Stadler Elmer, 2002). What do we do whilst singing a song? We produce sounds while exhaling, and the breathing pattern determines the phrases. Producing sonor or singing sounds is achieved by prolonging the vowels (Dowling, 1984). This in turn allows modulating the pitches of these sounds. We might use syllables to build words and to tell something, for instances a brief story or nonsense. By periodically accentuating syllables, combined with movements or entrainment, meter is produced. Feedback by hearing is used for constant monitoring the vocal production and comparing with an external or internalized model. In other words, song singing is deeply rooted in the human sensorimotor system. The capacity for vocal learning leading to speech and song, is not only a specific human characteristic (Merker, Morley, & Zuidema, 2015) that starts very early, but also seems to be the

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very first and most important cultural act for recognizing structures and rules, and for making abstractions. In this process, visualized in figure 1, we segment the auditory stream into meaningful units and acquire the rules to combine them in a generative and well-formed manner.

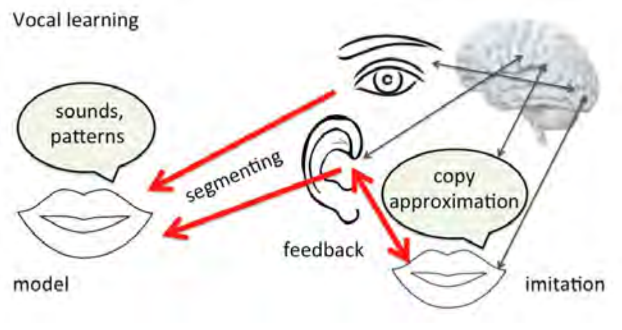

Figure 1: Visualization of vocal learning (© Stadler Elmer, 2015).

The creation of songs as well as primitive categories of grammar both refer primarily to actions that are necessary in the very making. The practice of song singing, their use and its related affective states reflect the structure of attention, of expected structures (via prediction), as well as the structures of jointly organized actions. Song singing is first realized as socially shared actions. Bruner (1976) would say that the child has the innate capacity to construct schematas for "knowing how to share experience" and for knowing about other's intentions.

IV. PRINCIPLES AND RULES OF CHILREN'S SONGS

As shown so far, song singing formally encompasses lyrics and melody or language and music. The two generative systems share the same organizational principle and vocalization as the expressive means. Before dealing with the differently organized vocal features, it is important to summarize basic principles of children's songs. Stadler Elmer (2015) proposed a grammar of children's songs (CS) that makes explicit the underlying principles and rules. So far, the rules are restricted to German language since each language has specific prosodic rules that need to be taken into account (Hall, 2000). Up to now, seven general principles are formulated:

1) CS consists of lyrics (a verse or a poem) and a melody.
2) Two *generative systems* – music and language – are simultaneously involved that allow creating infinite possible songs.
3) The building block of both systems for making songs is the s*yllable* since it also contains musically relevant features such as pitch, time, and accents.
4) Songs are *hierarchical organized.*
5) Lyrics and melody are relatively autonomous (see 2), forming parallel hierarchies (cf. Baroni, Dalmonte, & Jacoboni, 1995). Ideally, lyrics and melody fit together in an equal manner. If this is not possible, one is super- and one is subordinated.
6) The poetic meter of the lyrics and the musical meter of the melody simultaneously rule the timing of the syllables. As aforementioned, this may create tension.
7) Symmetries of temporal and sonor forms aim at creating *well-formed wholes* or a Gestalt.

In order to understand the generative nature of the two systems, table 1 gives an overview on vocal features differently organized while singing, reciting, and speaking.

Table 1: Singing, reciting, and speaking share the same, yet differently organized vocal features. (© Stadler Elmer, 2015)

	Continuous dimension	Discrete categories (generative)	Common elements
singing	intensity	pitch, time	
reciting, chanting	intensity, pitch	time, phonems (vowels, consonants)	meter
speaking	intensity, pitch, time	phonems	phonems syllables

Note that poetic language – reciting or chanting – shares with singing the periodically accentuated pulse, a meter. Most notable is the fact that syllables are the commonly shared building blocks of the entire system, as formulated in principle 3. The traditional German song represented in figure 2 serves as an example to verify the given selection of rules. To date, 21 rules are formulated with respect to the tonal organization, the timing, and the lyrics (Stadler Elmer, 2015).

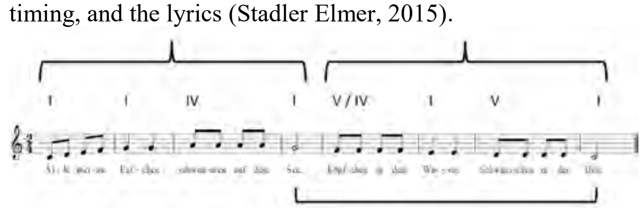

Figure 2: An example of a traditional German children's song. The top line shows the two phrases, the symbols I, IV, and V indicate the underlying harmonic structure of the melody, the last line points to the rhymes in the lyrics that mark the boundaries of the phrases. (© Stadler Elmer, 2015)

Timing rules - examples

1) Once the meter (measure) is set, it is valid for the entire song. CS don't change the measure or meter.
2) The number of measures in CS is dividable by two. Possible quantities of measures are 4, 8, 10, 12, 14, and 16.

Tonal rules – examples

1) CS are in *major keys*, rarely in pentatonic scale or minor keys.
2) The major key once chosen is maintained through the entire song. There is *no change of key*.
3) CS *begin* with one of the three tones of the tonic accord (do, mi, so).
4) The first measure of a CS marks the key.

Rules concerning lyrics - examples

1) The lyrics are formed in poetic language. That means it has a *meter*, and *verse lines* that end with *rhymes* (pair and cross rhymes).
2) The meter defines the periodic accents, and the verse lines is defined by the quantity of syllables.

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3) The meter (trochee, jambus, dactylus, anapest) is contingent with the musical meter (measure) of the melody to yield a well-formed entity or Gestalt.

V. HOW DO CHILDREN ACQUIRE AND APPLY GENERATIVE RULES?

In order to investigate children's strategies in generating new songs – be it invented or reproduced – we carried out a quasi-experimental study. We composed new songs that deliberately violated some of the CS rules, and we asked children to invent songs. Pictures stimulated all singing activities. In order to exemplify the application of CS rules, I use an excerpt of a previously published case study (Stadler Elmer, 2000, 2002) with Tom, 4;7 years old, and discuss it in the light of the CS grammar. Figure 3 shows Tom's first reproduction of a new song, he previously listened two times and joint in singing once. This graphic representation is based on a micro-genetic methodology including acoustic analysis by the Pitch Analyzer, and with the aid of the Notation Viewer (Stadler Elmer & Elmer, 2000).

Tom's first solo version (figure 3) shows first of all an exact match between his temporal organization and the model: Without counting 15, he produces 15 syllables that correspond to 15 notes or pitch categories, altogether forming a coherent and new song. He seems to have a sense for this formal aspect, or in other words, for the Gestalt of a song in terms of its temporal framework. He subordinates the lyrics by adopting only the first two words and by subsequently reducing the lyrics to the repetitive syllable */ne/.* The melody is remarkable: he adopts the first phrase, but he replaces entirely the second, unconventional one by a newly invented and well-formed tune. Thereby he generalizes the rule that a CS does not change the key, and therefore it ends with the tonic of the key introduced at the beginning. He continued acquiring this song by applying various strategies (adopting the lyrics, asking for help, focusing absolute pitch etc.).

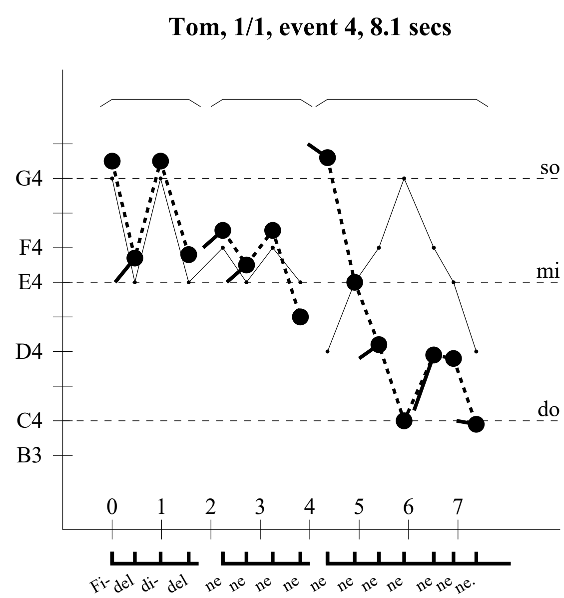

Figure 3: Tom's first version of a new song. The thin line represents the song model, and the dots represent pitches sung by the child. The *y*-axes shows pitch as a continuum, and the *x*-axes shows the continuous timing categorized as seconds, and measured by the onset of the syllable and duration. The horizontal lines indicating *do, mi, so* visualize the tonic triad as a conventional tonal framework (Stadler Elmer, 2000, 2002).

This example shows that song singing is more than a sequence of producing words, adding rhythm, then a melody contour, and finally intervals – one of the traditional conceptions of singing development (e.g., Welch, Sergeant, & White, 1998; Hargreaves, 1986; Moog, 1976). Microanalyses repeatedly reveal that children have an overall understanding for song singing being a coherently and densely organized social event with predictive features. It can't be acquired by adding elements or by focusing accurate pitch, but rather by grasping the entire form at the basis of related and repeated sensorimotor and simultaneously socially shared experiences (e.g., Eckerdal & Merker, 2009). In this perspective, "mistakes" are interesting because they indicate some of child's understanding of the task and the strategy to achieve well-formed and socially shared performances.

VI. CONCLUSIONS

What is the advantage of conceptualizing song singing and its development with a focus on the generative systems underlying vocal organization? Rather than describing song singing by selected and single features such as pitch accuracy or vocal range, the present approach provides a conception of songs as complexly ruled cultural devices that are rooted in sensorimotor and socially shared feelings and experiences. As traditional rituals, songs convey hyper-generalized feelings (Branco & Valsiner, 2010), yet transmitted as highly formalized and socially shared performances. Feeling and form are mutually constitutive, and normally, they function at subconscious or intuitive levels. Microanalyses of the process how children create new songs provide insights into the complex organization of a hitherto seemly simple act. The analysis and description of vocalisations also allow visualizing otherwise transient events and thereby investigating some crucial moments of the very act of creating vocal forms at the basis of felt and remembered sensorimotor experiences. It is still a mystery, how to explain the fact that even very young children strive for creating well-formed vocal products or well-formed expressive entities. Of course it is related to experiencing parents or caretakers as creators of songs whose timing of vocal sounds is metrical, symmetrical, and hierarchically organized, stimulating simultaneous body movements and countless repetitions.

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Enriching the blend: Creative extensions to conceptual blending in music

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ABSTRACT

In this paper we critically investigate the application of Fauconnier & Turner's Conceptual Blending Theory (CBT) in music, to expose a series of questions and aporias highlighted by current and recent theoretical work in the field. Investigating divisions between different levels of musical conceptualization and blending, we question the common distinction between intra- and extra-musical blending as well as the usually retrospective and explicative application of CBT. In response to these limitations, we argue that more emphasis could be given to bottom-up, contextual, creative and collaborative perspectives of conceptual blending in music. This discussion is illustrated by recent and in-progress practical research developed as part of the COINVENT project, and investigating structural and cross-domain blending in computational and social creativity contexts.

I. BACKGROUND & CRITICAL QUESTIONS

A. Conceptual Blending in Music

Conceptual Blending or Conceptual Integration (Fauconnier & Turner 2001) is a cognitive theory whereby elements from diverse but structurally compatible mental spaces are 'blended' giving rise to new or enriched concepts. The blending paradigm extends Lakoff & Johnson's (1980) influential theory of Conceptual Metaphor (CMT), to suggest multiple integrations operating across different conceptual spaces, rather than unidirectional cross-domain mapping between a source and a target domain. Blending has been discussed extensively with regard to several fields, but has primarily been applied to language and mathematics. The theory has also been criticized as a 'theory of everything' (Gibbs 2000), given that its potential scope is so broad. Consequently, research in blending often focuses more on designing case-specific experiments for particular applications of the theory, and on building constraints and optimality principles for narrowing its scope (e.g. Bache 2005).

With regards to music, conceptual blending has been predominantly theorized as the cross-domain integration of musical & extra-musical domains such as text or image (e.g. Zbikowski 2002 & 2008; Cook 2001; Moore 2012), and primarily discussed from a musico-analytical perspective focusing on structural and semantic integration, between e.g. musical and textual rhythms, verbal and musical meaning etc.

Blending as a phenomenon involving "intra-musical" elements (Spitzer 2003, Antovic 2011) is less straightforward. In principle, one of the main differences of blending theory from CMT is that it may involve mappings between incongruous spaces *within* a domain (e.g. conflicting tonalities in a musical composition). In this case, 'intra-musical' conceptual blending in music is often conflated with the notion of structural blending (e.g. Kaliakatsos-Papakostas *et al.* 2014, Ox 2012) and Fauconnier and Turner's theory is primarily applied to the integration of different or conflicting structural elements, such as chords, harmonic spaces, or even melodic-harmonic material from different idioms. Nevertheless the recourse to intra-musicality, and its implicit identification with structure, is not a neutral gesture; in fact it brings a number of questions to the fore, including:

- What is a musical concept?
- What constitutes structural blending in music and how does it relate to / differ from cross-domain blending and mapping?
- What can blending theory tell us about music not only as top-down formalized structure but as an emergent, data-driven, creative activity?

In their work on algebraic semiotics, Goguen & Harrell (2010) have distinguished conceptual blending from structural blending; they have used the latter to enrich the linguistic notion of blending with "structure building operations" (291), which include the composition of syntax, narrative etc. In this respect, their approach is one of the few cases that have dealt with blending from a bottom-up, creative perspective of *generating* novel blends rather than analysing existent ones (see next section).

In defining musical concepts and the process of their formation, it is common practice to rely on divisions between what is 'music in the proper sense' and what falls outside of its scope. Such divisions, as we shall argue in the next section, are perhaps one of the reasons for the relatively limited application of blending theory in music thus far.

B. Revisiting the Intra- / Extra-musical Divide in Musical Conceptualization

"The intramusical (simply referred to, in music parlance, as 'music') is captured either in the inscription of notation, or in specifically quantifiable, audible phenomena. Only what avails itself of the assignment of specific musical values (i.e., pitch [and pitch relations], meter, tempo, dynamics, instrumental voicing) is proclaimed internal to the proper concerns of music. All else is extramusical." (Kim-Cohen 2009, p.40)

The passage above illustrates the problems of an age-old division between "absolute" and "programme" music (Hanslick 1891), also manifested in "absolutist" versus "referentialist" accounts of musical meaning (Deutsch 2013, p.589). Several recent theories attempt to break this binary down, or develop it into somewhat more encompassing, tripartite models of musical

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meaning and conceptualization. Koelsch (2013), for instance, adds a further category, "musicogenic" meaning, which refers to physical, emotional and "personality-related" responses to music. At the same time, he essentially retains the traditional definition of intra-musical meaning as the product of "structural relations between musical elements" (p.xi) and considers extra-musical meaning as "iconic, indexical or symbolic" (p.xi, p.157).

Koelsch's tripartite model is not without its parallels. Brandt's (2009) typology of formal, emotional and referential levels of musical conceptualization can be neatly mapped onto the former categories of intra-, musicogenic, and extra-musical meaning respectively. A similar division is found in Kühl (2007), but, unlike Brandt, the tripartite typology of emotion, cognition and kinaesthetics is not depicted as a linear progression, but rather as a cycle (for a detailed evaluation of tripartite models such as these, as well as an overview of terminological issues relating to levels of conceptualization and the number of conceptual spaces at play in this process, see Antovic 2011).

Fauconnier and Turner's theory, however, rests more on the assumption of conceptualization as an ordered, if not entirely linear, progression, and essentially posits three stages (or "levels") of blending: Composition, Completion and Elaboration. As Bache (2005) notes, progression between these stages is depicted as a directional process, which emphasises the subconscious, automatic aspects of integration over the conscious process of dis-integrating elements in order to reach an optimal selection of features for blending. In response, Bache proposes an alternative three-level model, starting from a low-level process of "Binding" conceptual spaces (Level 1), then moving on to more abstract "Construction Building" (Level 2), and finally, reaching a "Partial Selection" Blend (Level 3), achieved through a number of consciously imposed constraints on the lower-level blends.

A fundamental limitation in all of the above divisions is that they are retrospective analyses of progressions between different levels of conceptualization; in other words post-hoc accounts of concepts that have already been formed and are in common use. Hence, even though Fauconnier and Turner (1994; 2002) have theorised blending in relation to concept formation, emergence and invention is largely studied by looking at concepts as the already formed *products* of blending processes, rather than setting up processes that may lead to a new formation. As Schorlemmer *et al.* (2014) note, CBT is "silent on issues that are relevant if conceptual blending is to be used as a mechanism for designing creative systems… [It] does not specify *how* novel blends are constructed" (2014, p.2). Studies like Goguen and Harrell (2010, see previous section) are a promising step in this direction, which in recent years has been followed more systematically in some domains, particularly the intersection of computational creativity and poetry (see e.g. Corneli *et al*, forthcoming). To our knowledge, however, there is very little evidence of similar research dealing with generative, creative theorisations and applications of blending in music. The fact that "composition", a term assigned to one of the most complex high-level functions in music is used in CBT to refer to the most basic-level process of subconscious binding between domains also indicates that the ordering of levels in CBT might require some adjustment and relativisation if it is to be applied to musical creativity.

A further problem with retrospective applications of the blending model (i.e. identifying a pre-existent blend, then examining how it was constructed) is that they are less relevant to High-Context situations (Hall 1992), where structural and semantic relations are formed ad-hoc and are extremely case-specific. However, for socio-centric, contextualist theories of musical meaning, pretty much all music could be considered high-context, so long as it is inextricably tied with the subjective, variable nature of real-time performance and interpretation. Schutz (1951) goes so far as describing music as "a meaningful context which is not bound to a conceptual scheme". In practice, this could mean that musical conceptualization is much more dependent on dynamic, context-specific processes than it is tied to fixed, determinate products.

The issue at hand, then, is to develop ways of overcoming an analytical bias on fixed content theorisation and top-down / post-hoc formalisation, and to also look for bottom-up, creative applications of blending in the context of compositional and performative musical processes.

II. BLENDING AS MUSICAL CONCEPT INVENTION: TWO EXAMPLES

A. Melodic Harmonisation & Structural Blending

Structural blending processes appear in music across several formal musical levels, from the level of individual pieces harmoniously combining music features of different pieces or styles, to the level of entire musical styles having emerged as a result of blending between diverse music idioms (for instance, jazz can be seen as 'blend' of african music, european harmony and american pop, or, bossa nova as combining samba and jazz; more generally, fusion music 'fuses' musical characteristics of different idioms/styles). Can such blending be considered as conceptual blending or is it a different type of blending? What is a music concept in the context of structural blending?

Goguen (2003) suggests that structural blending is different from conceptual blending: "Whereas conceptual spaces are good for studying meaning in natural language, they are not adequate for user interface design and other applications where structure is important, such as web design and music. For example, conceptual spaces and conceptual blending can help us understand concepts about music, but semiotic spaces and structural blending are needed for an adequate treatment of the structure of music, e.g., how a melody can be combined with a sequence of chords." (p.9). Conceptual blending is good for blending concepts about things (i.e. conceptual spaces that describe high-level language-related descriptions of things) but less adequate for blending the structure of things.

In the context of the COINVENT project (Schorlemmer et al., 2014) a model is being developed that is based on Goguen's proposal of a Unified Concept Theory (Goguen, 2006), inspired by the category-theoretical formalisation of blending (Goguen,

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1999). As an illustration of the model's potentialities, a proof-of-concept autonomous computational creative system that performs melodic harmonisation is developed. In this section, we present and discuss a couple of creative examples that have arisen in the context of the COINVENT melodic harmoniser.

In the current project, music concepts are taken to be generalisations of harmonic entities and relations, derived from a corpus of harmonic annotated data via statistical learning. This data-driven approach ensures that learned concepts adequately reflect characteristics of different harmonic idioms. From each independent harmonic space (e.g. modal, common-practice tonal, jazz, atonal, organum, etc.), represented by a set of characteristic annotated music pieces, important harmonic concepts (e.g., chord types and categories, chord transitions, chords at phrase endings, note connections of successive chords, etc) are automatically extracted and encoded. This structural information sometimes corresponds to standard musicological linguistic terms (e.g. 'cadence', 'perfect cadence', 'dominant', 'leading-note' etc.), bringing the learned musical concepts closer to the standard notion of 'concept' in the domain of cognitive linguistics. In any case, the important aspect of this approach is that manual hand-coding of structural concepts is avoided, and emphasis is given to bottom-up data-driven knowledge acquisition.

Another important aspect of the adopted methodology, is context-sensitivity. The acquired structural descriptions are relative and meaningful within the context of a particular corpus of musical works. Music is defined in a circular manner as something that specific human cultures identify as being music (no general definition of music exists); specific music contexts define relative musical concepts. The adopted corpus-based learning methodology is one way to respect contextuality, flexibility and adaptability of harmonic descriptions; such automatically derived 'ontologies' may be employed in conceptual blending.

Most of the research in conceptual blending in the domain of music involves *explication* – particular music passages or pieces involving, for instance, music-image or music-text blends, or even structural blending between chords (as in an excerpt by Stravinsky, analysed by Ox, 2014). All such studies provide a rich interpretation of the selected music examples via Conceptual Integration Networks (CINs). It is, however, anything but trivial to reverse such processes so as to employ the constructed CINs with a view to generating new music examples. Constructing a blending framework that can be used for the invention of new concepts and new musical structures is a much more complex procedure; an abstract language-based CIN outline is not sufficient. What is required, is rich ontologies for the input spaces (including redundancy), a strategy for constructing the generic space (i.e. what the two input spaces share), and then to find efficient strategies to combine 'weakened' descriptions of the input spaces that avoid inconsistencies/contradictions and at the same time preserve important properties of the input spaces (using possibly priorities/saliences and other heuristics). Some preliminary examples in this vein are given below.

Take, for instance, blending chords and more specifically blending (prefinal) chords in the context of cadences (Cambouropoulos et al. 2015; Zacharakis et al. 2015). It is possible to interpret a certain chord as a blend between other established types of chords. For example, let's examine briefly the augmented sixth chords, and more specifically the German sixth chord (Figure 1). It is established that augmented sixth chords have a strong predominant function (Kostka-Payne, 2000, p. 385) and can be seen both as having a secondary dominant character (Piston, 1978) and a phrygian cadence character (Aldwell & Schachter, 2010). A Conceptual Integration Network (CIN) can easily be constructed to illustrated the German Sixth as a blend, with the Secondary Dominant (V7/V) and the Phrygian cadences as input spaces, and a general cadence description as generic space (brief verbal descriptions can be introduced in the CIN such as 'leading note' for the secondary dominant or 'descending semitone to tonic' for the phrygian input space). This may look good and may highlight the character of a given chord, but it cannot be used to generate new blended cadences or chord progressions.

The current research project is geared towards generation and creative production, not simply explanation. Conceptual blending is employed as a means to construct novel melodic harmonisations and, even more so, new harmonic spaces that can harmonise new unseen melodies. In this sense, constructing rich ontologies for chords and chord progressions in the above example, i.e. chord blending in the context of cadences, and specifying precise mechanisms for blending is anything but trivial. Multiple representations of constituent chord types, roots, bass notes, chord note doublings or ommissions, chord transitions and voice leading, relations between constituent chords in conjunction with weights/priorities for all these properties (i.e., which are more important/salient) are necessary, for a plausible chord blending mechanism to be devised and implemented as a computer program. Appropriate search strategies are paramount in any attempt to create 'meaningful' cadence blends, i.e. blends that preserve salient properties of the two input spaces. A more detailed account of how the COINVENT blending core model can create useful chord blends is given in (Eppe et al, 2015) and an empirical evaluation of the algorithm's output is presented in (Zacharakis et al. 2015).

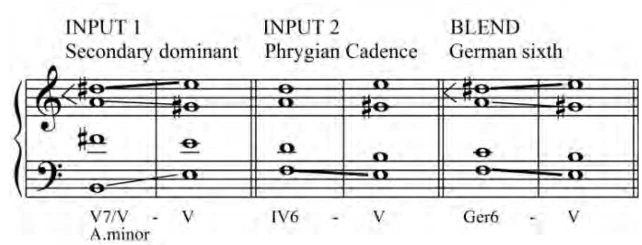

Figure 1. Blending between the secondary dominant and phrygian cadences (both ending on the dominant) gives rise to the augmented sixth chords, such as the German sixth.

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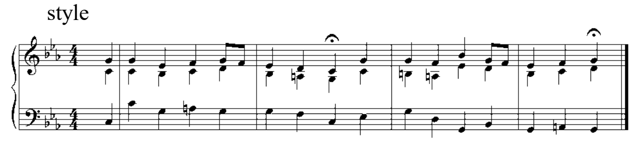
If blending of chords is a relatively complex procedure, employing blending in melodic harmonisation is much more so. A melody embodies a rich set of musical concepts that relate to scales, tonal centres, motives, cadential patterns, phrase structure, rhythmic characteristics, implied harmony, and so on. Harmonising a given melody within its implied 'natural' harmonic space involves primarily exploratory creative processes (finding a novel solution within a given harmonic space), whereas a foreign harmonic language triggers the need to combine different musical spaces leading to novel harmonic concepts (combinational creativity). A number of different harmonisations of a single melody are given in Figure 2; the harmonisations are created automatically by the COINVENT melodic harmoniser (at this stage, chord types are computer-generated - voice leading is added manually). The creative system is expected to be able to adapt/adjust existing harmonic systems to foreign (possibly incompatible) melodic structures by means of transformation and/or invention of new harmonic concepts (more details in Cambouropoulos et al. 2015).

a. Bach Chorale melody harmonised in medieval Fauxbourdon style



b. Bach Chorale melody harmonised in Renaissance modal style

Figure 2. Two different harmonisations of a Bach Chorale melody (chord types generated by melodic harmoniser) – reprint from (Cambouropoulos et al. 2015).

It is maintained that a melodic harmonisation assistant that facilitates conceptual blending should allow a modular highly structured representation of harmonic concepts in an explicit manner at various hierarchic levels and parametric viewpoints. In this study, these harmonic concepts are not manually conctructed, but, instead, are induced via machine learning from harmonically annotated datasets. Five constituent structural components of harmony are explicitly represented:

- Harmonic pitch space: scales, pitch hierarchies in scales, consonance/dissonance, chord types.
- Chord transitions: Learning of chord transitions from corpus data in one or more idioms/styles.
- Cadences: Learning of chord transitions that end phrases at various hierarchic levels.
- Modulations: Changes of harmonic pitch spaces that characterise a certain style.
- Voice leading: general characteristics of the way chords are realised and connected in a given idiom.

Once structural characteristics of diverse harmonic idioms are induced in an explicit modular fashion, then blends can be created that combine different harmonic aspects from different harmonic spaces. For instance, modal chord transitions may be combined with tonal cadences (see example in Figure 3), or, more daring blends may be generated that combine, say, messiaen-like octatonic chord transitions with tonal voice leading and modal Renaissance cadences. Such harmonic blending experiments may produce novel harmonic spaces that can generate new interesting melodic harmonisations.

Figure 3. Bach Chorale melody harmonised in medieval Fauxbourdon style with inserted tonal cadences (cf. Figure 2a) – reprint from (Cambouropoulos et al. 2015).

B. Blending in the Context of Social / Distributed Creativity: FolioHarmonies

The importance of collaboration and social interaction in problem-solving as well as more open-ended creative tasks involving structural blending has formed the basis of a series of recent studies, particularly in the fields of mathematics and computational creativity. Inspired by Tim Gowers' (2009a; 2009b) work on collaborative mathematics, Pease (2012; 2014) and Corneli (2014) employ qualitative methodologies to look at the process by which novel solutions, often the result of blended thinking, emerge in social situations (such as an online community of bloggers or peer-to-peer environment contributors, sharing solutions to a mathematical problem).

In music, Georgina Born's notion of "distributed creativity" (2005, p.34) and its subsequent elaboration by Clarke *et al.* (2012; 2013) extends the understanding of musical creativity towards a more pragmatic, process-based understanding of music as an activity distributed across several different agents and attached to everyday activities. This is not without its contingences, particularly when considering music's double role as a social practice and as an autonomous art object in some cultures. In the majority of Western Art Music contexts, for instance, musical performance itself is of secondary importance, and emphasis is placed on fixed-content musical works; consequently, the social distribution of creativity is seen as an extraneous side-effect of the musical process (hence the performance ideal of Western Art Music largely assumes a Low-Context distribution of musical meaning). By contrast, in situations where music is understood as a more flexible, context-sensitive continuum of actions, as in various kinds of improvised or indeterminate composition (e.g. using graphic scores) the unique creative content of every performance can be examined according to more case-specific rules.

In such situations, multiple agents are engaged in a real-time as well as post-hoc interplay of subjective questions and answers: "what is this? is it good/right? is it bad/wrong? is it

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even music?". As a result, the very question of ontology for every improvised soundwork is both formative and dependent on the process of performance. As Russell (2009) summarizes, "this approach is not ontology understood as the deduction of reality from logical categories: it is the deduction of those categories from reality." (Russell 2009, 78).

How do musical structures emerge and combine in such contexts, and what is the role of conceptual blending in an open-ended, indeterminate music-making situation? In May-June 2014, a loosely structured qualitative study was set up and carried out at the School of Music Studies, Aristotle University of Thessaloniki, to explore social creativity & cross-domain musical blends, supported by the COINVENT project. A private blog was set up at http://folioharmonies.wordpress.com and student participants were invited to contribute as Authors, documenting their responses to an open task.

Participants were given two kinds of sources: (A) an example of a post-1945 graphic score (Folio: December 1952 by Earle Brown, which bears no verbal instructions and uses abstract visual symbols instead of conventional musical notation (B) a set of harmonic space paradigms, drawn from examples used in the COINVENT harmonisation trials. These included sample chord progressions and harmonic reductions of composition segments by five prominent early 20th-century composers, and suggestions for extending the harmonic framework beyond these paradigms (e.g. free harmony).

The task was to collaboratively compose and/or improvise a novel piece, putting these two kinds of sources to use in any combination, following discussion and rehearsal. This latter aspect was emphasized as equally if not more important than the collaborative end-product itself. Setting up and documenting an open-ended process with unknown outcomes was one of the study's key features, aiming at gathering a rich set of process-based, context-specific documentation data.

Participants formed four ad-hoc groups of two to three students each, and collaboratively composed and performed four new pieces. A summary of end products as described by participants themselves upon completion of the study is presented in Table 1 below.

Table 1. End Products in FolioHarmonies

Piece	**Ontology description (by participants)**	**Content description (by participants)**	**Study materials used**
Routes and Destinations	Original composition, resulting from a reworking of the Earle Brown graphic score	A combination of 'noise' and harmonic spaces	Graphic score as structural device & free selection of harmonic paradigms (diatonic / chromatic / clusters)
Me, You, Them	Original "sonic narrative"	A non-verbal narrative around the idea of people forming groups and/or struggling on their own. Each person's 'colour' depicted through a distinct harmonic space, running concurrently and occasionally blending.	Graphic score as structural device & literal individual quoting of particular harmonic successions by each player
December 1952 / Great Smog	Collage or controlled improvisation in two sections	2 pieces in 1, starting with a realization of the graphic score and culminating in a controlled improvisation, with set harmonic material structured around elements of the graphic score	Graphic score as structural and semantic device (on one section) & personal selection of particular harmonic paradigms for each player (drawn from Satie, Messiaen, Bartok)
3/2D in 5-10	Controlled improvisation (inspired by the Earle Brown graphic score).	A 2-dimension space being permeated by 3-dimension volumes, depicted musically as vocal and piano pitches and «noises» against an atonal ostinato background	Graphic score only as a starting reference. Harmonic spaces explored at random and in real time by each player.

What kinds of data can an open-ended experiment like this yield, and what can it tell us about musical concepts and conceptual blending in music? Working with participants who had no prior conceptions or experience in free improvisation, composition or open score performance, and focusing on how they approached the open-ended tasks of combining two dissimilar sources into the composition and performance of original piece of music, enabled us to examine the emergence of novel blends in a social setting. Questions regarding ontology,

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structure, style and evaluation ("what are we making?", "what context are we making it for?", "why are we making it like this?" and "how do we assess it?") were formulated and answered on an ad-hoc, context-specific, dialogical basis.

Upon a first-level analysis of participants' communication patterns, shared problem-solving patterns also emerged across all four groups. Although not always in the same linear order, all groups followed strategies that could be summarised as follows (Stefanou 2015):

1. *Narrowing the problem space* (e.g. from an open "what if..." or a more case-specific "what to do with these two sources" to a directional "how can we use source A [the harmonic spaces] to interpret source B [the graphic score]" and "how do we make this work?")

2. *Assigning functions and/or meaning to the set material* (e.g. using particular elements in the graphic score as durational markers, or assigning narrative significance to particular harmonies)

3. *Mapping sonic elements onto visual ones*, and vice versa (e.g. creating subscores and testing them via different realisations)

4. *Defining end-product ontologies* (agreeing on what the resultant piece should be described as, and what its constituent elements are).

Three out of four groups (Groups 1, 2 and 4) also produced visual work in the form of 'study scores', aside from their sonic end-products and performances. In the example below (Figure 4), the graph depicts physical motion of the performers in space (red line), with sonic events marked as numbered rectangles on the Earle Brown score. Horizontal rectangles in this version were interpreted as phrases and vertical ones as cadences, drawn from the given harmonic spaces. The marked course was to be followed by a 'lead' singing performer, while two other performers on pianos played melodic and harmonic segments in two clashing tonalities.

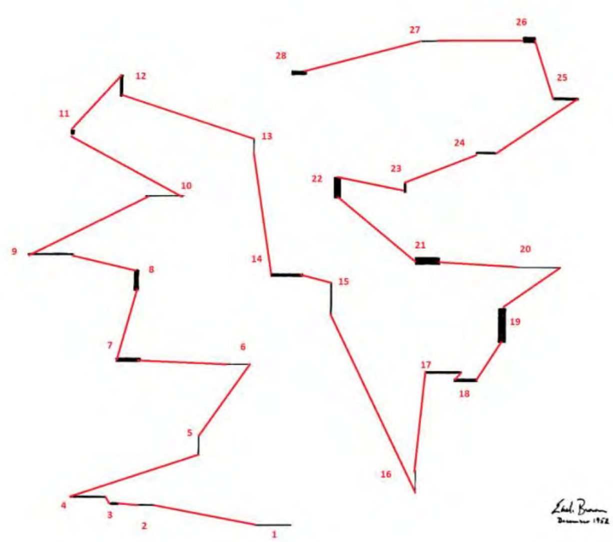

Figure 4. Sub-score developed by Group 2 for *Me, You, Them*.

By creatively integrating two types of inputs – an indeterminate graphic score and a set of determinate harmonic spaces – each group produced something more than a hybrid, exceeding and transcending the two sources. This was largely assisted by the introduction of new elements as 'constraints', to optimize the process. The two types of input might appear to be drawn from the same broad domain (music), and both were presented as source material from which a composition could be made. Nevertheless, they were in fact associated with two distinctly different idioms or even genres (indeterminate / open score music in the case of source A, and harmonic composition in the case of source B). As a stylistic and/or structural constraint, most participants resorted to a third kind of source, which was not given from the onset. Such parameters could be thought of as 'extra-musical', but were described and handled by participants as anything but that; they included noise, pre-recorded sounds and mixed-media (Group 1) narrative and spatial / theatrical motion (Group 2, see Figure 4 above), videos (Group 3).

The cross-domain mapping between visual and sonic spaces was extensive, and permeated all levels of the process. One of the most significant, and somewhat unexpected conceptualisations to have emerged during the study was the dual metaphor "HARMONIES ARE TEXT" / "GRAPHIC SCORE IS SOUND". Across all four groups, participants used references to reading, vision, and texts when referring to source B (the harmonic paradigms), while consistently evoking hearing, listening and sound in relation to source A (the graphic score example). Harmonic paradigms were conceived as something to be "read", "said" (see example 1) and made quasi-verbal sense of. Moreover, they were metonymically associated with the composers of the examples they were drawn from (mentions of "octatonic harmony", for instance, were quickly substituted by references to "the Stravinsky").

A further instance of conceptual metaphor in operation could be articulated as "GRAPHIC SCORE IS SPACE". Despite assigning different status to the two source materials (as e.g. prompts, scripts, maps, targets, or sources) all groups tackled the graphic scores in terms of a space that had to be "navigated" (Groups 1 and 4), a surface that had to be "mapped" (Group 2), or a framework that the harmonies had to "fit into" (Group 3), consistently employing spatial metaphors and in some cases (as in Figure 4 above) translating these into literal motion in the performance space.

In terms of the transformation and structural integration of the given harmonic paradigms, it is interesting also to compare how the exact same material received different handling and was therefore imbued with entirely different meaning across groups. A modal mixture exemplified in bars 3-16 of Bartok's Romanian Dance no.4, for instance, was employed as a structural and narrative device by Group 2, and was used as a kind of main theme, introduced by the leading performer at the start of the piece, and strategically reiterated at the end, to bring the harmonic spaces of all three performers to a convergence. By contrast, Group 1 (see example 1 below) re-framed the mixture entirely, conceptualising it as "oriental".

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Example 1: conversation segment, Group 1

Player 2: I won't tune the C differently. Because it sounds nice as it is written. Actually you know what? With a guitar we can say [*sic*] Bartok. And the other could be e.g. pentatonic, like you also said. Also thirds would be nice.

Player 1: With thirds yes, this could work. Shall we try it? Actually shall we try doing it first, to see how it sounds if we both have Bartok going on? On both guitars. Or we may even include another two guitars. And we have the electric one too. […]

[playing]

Player 1: […] Now it has this kind of, I don't know, a Chinese quality to it.

Player 2: So yes, let's add an extra layer… like something oriental, you know, Chinese.

While the material gathered during this study allows for much deeper analysis across several levels, overall the prioritisation of process and social context enabled the formulation of radically relativised ontologies and shared concepts to describe such ontologies. It also fostered a dynamic, multi-level approach to blending, from the level of harmonisation and melodic-harmonic relations, to that of overall forms and end-product pieces.

III. CONCLUSIONS & NEXT STEPS

What becomes evident during a preliminary evaluation of the above examples is that, in applying conceptual blending models to compositional / creative musical processes, a lot needs to be specified, particularly if we are to move beyond a post-hoc explication of existent musical structures and onto the invention & creation of new blends.

In this research we have been going in two directions simultaneously:

a) exploring structural blending in music, in the context of computational creativity

b) investigating how cross-domain blending and conceptual metaphor are implicated in collaborative musical creativity situations in humans

We have also been looking at issues of terminology in the applications of CBT to music so far, particularly with an eye to better situating such research in contexts that are both inclusive (i.e. not using unnecessary or aesthetically biased divisions between conceptual categories) and specific (i.e. formulating a given scope as precisely as possible, so that the appropriate kinds of constraints and optimality principles can be identified and applied in the construction of new blends).

The idea that emergent structural blends do not have to be classified as intra- or extra-musical, but at the same time, need to be described more precisely in terms of the level at which they operate and the context / framework in which they can be considered as blends, is key to this effort. The rather vague, and historically loaded metaphor of music as an exclusive core around which other domains orbit independently (Spitzer 2003) appears less and less relevant to an investigation of structural blending and concept invention in music. By contrast, further research on the types of blending observed in bottom-up creative processes might have significant impact on our understanding of how novel structures and concepts emerge in music, how they are dynamically re-framed and re-situated in high-context situations, and how we conceptualize these transformations across different styles, idioms and genres.

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The effect of the presence of music on soundscape evaluations

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ABSTRACT

Background

Music is an important part of our everyday acoustic environment. While many sounds in our environment may cause annoyance in people, music is the canonical example of a sound source that can enhance mood states (e.g. Saarikallio, Nieminen, & Brattico, 2013) and support everyday activities like sport and exercise (e.g. Baldari et al., 2010). The motivation of a person to listen to music and the actual use of music is dependent upon situation (e.g. North & Hargreaves, 1996). Juslin et al. (2008) studied music listening in its natural context by comparing musical and non-musical episodes in everyday life situations. The authors observed differences in the prevalence (relative frequency of occurrence) of certain emotions such as happiness, nostalgia (more frequent in musical episodes), anger, and anxiety (more frequent in non-musical episodes).

The use of music is further related to certain personality traits such as Openness to Experience. This factor is associated to a high frequency of aesthetic chills and excitement in response to art (McCrae & Costa, 1997). Chamorro-Premuzic et al. (2009) could show that Openness to Experience particularly predicted cognitive use of music while individuals scoring high in Neuroticism were more likely to use music for emotional regulation. One personality trait governing soundscape in general is noise sensitivity. This trait covers attitudes toward a wide range of environmental sounds and has shown to be a major factor explaining noise annoyance reactions (Ellermeier, Eigenstetter, & Zimmer, 2001).

Investigations on the influence of situational variables and personality traits on soundscape on the one hand and music perception on the other have predominantly been done by researchers belonging to different research areas, despite the overlapping contexts and relevance of findings. Thus, the main aim of our study is to bridge gaps between both disciplines and to investigate how music contributes to our perception of the “acoustic environment as perceived or experienced and/or understood by a person or people, in context" (soundscape as defined by the ISO working group TC43 SC1 WG 54).

Aims

In more detail, we were interested in understanding how the presence of music as a possible sound source amongst others in a soundscape influences its evaluation, namely: the perceived pleasantness, eventfulness, and familiarity of a soundscape (the three main soundscape dimensions according to Axelsson, Nilsson, & Berglund, 2010), the pleasantness of the visual environment, and psychological factors such as mood and attention paid to the soundscape.

Moreover, we investigated which situational factors and personality traits can predict whether music is reported as being the predominant sound source in a soundscape (e.g. can we predict that certain types of participants will seek out musical soundscapes?).

Method

For our study, we used the Experience Sampling Method (ESM), an increasingly common method of data collection in which people are periodically prompted to make instantaneous judgments while going about their normal routine (Larson & Csikszentmihalyi, 1983). During our 7-day ESM study, 31 participants (16 women, 15 men, mean age: 28.8 years, SD: 5.6, 80.8% students) were prompted by a smartphone app at 10 near-random times per day within a pre-chosen 12-hour timeframe. They were asked to rate the pleasantness, eventfulness, and familiarity of the soundscape, the pleasantness of the visual environment, and the situational variables mood and attention paid to the soundscape. All evaluations were taken by means of a seven-step Likert scale ranging from 1 to 7. Additionally, participants had to report on their location (alone, around other, interacting with others), activity (free response format), and the predominant sound source(s) occurring in the soundscape (free response format). In our study, we only considered music as part of the soundscape when played live or via loudspeakers, not when played by headphones in public settings (an exception was made for situations where, for example, participants were watching movies or video chatting with headphones on). Upon completion of the study, participants filled out standard personality questionnaires (e.g. 10 Item Big Five Inventory (BFI-K; Rammstedt & John, 2005); Weinstein Noise Sensitivity Scale (Kishikawa et al., 2006)).

Results

Music was reported the predominant sound source in 11.2 % of the cases, in particular when people are at home (57.0 %) and/or alone (54.5 %). To investigate the effect of music as predominant sound source (hereinafter referred as to “musical episodes”, index: music), several linear mixed-model analyses were performed (Type III test of fixed effects; repeated covariance type: compound symmetry, within-subject factor: time, significance level □ = .05). These analyses reveal that in musical episodes significantly higher ratings for the soundscape factors pleasantness ($M_{music} = 5.5$, $M_{others} = 4.6$, $F = 82.1$,

$p < .001$), and eventfulness ($M_{music} = 3.8$, $M_{others} = 3.3$, $F = 13.6$, $p < .001$), are reported. These effects can also be observed when the home environment is considered separately (pleasantness: $M_{music} = 5.6$, $M_{others} = 5.0$, $F = 37.4$; $p < .001$; eventfulness: $M_{music} = 3.7$, $M_{others} = 2.9$, $F = 29.8$, $p < .001$). For the soundscape dimension familiarity, no analysis could be calculated due to convergence problems.

The results further reveal that ratings of the visual environment are significantly higher in musical episodes ($M_{music} = 5.2$, $M_{others} = 4.6$, $F = 16.0$, $p < .001$). Also this effect can even be observed when only considering the participants' home environment ($M_{music} = 5.5$, $M_{others} = 5.0$, $F = 10.7$, $p < .001$). Moreover, people report better mood states in musical episodes ($M_{music} = 5.5$, $M_{others} = 5.1$, $F = 16.1$, $p < .001$) and higher attention paid to the soundscape ($M_{music} = 4.1$, $M_{others} = 3.3$, $F = 42.7$, $p < .001$).

Last but not least, we investigated whether the prevalence of situational variables (e.g. company of other people, certain activities), personality traits, and their interaction terms are correlated with the prevalence of musical episodes for each participant. Within the analysis, we found two factors significantly correlating with the prevalence of the musical episodes (Pearson product-moment correlation coefficients): First, the interaction of percentage time spent alone and the Big Five trait Openness to Experience ($r = .40$, $p = .03$). Second, the interaction of the prevalence of the activity "working on a task" and the noise sensitivity of a person ($r = 43$, $p = .05$). The interaction of entertainment and recreational activities shows a tendency towards statistical significance ($r = .39$, $p = .08$).

Conclusions

The results clearly show that music played live or via loudspeakers contributes positively to the pleasantness and eventfulness of a soundscape. The findings further suggest that music influences psychological states such as the attention paid to the soundscape and (as already found by other authors) peoples' mood states. Music does not only seem to govern the perception of the soundscape, but also how we experience our visual environment. The enhancing effect of music is possibly mediated by the person's mood which again has a positive influence on the judgment process in general.

The study provides insight on how people actively design and modify their soundscape by means of music, and how their reasons for doing so are dependent on their personality and the situation. The data analysis for example suggests that participants scoring high on noise sensitivity tend to listen to music to support working and recreational activities. It may be assumed that noise-sensitive people use this strategy to also mask unwanted environmental sounds. Musical episodes were further reported more frequently by participants who score high on Openness to Experience and spend a lot of their time alone. The results related to the association between music listening and Openness to Experience are in line with the findings reported in the introductory section. It may further be assumed that the influence of this personality trait only manifest in certain situations where people have high autonomy (like home alone) and where they are most likely to modify the soundscape according to their particular needs.

It must be stated that – as in (almost) every study using the Experience Sampling Method – no definite conclusions about causal relationships can be drawn due to a lack of experimental control. However, the ESM proves to be a valid method to help understanding the factors governing music listening behavior and the role of personality and situation in soundscape and music perception.

Keywords

Music in everyday life; Music and Emotion; Multimodal perception and performance.

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Inter-disciplinary integration in piano studies and music theory in one Estonian music school

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ABSTRACT

Background

Inter-disciplinary integration has been used in Estonia for a long time and it is in the state curricula for general schools. Still, awareness about the necessity of integration in Estonian music schools and the content connections between subjects are lacking.

Aims

The aim of the study is to analyze inter-disciplinary integration in Estonian music schools using the example of one school's piano studies and solfeggio, and to offer advice for further and more effective integration of piano studies and music theory.

Method

This study uses the case study model. For analyzing the integration of piano and music theory studies, first the curricula were compared. Second, the piano lessons of five teachers with five students were observed (each teacher and student combination for 3 hours). The qualitative content analysis method was used for the database.

Results

Based on the study, it can be claimed that in music school curricula, there is a plethora of ways to integrate music theory with piano studies. Yet, the lessons observed showed that these ways aren't utilized and the teachers are focused on their own subject, leaving the broader context aside (including supporting students' studies by integrating music theory and piano studies).

Conclusions

This case study offers the conclusion that inter-disciplinary integration in piano studies needs more attention. The study gives recommendations for more effective integration of piano and music theory studies. In addition to the pedagogical repertory of piano studies, more creative content, improvisation, rhythmic texture, etc., should be applied combining this into a specific music theory context, which supports inter-disciplinary integration.

Keywords

piano studies, music theory, inter-disciplinary integration, music studies.

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Visual rhythmicity in music-related human movements and its influence on auditory rhythm perception

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ABSTRACT

Background

Musical rhythm perception is closely connected to human movements, as humans move naturally to the musical beat, and that even passive listening to rhythms engages humans' internal motor system. The internal sensorimotor coupling found in auditory rhythm perception may, by means of action observation, occur in a similar manner when watching rhythmic human movements, such as dance. Thus far, it remains unclear how rhythms in dancelike movements are visually perceived, and how the auditory and visual rhythm information is combined perceptually in a music and dance scenario.

Aims

In a series of experiments, I examined how visual rhythmicity communicated by a periodic human bouncing movement influenced beat perception of concurrent auditory rhythms, and whether the effects supported the idea of audiovisual (AV) integration in the rhythm domain. A further study examined visual timing mechanisms of dancelike movements involving the upper and lower limbs, and their relation to auditory rhythm perception.

Method

In one study, participants listened to different auditory rhythms with or without observing a humanlike figure (presented as point-light biological motion) bouncing in-phase to the rhythms, and detected a possible auditory temporal deviant (perception task), or tapped synchronously to the auditory beat (synchronization task). Both tasks were performed under increasing levels of auditory interference. In a second study, the same figure moved either downward (congruently) or upward (incongruently) to an auditory beat sequence, while participants detected an auditory temporal deviant. In the last study, participants observed short videos of naturalistic dance movements that either contained periodic limb trajectories or not, and reproduced each duration by mental recall.

Results

The first study showed that observing the periodic human movement improved concurrent auditory beat perception and synchronization, as indexed by deviant detection and tapping stability, respectively. The effects were stronger when the auditory performance was more weakened by the interference, reflecting the inverse effectiveness principle in AV integration (Su, 2014a). The next study revealed poorer deviant detection when the observed movement was congruent than when it was incongruent with the auditory beat, suggesting stronger visual capture (i.e., AV integration) in the former based on perceived movement-beat compatibility (Su, 2014b). Finally, observation of dance movements containing periodic limb trajectories led to more accurate and consistent duration reproduction, compared to those without, and the same pattern was found in comparable auditory stimuli. This visual result persisted despite task-irrelevant auditory interferences.

Conclusions

Temporally structured movements, such as those found in dance, can communicate visual rhythms (here, a visual beat) to observers. While the visual mechanism resembles that of auditory beat perception, the movement information is not necessarily recoded into an auditory representation. Such observed movements can modulate beat perception of concurrent auditory rhythms, and the effects likely result from perceptual integration of auditory and visual rhythms. Thus, watching dancers' movements may affect the musical rhythms we perceive in parallel. Ongoing work is further investigating these effects in more complex movements.

Keywords

Rhythm perception, Cross-modal interaction, Music, Dance, Sensorimotor coupling.

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Exploring music-syntactic processing and language-syntactic processing in congenital amusia using MEG and EEG

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ABSTRACT

The current study is investigating music-syntactic processing and language-syntactic processing in congenital amusia using electroencephalography (EEG) and magnetoencephalography (MEG). For the music experiment, 80 western five-note-melodies were created with a piano timbre. They were randomly mixed with the same 80 melodies ending with an out-of-key note. Another 40 melodies were included that contain one note with a deviant instrument (i.e. guitar). Participants were asked to detect these timbre-deviants. For the language experiment, five-word English sentences were presented orally. The final word was either syntactically incorrect, semantically incongruent, or syntactically / semantically "correct". To ensure they attended to the stimuli, participants were occasionally required to answer questions on randomly selected trials related to the sentence they just heard. Brain activity was recorded using concurrent 160-channel MEG and 64-channel EEG. Preliminary EEG results showed that syntactic violations in both music and language elicited similar brain responses in normal controls (ERAN and N5 for the music task and ELAN and N400 for the language task); Amusics showed deficits to some extent in these event-related brain responses in both music and language tasks.

I. INTRODUCTION

Congenital amusia is commonly considered to be a deficit in fine-grained pitch perception that disproportionately disrupts the perception and appreciation of music, and includes an impaired ability to detect out-of-key tones in tonal music. The ability to detect out-of-key tones relies on music-syntactic processing, which is thought to be impaired as a consequence of lifelong difficulties perceiving and representing music. Behavioral studies have shown that congenital amusics exhibit reduced sensitivity to dissonance (Ayotte, Peretz, & Hyde, 2002) and harmony (Tillmann, Gosselin, Bigand, & Peretz, 2012). Not surprisingly, they also fail to exhibit a preference for consonant over dissonant chords (Cousineau, McDermott, & Peretz, 2012). Such findings suggest that deficits associated with congenital amusia extend beyond fine-grained pitch discrimination, and include difficulties employing music-syntactic rules.

Both music and language combine discrete elements into sequences according to learned conventions that can be codified into a set of rules (e.g., rules of harmony and counterpoint in music, rules of grammar in language). This common feature raises the possibility that the two domains share mechanisms for processing syntax. According to the "Shared Syntactic Resource Integration Hypothesis" (SSRIH) (Patel, 2003, 2012), linguistic and musical *representations* (e.g., words and phrases in speech; tones and chords in music) are stored in distinct brain networks (and can be selectively damaged), whereas the cognitive operations associated with syntactic processing may be shared. Support for the SSRIH has come from behavioural evidence (Fedorenko, Patel, Casasanto, Winawer, & Gibson, 2009; Slevc, Rosenberg, & Patel, 2009) and electrophysiological (ERP) evidence (S. Koelsch, Gunter, Wittfoth, & Sammler, 2005; Sammler et al., 2013).

Based on the SSRIH (Patel, 2003, 2012), the difficulty that congenital amusics exhibit with music-syntactic processing might extend to difficulties with linguisitic-syntactic processing. Conversely, a study of specific language impairment (SLI) revealed parallel deficits in music syntactic processing. Jentschke et al. used event-related potentials (ERPs) to examine music processing abilities in two groups of 4-to-5-year-old children. Children in one group had SLI and children in the other group were classified as having typical language development (TLD) (Jentschke, Koelsch, Sallat, & Friederici, 2008). For the TLD group, syntactic errors in language and music elicited an early right anterior negativity (ERAN) and N5. However, for the SLI group, neither ERAN nor N5 was observed. These results support the idea that linguistic-syntactic deficits extend to the domain of music.

Although individuals with congenital amusia do not appear to exhibit obvious language disorders in daily life (Foxton, Dean, Gee, Peretz, & Griffiths, 2004; I. Peretz et al., 2002), some studies have shown that they have subtle difficulties with aspects of language processing that depend on pitch information, such as speech intonation (Liu, Patel, Fourcin, & Stewart, 2010), lexical tone (Nan, Sun, & Peretz, 2010) and emotional speech prosody (Thompson, Marin, & Stewart, 2012). To date, however, little is known about their ability to process linguistic syntax. Any impairment may be subtle, as language is used so extensively every day. Thus, we used electroencephalography (EEG) and magnetoencephalography (MEG) to see whether individuals with amusia exhibit subtle impairments in linguistic syntactic processing.

There is a significant body of EEG research on music-syntactic processing and language-syntactic processing in a normal population. Some of the ERP components that are associated with music and language syntax are also of interest in the current investigation. Of primary interest is the early right anterior negativity (ERAN), which is correlated with music

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syntactic processing and has a latency of about 170-220 ms (Stefan Koelsch, 2012). ERAN is associated with frontal to centro-temporal scalp distribution and has a right hemispheric predominance. It can be elicited by contrasting expected chords or tones with music-syntactically irregular chords such as Neapolitan chords (Koelsch, Gunter, Friederici, & Schroger, 2000) or syntactically unexpected tones in melodies (Koelsch & Jentschke, 2010). N5 – another negativity that occurs later than ERAN – can also be elicited by syntactically irregular musical events. It has a peak latency of about 500-550 ms at the frontal electrodes. N5 is sensitive to harmonic context and may be related to the extraction of the musical meaning of events (Stefan Koelsch, 2012).

Similar to the ERAN, the early left anterior negativity (ELAN) has a latency of about 100-300 ms and is typically elicited by language-syntactic violations, including violations of the expected word category (Friederici, Pfeifer, & Hahne, 1993) and violations of morpho-syntactic agreement (Hasting & Kotz, 2008). On the other hand, N400 is typically related to semantic processing. It can be elicited by semantically or conceptually incongruent sentences or words. N400 has a negative polarity and a peak latency of around 400 ms at centro-parietal electrodes (Kutas & Federmeier, 2011).

In the current investigation, we examined music-syntactic processing and language-syntactic processing in congenital amusia using MEG, because its spatial resolution allows us to draw inferences about brain generators. We also collected EEG data in order to compare our results with the existing EEG literature (e.g., Jentschke et al, 2008). Two separate experimental sessions were conducted to evaluate music-syntactic processing and language-syntactic processing. A control condition involving semantic processing was also included in the language session. We predicted that individuals with congenital amusia should exhibit impaired brain responses during music-syntactic processing because of their musical impairment. However, no such impairment should be observed in the semantic condition, because semantic processing in language should operate independently of any music-related processing.

If language-syntactic processing is associated with abnormal brain activities in individuals with congenital amusia, then it would support the view that music-syntactic and language-syntactic processing share resources for syntactic processing. Conversely, if language-syntactic processing is associated with normal brain activities in individuals with congenital amusia, then it would suggest either that music and language syntactic processing operate independently, or that the musical impairment exhibited by amusics is unrelated to a shared network.

At this point, data collection is in progress and only a subset of the data can be described. Therefore, we will report a preliminary analysis based on the EEG data from nine control participants and three amusic participants.

II. METHOD

A. Participants

Participants had no self-reported neurological or psychiatric disorders, were metal-free for the MEG-EEG experiments, were right handed and had normal hearing. Twelve qualified participants have taken part in this study thus far (3 amusics and 9 controls, 18-33 years old). Three subtests (Scale, Contour and Interval) of the Montreal Battery of Evaluation of Amusia (MBEA) were used to evaluate whether or not participants had congenital amusia (I. Peretz, Champod, & Hyde, 2003). Participants who scored 65 or less out of 90 points on the three melodic subtests were classified as amusic. Handedness was determined using the Oldfield Handedness Questionnaire (Oldfield, 1971) and hearing was measured using an Otovation Amplitude T3 series audiometer (Otovation LLC, King of Prussia) for both ears at frequencies 0.25, 0.5, 1, 2, 4, and 8 kHz (20 dB is the cutoff for each frequency).

B. Pre-test

In order to evaluate tonality processing, an out-of-key detection task was administered to all participants prior to the EEG/MEG experiments. The task was taken from Peretz et al. (2008) and consisted of twelve melodies and twelve out-of-key versions of those melodies, drawn from the scale subtest of MBEA. On each trial, participants were presented with a single melody and they judged whether the melody contained a “sour” or “strange” note (i.e., outside of the implied key).

C. Stimuli

The music stimuli consisted of 80 five-note-melodies created in C major with piano timbre and no periods of silence between consecutive tones. These “in-key” melodies were randomly combined with the same melodies in which the final tones were shifted up or down until they were no longer compatible with a C major scale (out-of-key melodies). All tones fell within the pitch range of G3 to C5. The final interval size (small interval: 1-3 semitones or big interval: 4-7 semitones), interval direction (upward or downward) and number of contour changes in the whole melody (2, 3 or 4 changes) were not significantly different in the in-key and out-of-key conditions (final interval size, χ^2 (1) = 0.025, p = 0.873; final interval direction, χ^2 (1) = 0.025, p = 0.873, contour changes, χ^2 (2) = 0.039, p = 0.981). Each of the first four notes had a duration of 600 ms and the final note always had a duration of 1200 ms. The melodies were digitally generated using GarageBand, v. 6.0.5 (Apple Inc., 2012).

An additional 40 probe melodies were included (half ending with an in-key tone and half ending with an out-of-key tone) that contained a single tone with a deviant instrument sound, i.e. a guitar sound. The deviant instrument sound could occur at any position except for the first position in the melody. Probe melodies were included to ensure that participants attended to the melodies (they were required to indicate when ever they detected a timbre change). Electrophysiological responses to these trials were excluded from the analyses.

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For the language stimuli, five-word sentences were constructed in English and had a fixed structure with the general form "[some one] is [doing] [one/two] [thing/things]". The final word was either grammatically and semantically correct, morpho-syntactically incorrect but semantically correct, or grammatical correct but semantically incongruent. Examples are given in Table 1. In order to avoid confounding the sound of "s" with the experimental conditions, both singular and plural words were included in each condition, as illustrated in Table 1. Each condition had 40 sentences ending with a singular noun and forty sentences ending with a plural noun. The semantically incongruent words were derived from the nouns contained in the semantically correct sentences.

Table 1. Examples of language stimuli.

Conditions	Patterns	Sentences
Correct	Singular	Linda is feeding one pig.
	Plural	Linda is feeding two pigs.
Incorrect	Singular	Linda is feeding one pigs.
	Plural	Linda is feeding two pig.
Incongruent	Singular	Linda is feeding one kite.
	Plural	Linda is feeding two kites.

This procedure resulted in 80 correct and 160 incorrect sentences (morpho-syntactic violations and semantic violations). Because an unbalanced number of correct and incorrect sentences might bias responses, another 80 filler sentences were constructed in the same way as the target (correct) sentences. Sixteen spoken questions concerning the content of the filler sentences were also recorded and subsequently used in the probe task. These questions were included to ensure that participants attended to the sentences, and related to the subject, verb or object of the sentence (e.g., "what is Linda feeding?" or "Who is feeding one pig?"). The fillers and probe questions were excluded from the data analyses.

The verbs and nouns used in all sentences were obtained from a corpus (Brysbaert & New, 2009) (SUBTLEXusExcel2007.xlsx. Retrieved November 26, 2013 from http://expsy.ugent.be/subtlexus/). A word frequency analysis (based on the value of log10WF from above corpus) was conducted to ensure no statistical difference in the frequency of verbs and nouns in the sentences across the three target conditions and fillers ($F(3, 319) = 1.227$, $p = 0.300$). The subject of each sentence was always a common English name (e.g., Linda). The various names that were used occurred consistently across conditions (e.g., "Linda" occurred in all conditions).

To standardise the acoustic features of the audio recordings across conditions, the correct sentences were spoken naturally by a female native Australian English speaker and recorded digitally. They were then edited and spliced using Praat software (en.wikipedia.org/wiki/Praat) to generate the audio recordings of the corresponding morpho-syntactically incorrect and semantically incongruent versions of those sentences. The duration of sentences was from 1.91 s to 2.88 s (mean = 2.57 s).

D. Procedure

For the music session, 200 melodies including 40 probe melodies were presented in an individually randomized order for each participant. Participants were not informed of the tonality violation but they were asked to take part in a probe task, i.e. detect any timbre-deviants by pressing a button. As five notes may not be sufficient to establish a strong sense of key, all participants started with a short warm-up session consisting of a looped presentation of the C major scale, which was intended to induce a strong C major context.

For the language session, 320 sentences including 80 fillers were presented randomly to each participant. Sixteen questions were also displayed at random points in the session. The participants were not informed about the morpho-syntactic or semantic violations. Instead, they were instructed to listen to the sentences and answer the questions by voice when they appeared. The question always appeared after the sentence to which it referred. Participants' answers to the questions were recorded manually.

The music and language sessions were presented in separate blocks in a counterbalanced order across participants. All stimuli were presented through insert earphones (Model ER-30, Etymotic Research Inc., Elk Grove Village, IL) and the intensity level was fixed at 80 dB SPL as measured on an audiometer.

E. EEG/MEG data acquisition

EEG was recorded using a BrainAmp MR plus MEG-compatible EEG system (BrainProducts Gmbh, Gilching, Germany). The EEG cap has 64 Ag/AgCl electrodes including an EKG channel and an EOG channel. All EEG data were referenced to FCz on-line.

Prior to MEG measurements, five head-position indicators (HPI) were attached to the EEG cap. Fiducial positions (preauricular points and nasion) and head shape were measured with a pen digitizer (Polhemus Fasttrack, Colchester, VT), in order to determine the position of the head inside the helmet using the co-registration between the HPIs on the head and the MEG sensors inside the helmet. The head movement tolerance was a maximum of 5 mm in any recording session. MEG measurements were conducted with a 160 channel whole-head MEG system (Model PQ1160R-N2, KIT, Kanazawa, Japan) with a 50 mm baseline (Kado et al., 1990). Both MEG and EEG data were acquired with a sampling rate of 1000 Hz and a filter band-pass of 0.03-200 Hz.

F. EEG data analysis

EEG data were processed and analyzed off-line using EEGLAB 13.3.2b (Delorme & Makeig, 2004) in MATLAB 7.11.1. All data were resampled to 500 Hz and re-referenced to the average reference offline. A 0.3 Hz high-pass filter (fir, 5500 points, Blackman window) was used to filter slow drifts. Strong muscle artifacts or technical artifacts were manually rejected. The data were segmented into epochs including the whole trial before entering into an independent component analysis (ICA) (epoch window was -500 to 3600 ms for melodies and -500 to 3900 ms). The resulting components were

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used to remove eye movement and blink artifacts, and artifacts of heartbeat. Afterwards, the data were filtered with a 30 Hz low-pass filter (fir, 184 points, Blackman window), and were segmented into epochs ranging from -200 to 1200 ms relative to the onset of the final tones in melodies and 1000 ms epochs ranging from -200 to 1000 ms relative to the onset of the final words or the onset of "s" (the morpheme of the plural) in sentences.

Considering the limited sample size, statistical analyses were not conducted. To look at the ERPs of interest, one electrode was selected for each condition: FC2 for the music-syntactic condition; F3 for the morpho-syntactic condition; and Cz for the semantic condition. The mean latency of the difference wave (the incongruous condition minus the congruous condition) at these electrodes was also calculated, in order to determine whether ERPs of interest were elicited by the manipulations.

As the MEG data have not been analysed, the analysis and the preliminary MEG results will not be discussed.

III. RESULTS AND DISCUSSION

A. Preliminary results on the out-of-key detection task

As predicted, the three amusic participants performed worse on the out-of-key detection task compared with the six control participants (for amusics, mean of d-prime value = 1.30, SD = 0.75; for controls, mean of d-prime value = 2.19, SD = 0.94; see Figure 1), though statistical analysis was not conducted given the limited sample size.

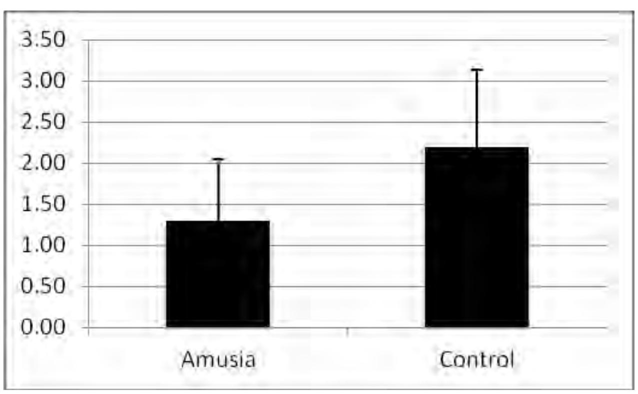

Figure 1 D-prime scores on the out-of-key detection task for amusic and control participants.

B. Preliminary EEG results

In the music session, the control group showed an ERAN in the time window of 150-300 ms (mean latency of different wave = 218.22 ms, SD = 44.23) and an N5 in the 400 - 600 time window (mean latency of different wave = 525.56 ms, SD = 46.24) as shown in Figure 2 (Panel A). However, such components were not observed in the amusia group, as illustrated in Figure 2 (Panel B).

In the language session, an ELAN within the time window of 100 to 300 ms was observed for the control participants, elicited by the morpho-syntactically incongruous words (mean latency of the difference wave = 200.67 ms, SD = 50.27) whereas a corresponding ELAN was not observed for the amusic participants (see Figure 3).

As displayed in Figure 4, an N400 elicited by the correct and semantically incongruous words was observed for both amusic and control participants (for amusic participants, the mean latency of the difference wave = 482.67 ms, SD = 67.21; for control participants, the mean latency of the difference wave = 481.55 ms, SD = 49.31).

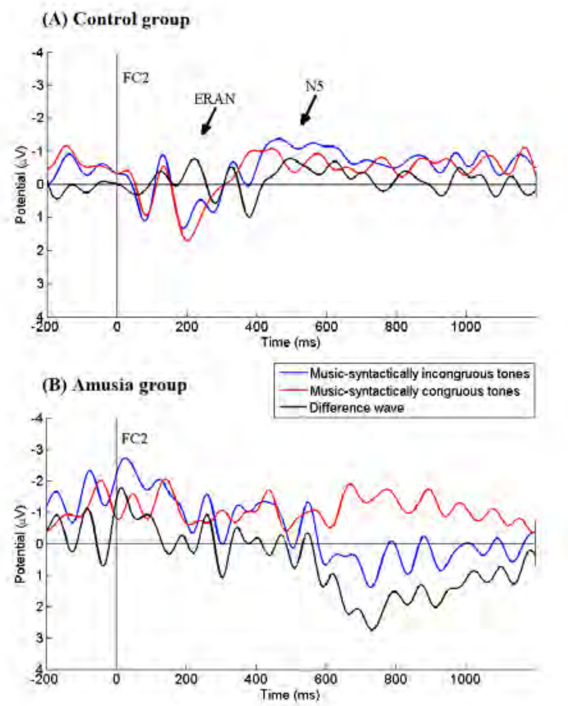

Figure 2 Grand-average ERPs elicited by music-syntactically incongruous tones recorded at electrode of FC2 from 9 control participants (top) and 3 amusic participants (bottom) (with 15 Hz filtering for display).

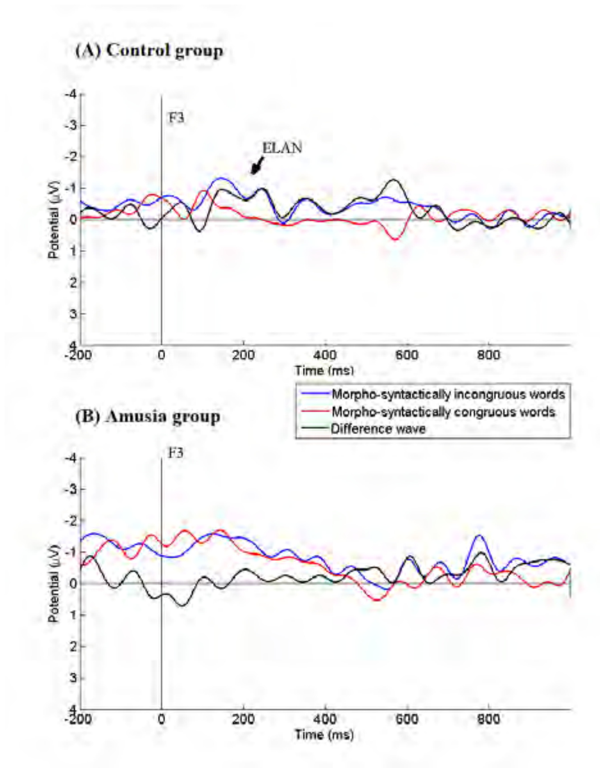

Figure 3 Grand-average ERPs elicited by morpho-syntactically incongruous words recorded at electrode of F3 from 9 control participants (top) and 3 amusic participants (bottom) (with 15 Hz filtering for display).

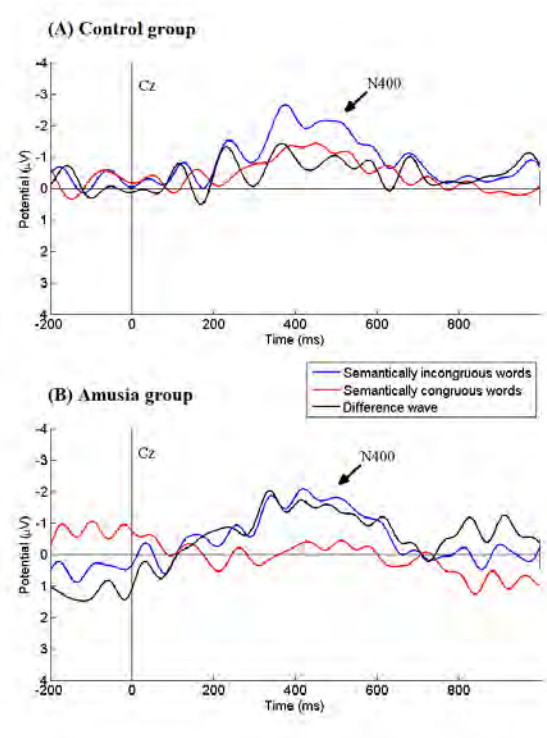

Figure 4 Grand-average ERPs elicited by language-semantically incongruous words recorded at electrode of Cz from 9 control participants (top) and 3 amusic participants (bottom) (with 15 Hz filtering for display).

As seen in Figures 1 and 2, congenital amusia exhibited a music-syntactic impairment in both the behavioural paradigm (i.e. the out-of-key detection task) and the ERP paradigm. Amusic participants may also have impairment in morpho-syntactic processing, as no ELAN was evident for these three participants. However, they appear to have normal semantic processing, in that the N400 can be seen and has a similar latency and amplitude with that observed for the control group, at least by visual inspection.

Although the results are preliminary, we observed ERPs of interest related to the experimental conditions, especially for the control participants. These ERPs include an ERAN and an N5 for music-syntactic processing, an ELAN for morpho-syntactic processing, and an N400 for semantic processing. The latencies of these ERPs are mostly consistent with other reports in the literature, suggesting that the current paradigm is capable of eliciting ERPs related to music and language processing. As more data are collected, it should be possible to identify some of the distinctive impairments in music and language that are associated with congenital amusia.

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Which basic emotions are universal in response to music?

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ABSTRACT

Background

Basic emotions, such as anger, happiness, and sadness are believed to be communicated cross-culturally. For example, there are ample ethnographic and psychological findings, since the work of Paul Ekman in particular, that suggest facial expressions intending to portray these emotions can be recognised as the intended emotion by viewers from different cultures. However, it is not clear to what extent these findings also apply to the communication of emotion in music. Some literature in cross-cultural emotional experience in response to music suggests that 'basic' emotions are communicable, but other studies report more mixed responses.

Aims

The aim of this study is to identify the extent to which basic emotions are communicated cross culturally.

Main Contribution

We report our analysis of 10 studies that explicitly investigated emotional communication across cultures. The most frequently investigated basic emotions were happiness/joy and sadness/sorrow, which were manipulated (as independent variables expressed in performance usually by the performing musician under instruction) for eight of the ten studies, In each of these eight studies, these emotions were communicated with statistical reliability across the cultures investigated. Another basic emotion that was regularly examined was anger (in six of the studies), but results were equivocal. Therefore, with the small data set investigated, we made the interim conclusion that this basic emotions is probably not communicable through music. However, we propose that this may and may not necessarily be a cultural issue. We first propose emotion locus constraints that may restrict the ability of music to induce anger. Finally, we propose Music Stereotype Theory as a possible cultural explanation for the findings.

Keywords

emotion in music; universality; cross-cultural communication; cue utilisation; Music Stereotype Theory

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A multidimensional model of arousal and its relevance for music-health research

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ABSTRACT

Background

The arousal construct is widely employed in music psychology, and, although it is defined differently by different authors, one common feature of most studies is that arousal is modelled as unidimensional (Eerola & Vuoskoski, 2013), despite longstanding arguments that unitary models of arousal are untenable, given the multiplicity of physiological systems and processes associated with the energisation of attention and action (e.g., Pribram & McGuinness, 1975). One problem with unidimensional models is that their lack of specificity restricts our ability to differentiate between states of arousal in studies of music. Some studies have addressed this problem by employing a two-dimensional model of arousal based on Thayer (1978, 1989) (e.g., Ilie & Thompson, 2006), which incorporates two biopsychological dimensions: 'energetic arousal' (energy versus tiredness) and 'tense arousal' (tension versus calmness). However, as explained later, 'energy' and 'tension' may themselves be multidimensional constructs whose components can be empirically dissociated.

Following the distinction made between perceived and felt emotion in studies of music (Gabrielsson, 2002), I maintain a similar distinction between perceived and felt arousal. This paper introduces a novel, multidimensional conceptualisation of felt arousal that aims to provide a basis for my larger research project, which is to develop a method and theory of emotion regulation for practice and research in music-for-health, particularly with reference to the self-regulation difficulties faced by people who are vulnerable to chronic depression, anxiety or fatigue. According to this approach, which I refer to as the openness model, a primary goal of music-based emotion regulation is to promote a more distributed, alert and relaxed awareness of interoceptive sensations, whether those sensations are perceived as positive or negative. The model shares common ground with mindfulness- and acceptance-based approaches to emotion regulation (see chapters in Gross, 2014), and contrasts with hedonic approaches, in which positive affect is the goal of emotion regulation (e.g., Västfjäll, Juslin, & Hartig, 2012).

Aims

This paper aims to introduce the conceptual basis for the openness model's approach to felt arousal, and to indicate how this approach is consistent with existing psychological constructs and knowledge of biological systems and functions.

Main Contribution

A premise of the openness model is that awareness of interoceptive sensations is a precondition for self-reported feelings of arousal and emotion. Interoceptive sensations are sensory representations of the physiological condition of the tissues and organs of the body, which includes the muscles, skin and viscera (Craig, 2002). When people report feeling, for example, good, bad, energetic, tired, tense, relaxed, or motivated to act in particular ways, they are reporting their awareness of the interoceptive sensations that represent the physiological condition of their bodies.

With regard to awareness of interoceptive sensations (or of any other type of sensation), a distinction is made here between, on the one hand, the entire spectrum of stimuli that are present to the senses at a given moment, whether or not one is aware of those stimuli, and, on the other, the particular set of stimuli that one attends to and is therefore consciously aware of (for similar distinctions, see, e.g., Barrett, Mesquita, Ochsner, & Gross, 2007). I refer to the former as 'stimuli that are present' and the latter as 'stimuli that are consciously perceived'. This distinction serves to differentiate between two types of variation in self-reported feelings of arousal: variations in the interoceptive stimuli that are present at a given moment, and variations in awareness due to differences in the deployment of attention. Based on this distinction, the openness model represents variations in self-reported feelings of arousal with reference to two sets of dimensions. The first set, relating to variations in the deployment of attention, comprises three dimensions: 'alertness' (high-low) refers to shorter-term, endogenous variations in sensitivity to incoming stimuli, and is associated with the noradrenergic locus coeruleus system (Petersen & Posner, 2012); 'selectiveness' (distributed-focused) refers to variations in the scope of perceptual attention, and is associated with distinctions between global (distributed) versus local (focused) modes of processing (e.g., Treisman, 2006); 'direction' (sensations-thoughts) refers to whether attention is focused more on sensory stimuli (including interoceptive stimuli) or the contents of working and long-term memory (e.g., Chun, Golomb, & Turk-Browne, 2011).

The second set of dimensions, relating to variations in the presence of interoceptive stimuli, comprises two multidimensional components: the interoceptive sensing of 'motivational energy' and 'motor tension'. Motivational energy, defined here as energy mobilised to support the metabolic demands of instrumental actions (see Requin, Brener, & Ring, 1991; Wright, 1996), can be represented on a single dimension of 'intensity' (associated with the level of activation of the sympathetic nervous system). However, a unidimensional description of motivational energy obscures important

distinctions between, for example, energy mobilised for *actual* metabolic demands (e.g., when an overlearned exercise routine is performed without anxiety or excitement) and energy mobilised for *anticipated* metabolic demands (e.g., when we think anxiously or eagerly about giving a public presentation), or between energy mobilised for *locomotive* action (e.g., to flee from danger, which typically necessitates faster breathing) and energy mobilised for *vocal* action (e.g., to cry for help, which necessitates longer outbreaths, a requirement that is contrary to the need for faster breathing when running from danger). Accordingly, the present model represents the interoceptive sensing of motivational energy in terms of multiple high-low dimensions: 'locomotive action preparation', 'vocal action preparation', 'actual demand', and 'anticipated demand'. Further distinctions can be made between types of instrumental action (fighting, exploring, laughing, crying, etc.).

Similarly, motor tension, defined here as competition between preparatory and inhibitory influences on motor output, could be represented on a single dimension. For example, although Thayer (1989) does not define tension in this way, he represents tense arousal (associated with activation of biological systems relating to danger and freezing) on a bipolar dimension of tension versus calmness. However, a unidimensional description of tension obscures important distinctions between levels of preparatory versus inhibitory influence on motor output, and between types of preparatory and inhibitory influence. For example, as noted above, motivational energy can influence respiratory movement in different ways (e.g., faster breathing versus longer outbreaths). There are also different sources of inhibitory influence on motor output, such as active and passive types of avoidance, associated with, respectively, freezing and approach-avoidance conflict (Corr, 2013), which, in turn, are dissociable from the types of inhibition associated with effortful control (Carver, Johnson, & Joormann, 2008). Accordingly, the openness model represents the interoceptive sensing of motor tension in terms of multiple dimensions, with preparatory influences represented on the same dimensions that represent motivational energy, and inhibitory influences represented on high-low dimensions of 'freeze responding', 'behavioural inhibition' (associated with approach-avoidance conflict), and 'effortful restraint' (associated with the effortful regulation of behavioural impulses and task-irrelevant movements). Further distinctions can be made between localised regions of motor tension, where competing influences are exerted on, for example, cardiac, respiratory, vocal tract, and facial effectors.

Implications

The above framework provides the basis for a development of the proposal that, through musical activity, individuals who habitually dysregulate emotions, with strategies of avoidance, suppression, rumination or worry (Aldao, Nolen-Hoeksema, & Schweizer, 2010), can learn to experience positively and negatively valenced changes in motivational energy more 'openly', that is, with more distributed attention, more alertness, and less motor tension. In a future paper I will examine the hypothetical processes through which music-based emotion regulation can promote such outcomes.

Keywords

Music, arousal, emotion, self-regulation, health.

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The association between musical skills and the discrimination of phonemes from a foreign language

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ABSTRACT

Background

Scores on music-aptitude tests tend to predict first language skills (e.g., Anvari et al., 2002), and musically trained individuals outperform their untrained counterparts on a range of native-language speech perception tasks, including perceiving fine-grained phonetic differences (e.g., Zuk et al., 2013). Music training is also associated with better second language outcomes (Swaminathan & Gopinath, 2013; Yang, Ma, Gong, Hu, & Yao, 2014).

Theorists have suggested that overlaps between music and speech abilities occur in the auditory-temporal domain (Tallal & Gaab, 2006; Goswami, 2011), and that music and language skills have more overlaps in childhood than in adulthood (McMullen & Saffran, 2004).

Aims

We had three aims: (1) to examine whether musical skills are associated with the perception of phonemes from a foreign language, (2) if associations exist, to study whether rhythm or melody perception skills are more strongly correlated, and (3) to study the nature of associations across development.

Method

In experiment 1, we tested 70 6- to 9-year-olds over two sessions. 25 children were musically trained and the remaining reported no history of private lessons. During the first session, IQ was assessed using the Wechsler Abbreviated Scale of Intelligence, working memory (WM) using the digit span test, and speech-perception using a well-studied Zulu phoneme discrimination task (Best, McRoberts, & Goodell, 2001; Best McRoberts, & Sithole, 1988). Music-perception skill (melodic pitch perception and rhythm perception) was assessed using the short version of the Montreal Battery of Evaluation of Musical Abilities (Peretz et al., 2013) during the second session. Parents reported the child's age and music training, parent education attainment, and annual family income.

In experiment 2, 34 musically trained and 103 untrained native English speaking undergraduates were tested on music-perception skills (melody and rhythm perception) using the Musical Ear Test (Wallentin, Nielsen, Friis-Olivarius, Vuust, & Vuust, 2010), IQ using the Raven's Advanced Progressive Matrices, WM using the digit span, and speech perception using the same Zulu phoneme-discrimination test as in Experiment 1. Participants also reported information relating to music training and demographics.

Results

After controlling for IQ, WM and demographic variables, rhythm perception, but not melody perception, was associated positively with Zulu phoneme discrimination ability in children and adults. Music training was also not associated with Zulu phoneme perception skills in children and adults. Interestingly, music training was associated with advantages in melody perception but not rhythm perception skills. The association between rhythm perception and phoneme discrimination was stronger in children than in adults.

Conclusions

These results suggest an overlap in auditory temporal processing for speech and music. The musically trained groups did not show a rhythm perception or Zulu phoneme discrimination advantage, suggesting that music training may not lead to phonetic perception advantages if it does not promote the development of rhythm-perception skill. These results also provide support for the idea that overlaps in music and speech skills are stronger in childhood.

Keywords

music, speech, modularity, transfer, development

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Music as a gender-related social adaptation

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ABSTRACT

Adaptive value of music is usually considered in terms of effects on individual reproductive success, early preparation of individuals for managing emotional and social interactions, and organization of social activity. In its social role music can act as a tool for strengthening social identity and group togetherness, for transmission of culture, and also for coordinating activities that are engaged in collectively. Such social uses of music are most of the time closely related to gender roles in a community. This paper aims to delineate the gender-related uses of music that may help survival of a group. One possible gender-related use of music appears to be contributing to defining gender roles as can be seen in musical activities that are segregated by gender in many cultures. A complementary function seems to be providing outlets for acting outside of the prescribed gender roles. Observations of musical traditions in which persons of one gender are permitted to act in ways that are not normally considered appropriate for that gender can be cited in support of this function. I would like to conclude that taking gender-related norms of musical behavior may be a productive approach to social, and possibly evolutionary, functions of music.

I. ADAPTIVE VALUE OF MUSIC

The adaptive value of music has been the topic of lively discussion especially after Stephen Pinker (1997) declared there is none. Although there are no societies we know of that does not have music it is possible to see music as a superfluous pursuit that humanity could have done without. In disagreement with Pinker, a range of ways in which music might have contributed to the survival and reproduction of the human species have been proposed. Although Huron (2001) made a more detailed classification, these proposals can be grouped into those that propose a mating advantage following from musical ability, those that propose a role for music in development of individual abilities that are important in social functioning, and those that propose an increase inclusive fitness by facilitation of social activity by music.

A. Individual mating advantage

One obvious way in which music could have adaptive value would be an advantage in mating and reproducing conferred on those individuals who engage in music. This is a viewpoint that has been expressed by Darwin as well as by more recent researchers (G. F. Miller, 2000). A variety of hypotheses have been offered on the question of why sexual selection may have favored musicality. It could be because specific abilities required for making music, such as producing isochronous beats (van den Broek and Todd, 2009), or just the luxury to engage in what seems to be frivolous would be signs of superior genetic material (G. F. Miller, 2000).

B. Music in the development of social skills

An alternative view would be that although apart from an adaptive function during the adulthood of the individual music is tied to processes in infancy that are critical for developing skills that will be necessary in adult life. One such argument can be developed on the basis of the views of Daniel Stern (2010).

Stern (2010) proposes that preverbal mother-child interaction is based on communication, imitation, and elaboration of dynamic forms. The qualities of movement that can be expressed as flow, rush, surge, release, etc. find their way into the dynamic changes in facial expressions, gestures, and vocalizations. The diminutions, exaggerations, foreshortenings, and prolongations of such dynamic forms by a partner allows the infant learn both the appreciation of other minds and the dynamics of social and affective interaction. Similar views have been formulated in different variations by other researchers. For example, Dissanayake (2009) also considers mother-infant interaction as related to the origin of all arts.

Concentrating on a different aspect of the social implications of processing music, Schubert (2009) proposed that the dissociative quality of emotional responses to music is an essential part of why we enjoy them. Music provides a safe environment for experimenting with feelings, including negative ones (Schubert, 1996; 2009). Thus, an inclination for music would be adaptive for a species that has to negotiate an intricate emotional life in adulthood.

C. Music as a social facilitator

A third domain in which one may consider adaptive advantages of music making is coordination of social activity. Group activity is important for human species because of the advantages of pooling of resources ranging from food to mental and athletic abilities. Such activities require both developing the ability to synchronize with the group and building up motivation for acting together. Music appears to be capable of both. In support of this, researchers have found that acting in synchrony is an important social phenomenon. Hove and Risen (2009) reported that synchronous movement with a stranger was predictive of liking for that individual.

Beyond immediate practical results of acting together, music can serve as a facilitator of group cohesion as well. Such cohesion would result in long-term organization of a range of social phenomena, such as dominance, conflict resolution, and cooperation that would benefit members of the group. Involvement of music in rituals especially of religious nature makes it a candidate for a prime social organizer. Huron (2014) also emphasized the role of music in symbolically experimenting with fear.

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Except for the functions of music that are related to sexual selection and mother-infant interaction, hypotheses about the adaptive value of music has disregarded gender issues. However, O'Neill, Trainor and Trehub (2001) have found that fathers do show similar behaviors in their infant-directed singing as mothers. Although mothers do an overwhelming majority of infant directed singing (Trehub et al, 1997) fathers can also engage in similar social interaction with infants through music. As made explicit by Cross (2009), to the extent that music has functions beyond capturing mates, these evolutionary functions of music are treated as applying to both genders: If music helps survival and reproduction, this should work similarly for men and for women. How men and women make use of differently and potential adaptive advantages that may follow from these differences will be the question taken up in this paper.

II. GENDER AND EVOLUTIONARY ADAPTATION

In evolutionary psychology differences between men and women are typically related to the disproportionate parental investment that women have to make as a result of an extended pregnancy and child care period (Trivers, 1972). This influences gender differences along two lines. First, pregnancy and the post-natal period during which the mother has to keep the child in close proximity limit women's mobility and ability for fast action. Second, women and men have to resort to radically different mating strategies in order to maximize their reproductive success (Buss, 2012).

It is widely assumed that female ancestors of present day humans mostly gathered food whereas male ancestors engaged in hunting. As hunting success, especially for large game, increases if hunting is done in groups. This probably has led ancestral men to hunt in organized gangs. This is usually considered to be the origin of activity oriented groups that men tend to form (Tooby & DeVore, 1987). Allegiance to such groups, coordination with group activity and respect for dominance hierarchies within groups are behavioral dispositions that would increase the success of this arrangement.

Mating strategies probably contribute to gender differences to a larger extent. Reproductive mechanisms of the human species require females to make larger investments in their offspring and limits the number of offspring they can have compared to males (Trivers, 1972). For this reason, females are expected to be much more selective in mating than males. This can be seen in the greater desire of males for variety and excitement in their sexual lives (Schmitt et al., 2003). Buss (2012) lists many expected differences in the mating strategies of males and females: Females would benefit from a mate that is in command of greater resources and also committed to the relationship and his offspring. Males, on the other hand should value reproductive potential because by establishing a long term bond they would be limiting their potential offspring by the number that their mate can produce. Another problem that males have to deal with is the uncertainty of paternity. Males would want to be certain of their mates' sexual fidelity in order not to invest the offspring of another male. Thus, it is advantageous for women to advertise their youth, fertility, and chastity, whereas men would be better off emphasizing their strength, status in the dominance hierarchy and commitment.

III. GENDER-RELATED ASPECTS OF ADAPTIVE CONTRIBUTIONS OF MUSIC

It is generally accepted that music functions as a tool for reinforcing social structure and coordinating social activity. However, usually the gendered aspects of this coordination is neglected. The gender-related social functions can be categorized under two headings: (1) Gendered use of music reinforces the kinds of gender segregation that evolutionary psychologists claim increases inclusive fitness of a group or a species. (2) Paradoxically, music con offer subversive areas in which individuals can express themselves in ways that would be considered gender-incongruent without the risk of ostracism.

A. Musical practices that run parallel to gender schemas

Savage, Brown, Sakai, and Currie (2014) provided statistical support for a ubiquitous idea that music is made mostly by men. The fact that making music is also a group activity is consistent with the evolutionary viewpoint that male coalitions are important for hunting and protection of the group. It should be noted however, that Morley (2014) proposes a social bonding function for music in same-gender groups of both men and women. A more contemporary and Western version of bonding among women through music can be seen in grassroots singing ensembles in which women make up the majority (Bithell, 2014).

The supposed male domination of music making is somewhat in contradiction with the feminine nature of music that is usually accepted from the time of Plato. As a matter of fact, Elpus (2015; Elpus & Abril, 2011) reported that females are overrepresented in chorus and instrumental ensemble courses in the United States. This is a fact that needs to be considered in the light of the gender stereotyping of instruments (Abeles & Porter, 1978; Coelho, Silva, & Machado, 2014; Kelly & van Weelden, 2014) and positions of power that are open to women. Wych, (2012) concluded that gender role development is central in instrument selection in ways that perpetuates stereotyped gender-instrument associations. As for the question of power, both Kruse, Giebelhausen, Shouldice and Ramsey (2015) in the United States and Coelho, Silva and Machado (2014) in Brazil report that positions of power and authority are occupied disproportionately by men in musical ensembles and music education.

A different aspect of how men and women contribute differently to music making is related to honor and chastity. In the Balkan region and especially in relation to Roma communities, it is observed that women's music making is accepted more in family functions rather than as commercial activity (Silverman, 2003) and making music as a way of earning a living by women may be interpreted as a moral fault (Hofman, 2015; Silverman, 2003). Hofman (2015) found that women *kafana* singers in Yugoslavia resorted to discourses

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related to dedication to music making in order to deemphasize the commercial nature of the music labor that they are engaged in.

These differences between the musical behaviors of men and women represent diversity that is consistent with the gender differences that would be expected on the basis of evolutionary psychology. Women engage in musical activities that may strengthen emotional bonding with females and refrain from, or are not allowed in, those that emphasize power or that may undermine women's perceived modesty and chastity.

B. Musical practices that subvert gender stereotypes

Music represents a complex human activity in its relation to gender. On the one hand, the dominant perception of music, at least in a Western tradition dating back a long time, is music as feminine. On the other, that same Western tradition especially, seems to have made considerable effort to contain music within a masculine order (McClary, 1990). This is also apparent in more contemporary genres such as hip-hop or metal that emphasize masculinity aggressively (Matias-Rodrigues & Araújo-Menezes, 2014; D. L. Miller, 2014; Shabazz, 2014). However, music also provides individuals with opportunities to express themselves in ways that are in variation with the accepted gender roles (Bithell, 2003). In addition, going against, rather than conforming to generally accepted views of the society about music may also constitute an avenue for personal expression that may not be equally easy in other domains.

One approach to the way musical choices may confront social norms is Green's (1997) analysis of music making and femininity. Green proposed that music may be used to affirm, interrupt or threaten femininity. In this analysis playing an instrument considered atypical for a woman interrupts femininity but seeking positions of power such as becoming a conductor or composer interrupts femininity. That is, crossing gender stereotypes in instrument selection can be considered as exercising personal variability without disrupting the social norms but there are limits beyond which musical choices may become truly subversive.

Conway (2000) discovered that most high school students who chose to play instruments that went against gender stereotypes were aware of the stereotyping and they stated the desire to be different as one of the reasons for their instrument choice. One of the factors that supports choosing and persevering in an instrument that crosses gender stereotypes, in addition to physical and acoustic qualities of the instrument, is found to be the ability to disregard social comment about it (Abeles 2009 cited in Abeles, Hafeli & Sears, 2014; Conway, 2000). Approval and support by parents and instructors is another important factor (Abeles, 2009; Conway, 2000). Thus, making musical choices that goes against gender stereotypes appears to be a social phenomenon rather than being based on musical taste only.

Acting against gender stereotypes is not limited to high school students of musical instruments. Kyker (2014) describes the case of women who became performers on the *mbira dzavadzimu* of Zimbabve. Most of these women had to learn the instrument in secrecy and by themselves because of disapproval by family and society generally. The instrument is perceived as the domain of older males and also associated with traditional religious beliefs such as spirit possession. Again, instrument choice is found to be a factor placed in a larger social context of going against the grain of social norms. Similar crossings of gender stereotype boundaries can be found in hip-hop music in different cultures (Matias-Rodrigues & Araujo-Menezes, 2014; Shabazz, 2014). Women in this genre use music as a way of establishing their presence in space, which is doubly denied because of their race and their gender (Shabazz, 2014), and to express the way they would like the world to be (Matias-Rodrigues & Araújo-Menezes, 2014). Another example of crossing gender lines through music is seen in the rebetika of early 20th century Greece (Holst-Warhaft, 2003).

Gender in music may permit expression of difference and unconventionality in more cultural ways as well. For example, Stokes (2010) proposes that displays of sentimentality and sexual ambiguity in some forms of popular music in the 20th century Turkey was a way of dissent against the modernist masculine republic and regeneration of more traditional and feminine values. This use of what Clarke (2005) would call "cultural affordances" of music represented the tensions between two cultural poles in a way that would be tolerated more than an explicit expression of them. To sum, music can be seen to provide avenues for expressing resistance and dissent on different scales in a number of quite different contexts.

IV. CONCLUSION

The point that I have tried to make in this paper is that social uses of music is gendered in many respects and this may be related to the social advantages that making music confers on human societies. One aspect of this may relate to music's use in organizing social structure and activity in gender-specific ways. A further contribution would be providing areas in which individual deviation from social norms can be expressed in more acceptable ways that may also be effective in producing social change or, at least, protecting the potential for change.

One issue that needs to be kept in mind regarding this discussion is the socially constructed nature of gender, which is the case in music as in any other context (Green, 1997), which is juxtaposed with the essentialist approach of evolutionary psychology. However, considering that the cultural can coevolve with the biological (Morley, 2014), this juxtaposition may prove fruitful rather than contradictory. It may also be mentioned in this context that the amount of within-culture variation that exceeds the between-culture variation (Savage & Brown, 2014) in musical traditions could point out the universal – in a statistical sense – aspects of the ways in which humans engage in music making.

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Spatial representation of pitch and its dependence on instrumental experience

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ABSTRACT

Background

Associations between pitch and vertical space (high-low) are well documented and have been shown to be coupled in perception from an early age onwards (Walker *et al*, 2009). Demonstrations are found in speeded classification tasks, spatial response tasks (Walker & Ehrenstein, 2000; Lidji, Kolinsky, Lochy, & Morais, 2007), but also free association and movement tasks (Eitan & Granot, 2006; D'ausilio, Altenmüller, Olivetti-Belardinelli, & Lotze, 2006). Less is known about the origin and development of associations between pitch and horizontal space (left-right). Non-musicians displayed a horizontal mapping of pitch only when the task was pitch-related (Lidji *et al*., 2007; Ruscconi *et al*., 2005). Stewart *et al.*, (2004) suggested that pianists are superior in vertical-to-horizontal mappings compared to other musicians (woodwind or string instrument players) because the musical training of sight-reading of musical notation and playing on the piano enables them to transfer vertically represented musical scores to horizontally displaced keyboards.

Aims

Three perceptual experiments were run to test the presence of an association between pitch and horizontal location in non-musicians, musicians, and among the latter in flautists and pianists in particular. The aim was to examine the dependency of the association between pitch and horizontal location on musical training and instrumental experience. A strong form of association was tested by examining whether sounds were perceived to come from different locations depending on the sound's pitch.

Method

Experiment 1. 12 non-musicians, 11 student musicians and 10 professional musicians participated in a perception experiment. Brief sine tones were presented to participants over speakers that differed in pitch height (9 different pitches) and horizontal location (9 different locations). A low and high reference tone was presented before each tone to help participants estimate the pitch height. They judged pitch height on a scale from 1 (low) to 9 (high). The mid-point of the speakers functioned as reference for the spatial location judgment. Participants judged the spatial location of sounds again on a scale from 1 (left) to 9 (right). Participants judged pitch in the first block of 81 trials and location in the second block of 81 trials, or in the opposite order. Stimuli were presented in random order within a block of trials.

Experiment 2. 7 flautists and 12 pianists studying music at UG level participated in the perception experiment. The material and procedure was the same as in Experiment 1.

Experiment 3. 9 flautists and 11 pianists studying music at UG level participated in the perception experiment. None of the participants had participated in earlier experiments. The material and procedure was the same as in Experiments 1 and 2, except that prior to doing the perception experiment, participants played three musical excerpts containing scales and arpeggios on their instrument. They performed each excerpt three times. The first and third time, they played it normally with sound, while the second time they played it silently, moving the fingers but making no sound.

Results

Regression analyses were run for each participant's responses separately to capture the relationship between 1) stimulus pitch and judged pitch, 2) stimulus pitch and judged location, 3) stimulus location and judged pitch, and 4) stimulus location and judged location. These four regression values per participant were then used as the dependent variables for a mixed model ANOVA with stimulus feature and musicianship as independent variables. Separate ANOVAs were run for judgments of pitch and judgments of location.

Experiment 1. The mixed model ANOVA for pitch judgments showed a significant effect of stimulus feature only ($F(1,30)=106.012$, $p<.001$). Judgments of pitch showed a strong relationship with stimulus pitch (mean regression value of .461) and no relationship with stimulus location (mean regression value of .033). There was no effect of musicianship or interaction between stimulus feature and musicianship.

The mixed model ANOVA for location judgments also showed a significant effect of stimulus feature in the expected direction ($F(1,31)=19.006$, $p<.001$), where the relationship with stimulus location (mean regression value of .476) was stronger than with stimulus pitch (mean regression value of .192). Additionally, however, there was a significant interaction musicianship and stimulus feature ($F(1,31)=6.316$, $p=.017$), defining the three levels of musicianship as a covariate. With increasing expertise, the relationship between judged location and stimulus location went down (regression values were .577, .505, .323 for non-musicians, student musicians and professional musicians, respectively), while the relationship between judged location and stimulus pitch went up (regression values were .098, .182, .315 for non-musicians, student musicians and professional musicians, respectively).

Experiment 2. The mixed model ANOVA for pitch judgments showed a significant effect of stimulus feature only ($F(1, 17)= 119.43$, $p<.001$). Judgments of pitch showed a strong relationship with stimulus pitch (mean regression value

of .674) and no relationship with stimulus location (mean regression value of -.003). There was no effect of instrument or interaction between stimulus feature and instrument.

The mixed model ANOVA for location judgments showed a significant effect of stimulus feature only (F(1, 17)=8.206, p=.011). Judgments of location showed a stronger relationship with stimulus location (mean regression value of .627) than with stimulus pitch (mean regression value of .180). Nevertheless, the relationship between location judgments and stimulus pitch was significantly larger than 0 (t(18)=2.537, p=.021). There was no effect of instrument or interaction between stimulus feature and instrument.

Experiment 3. The mixed model ANOVA for pitch judgments showed a significant effect of stimulus feature only (F(1,18)=71.301, p<.001). Judgments of pitch showed a strong relationship with stimulus pitch (mean regression value of .634) and no relationship with stimulus location (mean regression value of .025). There was no effect of instrument or interaction between stimulus feature and instrument.

The mixed model ANOVA for location judgments also showed a significant effect of stimulus feature in the expected direction (F(1,18)=6.233, p=.022), where the relationship with stimulus location (mean regression value of .545) was stronger than with stimulus pitch (mean regression value of .256). Additionally, there was a significant interaction between instrument and stimulus feature (F(1,18)=6.158, p=.022). For pianists, the relationship between judged location and stimulus location was equally strong as the relationship between judged location and stimulus pitch (mean regression values of .367 and .368, respectively). For flautists, the relationship with stimulus location was stronger than the relationship with stimulus pitch (mean regression values of .721 and .146, respectively).

Conclusions

The association between pitch height and horizontal location can lead to the illusion that low pitches come from the left and high pitches come from the right. This illusion is not present in non-musicians. It is however strongly present in professional musicians, whose location judgments depended equally on stimulus pitch and stimulus location. Playing a few exercises on the piano also seems to activate the illusion, in contrast to playing the flute, which does not influence location judgment. These results suggest that the active performance on a musical instrument and the action-perception coupling that results from it play a role in strengthening the illusion, but also that the particular mapping of low-left and high-right is preferred. This preference may depend on handedness (Deutsch, 1983) and may be latently present also in non-musicians.

Keywords

Pitch, localization, spatial representation, cross-modal correspondences, musical training.

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Influences of visual activity on memorized tempo of a performance

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ABSTRACT

Background

Previous research has shown that the similarity between performances is only to a limited degree predicted by measurements of tempo and intensity (Timmers, 2005). This suggests that in perceiving performance characteristics of music, listeners do not just perceive a performance to be in a particular tempo with particular intensity or with particular variation in tempo and intensity. Instead, as is well known, the performance communicates an interpretation of the music (Palmer, 1997; Kendall & Cartarette, 1990). This may include an emotional or metaphorical character (Gabrielsson & Juslin, 1996; Shaffer, 1995; Woody, 2002). It may be that this is how listeners perceive and memorise performance.

Aims

To test the hypothesis that metaphorical associations are an important component of how performances are remembered, an experiment was designed that manipulates the induced association with a performance and tests the effect on the memory of the performance.

Method

40 participants (20 musically trained) participated in a memory experiment. In the experiment, twelve musical excerpts performed with expressive timing and dynamics were coupled in the learning phase with pictures varying in activity. Four excerpts were coupled with pictures low in activity, four excerpts with pictures high in activity, and the other four excerpts were coupled with neutral pictures. Pictures were taken from the international affective pictures database (REF).

Participants listened to four musical excerpts in a row and saw three pictures with a certain level of activity per excerpt. In total they saw twelve pictures and listened to four musical excerpts during a learning block. Hereafter, a series of neutral pictures were presented for one minute. This was followed by the test block: The four musical excerpts were presented again in random order. In two out of four the excerpts had the same tempo as originally. The other excerpts were played back either 10% faster or 10% slower. The task of the participant was to indicate what the tempo was in comparison to the original tempo using a scale from 1 to 5, where 1 meant 'sure slower tempo' and 5 meant 'sure faster tempo'. 3 indicated 'same tempo'. Finally, to ensure attention to the pictures, participants were also tested on their memory for the pictures. They were asked to indicate whether a presented combination of pictures and music were previously seen or not.

Results

A repeated measures ANOVA was run with tempo and activation of pictures as independent variables and the ratings of the tempo of the test performances as dependent variable. The effect of tempo (linear contrast) was highly significant ($F(1,35)=28.234$, $p<.001$, $r=.668$). The predicted effect of activation of the pictures (linear contrast) was not significant however ($F(1,35)=1.647$, $p=.208$, $r=.212$), nor was there a significant interaction between the effects of tempo and activation ($F(1,35)=1.193$, $p=.282$, $r=.182$).

Conclusions

The effect of 'externally' induced activity on remembered tempo of a musical performance is at best a weak effect, complicated by the strength of the effect of the actual tempo of the performance, which was well remembered. Increasing the statistical power of the experiment may be necessary as well as fine-tuning of the experimental design to highlight the relevance of associations for the perception and memory of performance. Tempo may have been too well remembered due to the short time between learning and testing. Effects of associations are likely to be stronger if the connection between associations and music is more ecologically induced.

Keywords

Performance, memory, activation, cross-modal correspondences.

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Whole-brain functional connectivity during naturalistic music listening: Effect of musical training

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ABSTRACT

Background

Musical training has been found to have an effect on both the morphology and functionality of the brain. However, little is known about its effect on functional integration between different parts of the brain while listening to music.

Aims

We investigated differences in functional connectivity of the brain between musicians and non-musicians during naturalistic music listening conditions.

Method

Brain responses of thirty-six participants (18 musicians and 18 non-musicians) were recorded using functional magnetic resonance imaging (fMRI) during continuous listening of three musical pieces of different genres. Whole-brain functional connectivity analyses were performed using a graph-theoretical approach. Various measures of integration and segregation were determined per subject, including voxel-wise degree and efficiency, as well as community structure. Group-level measures were determined both on the level of the whole participant pool and within the two groups (musicians and non-musicians).

Results

Musicians were found to have higher connectivity from sensorimotor and cerebellar networks in terms of both degree and efficiency. Non-musicians, on the other hand, displayed higher connectivity from parts of the default mode network. Community structure analyses suggest that musicians have more consistent network structure over non-musicians within motor areas and enhanced connectivity between sensorimotor areas of cerebellum and temporal poles.

Conclusions

The results indicate a cross-modal transfer effect between musical training and music perception, in which auditory-motor training leads to stronger integration of motor areas to other areas during music listening.

Keywords

fMRI, functional connectivity, musical training, graph theory

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'Sad' music as a means for acceptance-based coping: An overview of relevant literature on self-identified sad music and recent studies on research

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ABSTRACT

Background

Many popular music pieces sound sad (Schellenberg, Peretz, & Vieillard, 2008), and studies indicate that after happiness sadness is the emotion most often attributed to music (Kreutz, 2002; Lindström et al., 2002). Recent research also indicates that many people listen to sad music as a means of coping with sadness and adverse negative affective states (Van den Tol & Edwards, 2013, 2014), and do so effectively (Chen, Zhou, & Bryant, 2007; Matsumoto, 2002). This seems surprising as listening to self-perceived sad music often increases sadness (Dillman-Carpentier et al., 2008; Eerola & Vuoskoski, 2011; Vuoskoski & Eerola, 2012).

But what motivates people to listen to sad music? Given the rise of sad sounding popular music in the last decade (Schellenberg & Von Scheve, 2012), and the availability of music given modern portable device technology, this question has important implications.

We will first provide a brief overview of the findings on the effects of, and motivations for, listening to self-identified sad music (Van den Tol and Edwards, 2011. 2014). We will additionally give a brief overview of preliminary findings of our recent research on how listening to self-identified sad music may contribute to acceptance based coping when feeling sad or dealing with an adverse situation.

Self-identified sad music and self-regulation

As part of a recent qualitative study (Van den Tol & Edwards, 2013), adults who sometimes listen to (what these authors were the first to describe as) self-identified sad music or SISM (Van den Tol & Edwards, 2013) after an adverse event were studied. Results were analysed using a Grounded Theory Approach (Charmaz, 2008, Corbin, & Strauss, 1990). Based on this analysis, it became apparent that in order to understand why people listen to sad music after a negative life event, it is important to look at people's expected psychological effect for doing so, that is their self-regulatory goals, and to look at why people select a specific piece of music which are termed their music selection strategy (Van den Tol & Edwards, 2013). These music selection strategies provide information on what someone decides to listen to, whereas self-regulatory goals are what people believe will happen via listening to the music (i.e., what they hope they will achieve in terms of psychological response). For example, someone may decide to listen to SISM with high aesthetic value (music selection strategy) in order to enhance a sad mood (self-regulatory goal). The strategy is the means by which the goal may be obtained.

Four music selection strategies were identified in previous research (Van den Tol & Edwards, 2013, 2014). Connection refers to choosing to listen to music because it portrays affect or lyrics with which the listener identifies. Memory Triggers refers to music selection based on perceiving that the music has high associations with past events. High aesthetic value involves selecting the music based on its beauty. Direction (called: Music Message in Van den Tol & Edwards, 2013) involves choosing music that conveys a message with which the listener wants to relate.

Several music selection strategies were also identified (Van den Tol & Edwards, 2014). Sadness (called: Re-experiencing affect in Van den Tol & Edwards, 2013) occurs when the music listening results in getting in touch with, intensifying or expressing feelings of sadness. Memories and Social occurs when the music results in recall of events or feelings related to friends and family. Cognitions refers to an outcome in which people experience re-appraisal and thinking through problems. Friendship refers to the feeling that the music is a symbolic friend. Distraction refers to the use of music to keep away from unwanted feelings and thoughts. Lastly, Mood-enhancement involves making one feel better. Although not directly categorized in any previous research on SISM, Acceptance of negative feelings has been mentioned by Van den Tol and Edwards (2013), as well as Saarikallio & Erkkilä, (2007), who noted that listening to sad music may be used as a means to resolve problems, or to feel better about circumstances one cannot change.

Aims

Research indicates that the most common reason people give for SISM is 'to be in touch with or express feelings of sadness.' But why might this be the case? We suggest that people choose to listen to sad music when feeling sad in order to aid acceptance coping and feelings of solace.

One type of emotion -focused coping is acceptance-based coping, which means accepting the current situation instead of trying to alter or change it (Carver, Scheier, & Weintraub, 1989; Yi & Baumgartner, 2004). We hence hypothesized that SISM will predict acceptance-based coping via the recognition of, and identification of, emotional states, and that people will

experience more solace from sad music than happy music when feeling sad.

Method

In Study 1, participants recalled an instance of SISM while feeling sad following an aversive life event.

In Study 2, participants recalled the name of any piece of music (happy or sad) that they can listen to for solace. In both studies, a variety of questions related to their listening experience were asked, including an assessment of acceptance coping.

Preliminary Results

Study 1: SISM to get in touch with and express emotions was the most important self-regulatory strategy (of 6 examined) through which acceptance was achieved across 4 music selection strategies.

Study 2: The results of a mediation analysis indicated that listening to sel-idenfitied solace music (i.e. music that participants indicated to use to provide solace) in a sad mood (rather than a happy mood) indirectly predicts acceptance of a sad situation trough the emotional experiences related to this situation. Further, people in a sad mood were more likely to listen to sad music than happy music when they had the goal of solace.

Conclusions

When experiencing sadness, SISM is associated with acceptance coping (through the identification of sad feelings) and the experience of solace.

Implications for music therapy and emotional coping are discussed.

Keywords

Sad Music, Sadness, Self-regulation, Acceptance, Coping.

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Empathy polarises search for meaning in life after hearing mood-incongruent music

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ABSTRACT

Background

According to the Meaning Maintenance Model (Heine, Proulx & Vohs, 2006), "meaning threats" should increase the pursuit of meaning. A meaning threat occurs when people's expectations, goals or values are violated.

Much research has shown that when people experience expectancy violations (e.g., thoughts of death, switching experimenters), they re-affirm their meaning in a variety a ways (e.g., worldview defense, increased pattern learning, group identification).

But research has yet to examine if "meaning threats" elicit heightened search for meaning in life while measuring meaning search directly.

Aims

It was examined if "meaning threats" elicit heightened search for meaning in life while measuring meaning search directly.

Hypothesis 1: Mood Incongruent music will increase meaning search for people high in trait empathy (or with an empathy goal).

Hypothesis 2: Mood congruent music will reduces meaning search for people low in trait empathy (or without an empathy goal)

Method

In 3 Studies, we measured trait or state empathy and then made it easy or difficult for people to empathize with music by either placing them in a mood congruent or incongruent state to the music.

Study 1: Psychology students (N = 142) signed up for a study exploring "mood and personality." The design was a 2 (Trait Empathy: Low, High) X 2 (Mood: Congruent, Incongruent) experiment.

Participants completed The Interpersonal Reactivity Index (Davis, 1980) as a measure for trait empathy. All items were averaged and set to + or - 1 SD to form the independent variable.

Participants (all in a neutral mood) were randomly assigned to listen to either neutral music (mood congruent) or sad music (mood incongruent) that was experimenter selected.

Participants then completed the "Meaning Search" subscale of the Meaning in Life Questionnaire (Steger & Frazier, 2006). Sample items include, "I am seeking a purpose or mission in my life."

Study 2: Amazon Mturk users (N = 168) completed the study in exchange for $0.35. The design was a 2 (Manipulation Empathy: Yes, No) X (Mood: Congruent, Incongruent) experiment.

All participants were primed to experience happiness. This was done using a face mimicking procedure while viewing happy faces.

Participants were instructed to attempt to relate to and understand the musician's point of view, or merely to listen to the music.

Participants were randomly assigned to listen to either happy or sad music that they self-selected. Happy music was mood-congruent and sad music was mood-incongruent; hence, the latter was a means of making empathy more difficult.

They then completed the "Meaning Search" subscale, as in Study 1.

Study 3: Psychology students (N = 59) signed up for a study exploring "mood and personality." The design was similar to that of study 1, with the exception that all participants were in a sad mood. They also were randomly assigned to listen to either sad music (mood congruent) or happy music (mood incongruent) that was self- selected instead of experimenter selected.

Results

Empathy expectancy violations increased meaning search when search for meaning was directly measured. For people with empathy expectations, mood-incongruence heightened meaning search relative to people without empathy expectations.

As mood-congruence hinders empathy, it appears that "meaning threats" increase search for meaning, consistent with the Meaning Maintenance Model.

Both neutral and positive mood inductions and sad, neutral and happy music elicited meaning search in different contexts.

Both empathizing with people and not empathizing with people elicited meaning search depending on a person's expectations.

Conclusions

Findings will be integrated with current literature on meaning, empathy and music psychology.

Keywords

Empathy, Meaning, Music, Meaning search, Expectancy violation

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How does music help us to sleep?

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ABSTRACT

Background

Sleep is a biological mechanism that helps to control brain health, cognitive function, and complex body systems. The deregulation of this mechanism has been linked to health issues including heart problems, depression, and weight gain. At present, two thirds of UK adults experience regular sleep disruption and 1 in 10 have a recognized sleep disorder, of which there are over 100 varieties (Mental Health Foundation, 2011). Popular sleep aid intervention methods include pharmaceuticals however, they can prove ineffective and expensive, and may have side effects such as nausea, dizziness, and dependency.

The cost of sleep deprivation is physical, social and fiscal. Sleep deprivation and resulting daytime fatigue have been cited as a factor in work place injury and error, as well as employee absence (Daley et al., 2009). Direct economic costs are exurbanite and increasing. Rosekind & Gregory (2010) reporting an annual cost of $1848 per person ($924 per 6 months) for individuals aged 18 to 64 in the US. A similar study in Quebec demonstrated an annual cost of 6.6 billion Canadian dollars with $16.5 million alone being attributed to prescribed sleep medication (Daley et al., 2009).

With both health and fiscal side effects creating problems for a sleep-deprived world, the search for an effective and accessible form of support is urgent. Music has shown potential as such an aid: it is low cost, portable, and side effect free (at appropriate volume), and has helped sleep in chronic insomniacs (Chang, Lai, Chen, Hsieh, & Lee, 2012) and hospital patients (Su et al., 2013). Subjective measures employed in such studies include the Pittsburgh Quality Sleep Index (PSQI: Jespersen & Vuust, 2012) while objective measures include polysomnography (PSG: Chang et al., 2012) and electroencephalograms (EEG: Lazic & Ogilvie, 2007). No study to date has studied the impacts of music on a larger and more typical population; people with transient insomnia. Immediate questions to ask before we begin such testing is what do people listen to normally at home to help them sleep and why?

Aims

The present study carried out the first large-scale online survey of the use of music to aid sleep. The aims were to better understand; 1) the kinds of music used by people to aid their sleep, and 2) the ways in which people believe music helps to improve their sleep.

The distal aim of the project is to use these results to design an informed and ecologically valid sleep intervention study for people who experience transient insomnia. This study will compare the effects of music that is selected on the basis of the present survey to other non-invasive sleep aids. It will also feature instructions that are directly informed by the answers provided in the present survey.

Method

A large-scale quantitative and qualitative survey (Qualtrics) was placed online between May and November 2014. The survey measured basic demographics (age, gender), two aspects of musicality, namely training and emotional engagement (Goldsmiths Musical Sophistication Index or Gold MSI: Mullensiefen, Gingras, Musil, & Stewart, 2014) and recent sleep quality (PSQI: Buysse, Reynolds, Monk, Berman, & Kupfer, 1989).

Using an open text model, participants answered questions regarding music and other non-invasive sleep aid techniques. In the present report we focus on the answers to two of these questions. In the first, participants were prompted: “You stated that you have in the past used music to help you sleep. Please tell us what kinds of music helps you to sleep”. For the second question: “Please use this text box to tell us about any other reasons why you / believe that music aids your sleep”. Responses ranged from simple, “Variety of classical”, to more detailed responses, “It can help me to avoid worrying/panicking/stressing about other issues and hence keeping me up, as it provides something else less stressful for me to focus on and fall asleep to before bed. Certain melodies and song lyrics can really help me to feel relieved from stress and therefor fall asleep sooner”.

The quantitative data (demographics, Gold MSI and PSQI) were analyzed using classification and regression tree models through the implementation of the R package ‘Party’ (Hothorn, Hornik, & Zeileis, 2006).

Qualitative data were analyzed using categorical/ thematic techniques. Question 1 (music choices) was organized into categories based on genre using an online music database. Answers comprised of artists, albums, or song titles were replaced with their appropriate genre classification. For each participant each genre was only counted once, though more than one genre was accepted. Further analysis will parse these genres for a specific depiction of commonly reported artists and songs.

Answers to Question 2 (reasons music helps sleep) were subjected to a two-person thematic analysis technique (Williamson et al., 2014) in order to determine the patterns within the written responses. This qualitative technique

requires two reviewers to code independently each written response from participants into themes that summarize the essential message of the text. In a first stage of joint analysis these themes were compared in a turn taking fashion across the researchers until they agreed upon final themes to be included in a codebook alongside their definition. This codebook was then applied by both researchers in a second round of coding on the same text. Finally, both researchers compared their coding and noted any inter-rater disagreements, which were settled by a third researcher.

Results

In total, 651 people completed the survey (67% female; age M 33.41, range 18-79). Sleep quality across the sample was good (PSQI = 6.61; SD = 3.43) and the majority (59%) reported that music helped them to sleep. Results from two regression tree models indicated significant effects of age and current stress levels on sleep quality as measured by the PSQI. More specifically, older individuals (over 36 years) who experienced high stress ($\geq$8) reported worse sleep quality (Mdn=7 on PSQI). An additional classification tree model was run to identify any subpopulation of participants who were more likely to use music to aid with sleep problems. Again, age was a significant variable in addition to music engagement as measured by the active engagement subscale of the Gold-MSI. Approximately 70% of the people with a musical engagement score of 22 or less showed no regular use of music during sleep. The classification tree also found that 75% of the people who were 27 years or younger with higher musical engagement, 22 and above, were more likely to report making use of music for coping with sleep problems.

Qualitative analysis is ongoing. Preliminary analysis of Question 1 (music type) indicates that popular genres for music to aid sleep include classical, folk, and jazz. In response to Question 2 (reasons music helps sleep), popular themes include music's role as a distraction from both external noise and internal thoughts. Additionally, the achievement of a supportive mental or physical state: relaxation and calm (anxiolytic effect) or improved focus.

Conclusions

These data represent the first large scale UK based survey to illustrate how and why people believe music helps them to sleep, and the music that they choose.

We observed numerous examples of intuitive music use to aid sleep. Based on the qualitative thematic analysis we can deduce that the reduction of negative thoughts and stress related states of mind are effective ways in which music acts to improve sleep. These anxiolytic effects have been observed in clinical settings (Macdonald et al. 2003; Nilsson, 2008). This may point to underlying neural or chemical system (Nilsson, 2009) that can mediate both transient insomnia and the observed use of music to improve symptoms. Further objective quantitative studies will be needed to pinpoint a direct relationships between the anxiolytic effects reported and subjective decreases in stress.

Analysis of demographic information shows that older individuals with higher stress levels report worse sleep efficiency. This leads us to suggest that an older population may benefit particularly from music as a non-invasive sleep aid option. Based on this finding further studies could aim to pinpoint populations that may gain the largest benefit from the real-world application of a music based sleep intervention.

The present study will inform an upcoming music intervention for sleep study, by nature of the music to be selected and the advice for application given to participants. This work will contribute to wider knowledge about the objective and subjective impacts of music on our often-troubled sleep patterns.

Keywords

Music for sleep, insomnia, musical sophistication, thematic analysis

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Correlations between musical descriptors and emotions recognized in Beethoven's *Eroica*

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ABSTRACT

Investigations on music and emotion have identified broad musical elements that influence emotions recognized by listeners, such as timbre, rhythm, melody, and harmony. Not many studies have studied the correlation between quantifiable musical descriptors and their associated emotions; furthermore, only few studies have focused on how listeners' demographic and musical backgrounds influence the emotion they recognize. In this preliminary study, participants rated how strongly they recognized the six GEMS emotions (transcendence, peacefulness, power, joyful activation, tension, and sadness) while listening to excerpts from Beethoven's Eroica. Musical descriptors (loudness, brightness, noisiness, tempo/rhythm, harmony, and timbre) were also extracted from each excerpt. Results indicate significant correlations between emotional ratings and musical descriptors, notably positive correlations between key clarity and peacefulness/joyful activation ratings, and negative correlations between key clarity and tension/sadness ratings. Key clarity refers to the key strength associated to the best key candidate; as such, these results suggest that listeners recognize positive emotions in music with a straightforward key, whereas listeners recognize negative emotions in music with a less clear sense of key. The second part of the study computed correlations between demographics and emotional ratings, to determine whether people of similar demographic and musical backgrounds recognized similar emotions. The results indicate that naïve listeners (i.e. younger subjects, and subjects with less frequent exposure to classical music) experienced more similar emotions from the same musical excerpts than did other subjects. Our findings contribute to developing a quantitative understanding of how musical descriptors, and listeners' backgrounds, correlate with emotions recognized by listeners.

I. INTRODUCTION

The known relationship between music and emotion has old beginnings, but in-depth research on this relationship has been stagnant until only recently. The stale state of research regarding the influences of music on emotions can be attributed to a few reasons. The main one is perhaps that human emotions are difficult to measure and quantify and thus considered "less than scientific", and adding music—an ephemeral, languageless creation that only exists in time—to that equation makes it an even more challenging topic (Sloboda & Juslin, 2001a).

However, it is undeniable that there is a relationship between these two very human entities. There is anecdotal evidence in support of this strong connection, and recently, empirical evidence as well. In recent decades, musicologists and psychologists alike have taken interest in the relationship between music and emotion. Musical performances have been shown to communicate emotion (Siegwart & Scherer 1995). Music has shown to trigger basic physiological responses such as heart rate or blood pressure (Krumhansl, 1997, Nyklicek, Thayer, & Van Doornen, 1997), as well as more extreme physical responses such as shivers and goose bumps (Gabrielsson, 2001). Some researchers have, as consequence of such findings, proposed theories that music can either represent an emotion to a listener.

How does music convey emotion? How can a listener "recognize" an emotion from a sequence of notes? Furthering our understanding of these questions would improve current applications, such as music services that generate playlists depending a user's mood, music therapy sessions where the therapist chooses a song depending on the patient's emotional state, or automated programs that could aid musicologists in analyzing the emotional content of a piece.

However, given the intangible and relatively abstract nature of both music and human emotion, research in this field is understandably populated with some problematic issues. Problems that previous researchers have faced include how to categorize emotions, how to quantify them, which emotional descriptors to choose in the first place, the choice of music selections, and how to quantify the "elements" that make up music. We will first look to previous literature in the field of music and emotion to understand the state of the art, which will offer us guidance to how to move forward in answering the question of how music conveys emotions.

II. LITERATURE REVIEW

Previous research on the relationship between emotion and music has, first and foremost, yielded evidence that listeners can experience emotions while listening to music. Such emotions that are perceived from music are believed to have behavioural, physiological, and experiential components. Hence, the three main types of evidence behind these research studies are self-reports, expressive behaviour, and physiological behaviour

Pike (1972), for example, conducted a phenomenological analysis of music experience, in which musically untrained participants freely wrote down responses towards excerpts of music. All the collected responses could be reduced to a limited set of experiences: stable moods, transient emotions, feelings of pleasure, feeling of "oneness with the music", and feeling of movement. Following this study were several more studies that offered evidence, through self-reports, that listeners experience emotional responses to music (Sloboda & Juslin, 2001b).

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The idea of "musical tension", as a subset of emotional and partially physical responses to music, also became of interest for researchers. The occurrences of "chills" or "shivers-down-the-spine" as a result of music inducing a pleasurable experience (Sloboda, 1991; Panksepp, 1995; Blood & Zatorre, 2001) have been reported in laboratory settings. Such intense emotional responses have also been recorded in live concert settings (Grewe, Kopiez & Altenmuller, 2009). Furthermore, researchers such as Farbood (2006) have identified musical elements that contribute to listeners' perception of "musical tension".

Once the belief that music can express emotion was established, researchers experimented with various methods to categorize music-related emotions. Before diving into a deep discussion on this, it is important to recognize the distinctions between certain terms that are often considered synonyms in their everyday uses—but entail critical differences in this context.

The first distinction is between "perceived" emotion and "experienced" (or "induced") emotion. "Perceived" emotion can be understood as "emotion in music", which is the emotion the composer intends to express, and that the listener recognizes. "Induced" emotion can be understood as "emotion from music", which is the emotion the listener feels while listening to a piece of music (Juslin & Laukka, 2004). Perceived emotions are more agreed upon, whereas induced emotions tend to differ more widely between individuals. The present study focuses on perceived emotion.

The second distinction is between the terms, "affect", "mood", and "emotion". "Affect" is a general term that refers to the positive or negative valence of an emotional experience (Oatley & Jenkins, 1996, as cited in Laurier, 2011). A "mood" is a long-lasting experience that is without an identifiable stimulus event, whereas an "emotion" is a briefly lasting experience with an identifiable stimulus event. Some suggest that emotions, unlike moods, are associated with facial expressions (Ekman & Davidson, 1994, as cited in Juslin & Sloboda, 2001b). The present study focuses on brief affective experiences triggered by short musical excerpts, thus "emotions" recognized in music.

Researchers have taken one of three main approaches to conceptualize emotions in relation to music: the categorical approach, the dimensional approach, and the prototype approach (Juslin & Sloboda, 2001b). The categorical approach suggests that people experience emotions as one of several distinct and recognizable categories. Early categorical studies such as Hevner (1936) initially adopted this approach with a list of adjectives, which has been revised since then (Schubert, 2003). One of the most recent categorized models of music-related emotions is the Geneva Emotional Music Scale (Zentner, Grandjean, & Scherer, 2008). The GEMS is a 9-factorial model of music-related emotions developed as the result of four interrelated studies that compiled and categorized music-relevant emotion terms generated by hundreds of listeners. The model is domain-specific to music; Zentner et al.'s (2008) fourth study demonstrated that the GEMS accounts for music-related emotions better than other basic dimensional models. The nine main GEMS emotions are "transcendence", "wonder", "joyful activation", "power", "tension", "sadness", "tenderness", "nostalgia" and "peacefulness" (Zentner et al., 2008). A subset of these nine emotions was used for the present study.

Secondly, the dimensional approach identifies emotions according to their location on a 1-dimensional to 3-dimensional scale of dimensions such as valence, activity, and potency. While there is some debate as to what the third dimension should be in the 3-dimensional case, this approach has enabled listeners to track their changing emotional responses to music in real-time, in a continuous manner ("continuous" measurement is discussed in the next paragraph). The most widely adapted valence-arousal model has been confirmed to be a valid metric in several studies (Russel, 1980; Laurier, Serra, & Herrera, 2009). Thirdly, the prototype approach is built on the idea that emotions are categorical, but have hierarchical relationships to one another (Rosch, 1978).

In addition to the various approaches to conceptualizing emotion, researchers have developed various methods to attempt to quantify and measure these emotions perceived through music. One common distinction between methods is whether the measurement is "continuous" or "discrete". In "continuous" measurements, listeners continuously adjust their emotional response in real-time while listening to the music. Some examples are by moving a knob vertically (in the case of a 1-dimensional approach, such as rating the strength of one emotion from "weak-strong", or rating the musical tension from "weak-strong"), or dragging a cursor on a computer screen (in the case of a 2-dimensional approach, such as "valence-arousal"). A "discrete" measurement, on the other hand, would involve a listener giving their response to a musical excerpt as a whole, without the time factor. Some researchers have argued that adopting a continuous, or "dynamic", approach is important for emotion recognition in music, because music itself continuously changes through time (Kim et al., 2010).

III. OBJECTIVES/MOTIVATIONS

Previous studies have suggested that certain musical parameters especially influence the content of emotional responses—notably timbre, orchestration, acoustics, rhythm, melody, harmony, and structure (Juslin & Laukka, 2004). Several studies have created mappings between musical descriptors and emotion categories (Laurier, 2011), but these emotion categories are limited to the five emotions based on the "Big Five Inventory": "happiness", "sadness", "anger", "fear", and "tenderness" (e.g. Eerola & Vuoskoski, 2011).

Secondly, not many studies have focused on the differences in demographic and musical background in how listeners may experience different emotional interpretations to the same music. While there do exist several cross-cultural studies on music and perceived emotion (e.g. Balkwill & Thompson, Fritz et al., 2009), these studies tend to focus on greatly different cultures, rather than on more subtle differences such as age, gender, and musical experience or exposure.

Thus the present study attempts identify the correlation between quantifiable musical descriptors and the emotions recognized in listeners, and identifying the influences of

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demographic and musical backgrounds of listeners in how they recognize emotion. The focus of the present study is on classical music, and specifically on the same musical pieces, namely Beethoven's Third Symphony. Our rationale for focusing on classical music is we can analyze the influence of listeners' level familiarity with the piece or familiarity with the musical style on the recognized emotion. Furthermore, by studying emotional responses to the same musical piece, we may accurately analyze the evolution of emotion along time, as features such as instrumentation, recording conditions, and musical style are all consistent. This approach is different from previous emotion studies on popular music or rock music (Laurier, 2011, p. 57).

Moreover, in the present study we integrate descriptors from both the audio and score. This approach is also novel with respect to the state of the art, such as the MIREX mood estimation (Hu, Downie, Laurier, Bay & Ehmann, 2008) which have generally focused exclusively either on the score or audio. While some studies have also studied song lyrics to detect the emotional content of songs (Hu, Chen, & Yang, 2009), this type of information is irrelevant for classical music, which unlike popular music, has no lyrics.

Gaining a further understanding of the above would have practical applications such as improved music recommendation services or playlist generators and improved automatic musical categorization, specifically for classical music. Currently, classical music is not very well covered by commercial applications, which focus on mainstream popular music. Improved applications could be combined with pre-existing mood estimators submitted to initiatives such as the Music Information Retrieval Evaluation eXchange (IMIRSEL, 2012). Furthermore, research on demographic and cultural influences on recognized emotions could also open the gateway to further research on individual differences in emotional responses to the same music.

This study was conducted in the context of the PHENICX project (Performances as Highly Enriched and Interactive Concert Experiences), whose goal is to make use of music information retrieval technologies to enrich classical music concerts, specifically in the symphonic repertoire (see http://phenicx.upf.edu for further information)

IV. METHODOLOGY

A. Materials and Online Survey

Fifteen excerpts (11 - 29 sec) were selected from Beethoven's Third Symphony, the *Eroica*. This symphony was chosen because, from virtue of being the focus of the PHENICX research project, scores, high quality wav files, and aligned MIDI files were available. The excerpts were selected by the authors, who are trained in music theory and performance, then reviewed by a musicologist in the PHENICX team. In order to select the excerpts, every section of the *Eroica* was labelled with one of the nine GEMS emotions, judged based on musical elements (tempo, rhythm, harmony, melody, and orchestration). The six emotions that most frequently appeared were transcendence, peacefulness, power, joyful activation, tension, and sadness. Criteria for selecting excerpts were that it contained a variety of musical characteristics, lasted the duration of a complete musical phrase, and strongly represented one of the above six emotions. Fifteen was decided to be an appropriate number of excerpts to ensure the subjects remained engaged throughout the study.

An online survey using Google Forms was created. The survey had two sections, a demographic information component and a listening component. The demographic information asked was alias, age, gender, country of origin, years of musical education, how often the subject listens to classical music, and how familiar the subject is with the *Eroica*.

In the listening section, subjects listened to an excerpt and rated how strongly they perceived each of the six chosen GEMS emotions on a scale of 0 ("not at all") to 3 ("strongly"). These emotion categories were explained to subjects through lists of adjectives as shown in Table 1. Subjects had the option to comment on the excerpt. Subjects repeated this procedure for 15 excerpts, and had the option to give general comments at the end.

Table 1. Adjectives corresponding to each GEMS emotion, as explained to subjects while they took the online study.

Emotion	Adjectives
Transcendence:	"I feel... fascinated, overwhelmed, inspired, chills, feeling of spirituality"
Peacefulness:	"I feel... serene, calm, soothed, meditative, relaxed"
Power:	"I feel... strong, energetic, triumphant, fiery, heroic"
Joyful activation:	"I feel... animated, bouncy, joyful, dancing, amused, stimulated"
Tension:	"I feel... tense, agitated, irritated, nervous, impatient"
Sadness:	"I feel... sad, tearful, sorrowful"

To prevent ordering effects, three versions of the survey were created, each with their own order. Each order was decided using a random number arranger in MATLAB. A link given to subjects linked to one of the three versions at random.

A Spanish version of the survey was also available for subjects who felt more comfortable in their native language. Translation was assisted by a native speaker of Spanish.

B. Participants

The survey link was sent to the Universitat Pompeu Fabra Music Technology Group mailing list, a Barcelona-based gospel choir mailing list, and was posted on several social networking sites. The survey link was active for a week. 26 participants answered the survey (14 female), of average age 36.8 (standard deviation 12.8). 13 participants were of Spanish origin, 5 from Japan, 4 USA, 2 France, 1 India and 1 South Korea. Average years of musical education was 6.3 years (standard deviation 5.1). 5 participants reported they listen to classical music "almost every day", 10 reported "a few times a

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month", 3 reported "a few times a year", and 4 reported "almost never". 4 participants were "very familiar" with the *Eroica* (listened to it more than 3 times), 11 were "somewhat familiar" with it (listened one to three times), and 11 had never heard the *Eroica* before.

C. Musical Descriptor Extraction

Thirteen musical descriptors were extracted from each excerpt using the MIR Toolbox (Table 2).

Table 2. Musical descriptors extracted from excerpts, organized by type.

Type	Features
Loudness	mean root mean square (RMS), RMS standard deviation, low energy rate
Brightness	brightness, spectral centroid
Noisiness	zero crossing rate
Tempo/Rhythm	mean tempo, tempo standard deviation, number of note onsets/sec
Harmony	modality, key clarity
Timbre	MFCC

V. RESULTS

A. Emotional Ratings of Excerpts

To begin, the mean and standard deviations of the subjects' rankings, for each emotion, were computed for each excerpt. The results are laid out in Table 3 and illustrated in Figure 1.

B. Correlations

1) Correlations between emotions. First, correlations between emotional ratings were computed (Pearson correlation, critical value 0.388 at n=26 and df=25 and two-sided level of significance of 0.05). Statistically significant negative correlations were found between peacefulness and transcendence, power and peacefulness, joyful activation and transcendence, tension and peacefulness, tension and joyful activation, sadness and peacefulness, and sadness and joyful activation. Statistically significant positive correlations were found between power and transcendence, joyful activation and peacefulness, tension and transcendence, tension and power, and sadness and tension. Full table of correlations is illustrated in Table 4.

2) Correlations between emotions and musical descriptors. Thirteen musical descriptors (as outlined in Table 2) were extracted and computed from the fifteen extracts using MATLAB MIR Toolbox. The correlations between subject-generated emotional ratings and the values of these musical descriptors was computed (Table 5).

Statistically significant findings were as follows.

- Ratings of transcendence correlated significantly with: RMS mean, RMS standard deviation, low energy rate, MFCC (4, 6, 10, 13)
- Ratings of peacefulness correlated significantly with: Key clarity, MFCC (4, 9, 10, 11, 12)
- Ratings of power correlated significantly with: Low energy rate, MFCC (12)
- Ratings of joyful activation correlated significantly with: Key clarity, MFCC (4, 6, 10, 12, 13)
- Ratings of tension correlated significantly with: Modality, key clarity, MFCC (4, 9, 11, 12)
- Ratings of sadness correlated significantly with: Key clarity, MFCC (7, 9, 11, 12)

Table 3. Mean and standard deviations of subjects' ratings of each excerpt, for each of the six emotions. Subjects rated how strongly they perceived each emotion, from a scale of 0 ("not at all") to 3 ("strongly").

Excerpt	Transcendence		Peacefulness		Power		Joyful Activation		Tension		Sadness		Highest Ranked Emotion
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
1	0.962	0.958	1.500	1.175	1.231	1.107	1.692	1.087	0.500	0.906	0.269	0.604	Joyful A.
2	1.154	0.881	1.115	1.143	1.654	1.129	1.154	0.881	1.077	1.164	0.615	0.852	Power
3	1.231	1.210	0.808	1.132	2.038	1.038	1.000	0.748	1.385	0.941	0.308	0.679	Power
4	1.115	0.864	0.615	0.804	1.423	1.270	0.808	0.939	1.077	0.977	0.731	0.919	Power
5	1.115	0.909	0.885	1.107	1.538	1.272	1.154	0.925	1.154	0.967	0.577	0.945	Power
6	0.923	1.055	1.500	1.175	1.192	0.849	1.885	0.952	0.808	0.801	0.346	0.629	Joyful A.
7	1.192	1.167	0.269	0.533	2.038	0.774	1.269	1.002	1.615	0.941	0.500	0.707	Power
8	0.923	0.891	1.269	1.151	1.192	1.059	1.308	1.123	0.923	0.977	0.308	0.618	Joyful A.
9	0.808	1.059	0.538	0.706	1.577	0.945	1.654	1.231	1.115	1.033	0.423	0.902	Joyful A.
10	1.269	1.218	1.115	1.275	1.538	1.208	1.269	1.218	0.808	0.801	0.269	0.533	Power
11	1.115	1.033	0.462	0.948	1.308	0.970	0.385	0.496	1.808	0.895	1.000	1.020	Tension
12	0.846	0.834	1.154	1.156	1.000	1.131	0.808	0.895	1.000	1.200	0.808	1.059	Peaceful.
13	1.231	0.908	0.500	0.906	1.577	1.137	0.538	0.706	1.846	1.120	0.885	0.909	Tension
14	1.115	1.033	0.385	0.697	1.885	0.909	0.692	1.050	1.962	0.958	0.885	1.107	Tension
15	1.077	0.935	1.000	1.131	1.423	1.027	1.154	1.156	1.346	1.093	0.462	0.706	Power
Avg	1.072	0.997	0.874	1.003	1.508	1.055	1.118	0.961	1.228	0.985	0.559	0.813	

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Table 4. Correlation coefficients between ratings of emotions. Statistically significant values are bolded. Using the Pearson r table for critical values, a correlation coefficient of over absolute value of 0.388 was considered statistically significant (n=26, df=24, and two-sided level of significance = 0.05).

	Transc.	Peaceful	Power	Joyful A.	Tension	Sadness
Transc.		**-0.392**	**0.644**	**-0.459**	**0.452**	0.145
Peaceful.	**-0.392**		**-0.632**	**0.593**	**-0.847**	**-0.587**
Power	**0.644**	**-0.632**		-0.146	**0.543**	-0.021
Joyful A.	**-0.459**	**0.593**	-0.146		**-0.733**	**-0.842**
Tension	**0.452**	**-0.847**	**0.543**	**-0.733**		**0.702**
Sadness	0.145	**-0.587**	-0.021	**-0.842**	**0.702**	

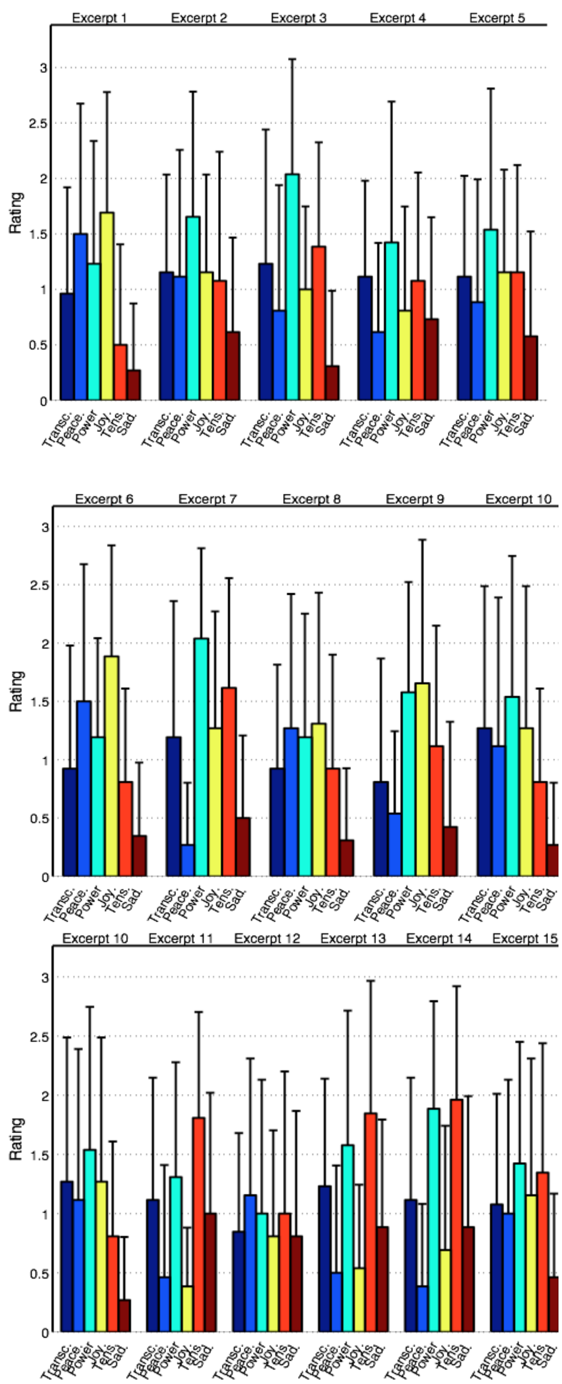

Figure 1. Mean and standard deviations in all subjects' ratings of six emotions, for each of fifteen excerpts.

3) Variations between all subjects. Another question we wanted to explore in this study was how musical experience and demographic background influence how listeners emotionally react to the same piece of music. To take a look at this question, we computed the standard deviations of subjects' emotional ratings in different contexts.

4) Variations between subjects with varying musical experience. Another point of interest was whether subjects with different musical experiences or demographic backgrounds reacted differently to the musical excerpts. Thus, standard deviations between subjects with varying musical experience were compared. First, the standard deviations of emotional ratings, for each emotion and for each excerpt, were split into two or three groups, depending on the criteria (Table 6). Then, whether there was a statistically significant difference between groups was determined using two samples t-tests (for groups of two) or a one-way ANOVA (for groups of three).

The three criteria in assessing levels of musical experience were years of musical education (Group 1: 6 years or less, Group 2: 7 years or more; the average years of musical education across all subjects was 6.3), level of exposure to classical music (Group 1: "Almost never" and "A few times a year", Group 2: "A few times a month" and "Almost every day"), and familiarity with the *Eroica* (Group 1: "Never heard", Group 2: "Somewhat", Group 3: "Very familiar").

There was no significant difference in standard deviations between subjects who had 6 or fewer years of musical education and subjects who had 7 or more years of musical education (two sample t-test, p=0.1592). Neither was there a significant difference between subjects who were very, somewhat, or not at all familiar with the *Eroica* (one way ANOVA F(2,267)=0.56, p=0.5726).

There was, however, a significant difference between standard deviations between subjects who listened to classical music frequently and subjects who listened to classical music infrequently (two sample t-test, p=0.02). Subjects who listened to classical music "almost never" or only "a few times a year" showed a smaller average standard deviation in their emotional ratings, compared to subjects who listened to classical music "a few times a month" or "almost every day".

5) Variations between subjects of varying demographic backgrounds. The second point of interest was whether listeners had different emotional responses to the same music depending on their demographic backgrounds. We looked at standard deviations between subjects of different countries of origin (Spain, USA, and Japan), gender, and age (Group 1: 36

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years or younger, Group 2: 37 years of older; the average age was 36.8). We split standard deviations of the ratings for each emotion, for each excerpt, into groups of two or three, depending on the criteria (Table 7).

No statistically significant difference was found between subjects of different countries (one-way ANOVA $F(2,267)=0.62$, $p=0.5376$). Neither was any statistically significant difference was found between male and female subjects (two sample t-test, significance level 0.2922). However, a significant difference was found between subjects of different age groups (two sample t-test, significance level 0.0228). Subjects of age 36 or younger showed smaller standard deviations (i.e. more agreement on what emotions they felt) than subjects of age 37 or older.

Table 5. Description Correlation coefficients between emotional ratings and musical descriptor values. Statistically significant values are bolded. Using the Pearson r table for critical values, a correlation coefficient of over absolute value of 0.388 was considered statistically significant (n=26, df=24, and two-sided level of significance = 0.05)

	RMS mean	RMS standard deviation	Low energy rate	Bright-ness	Spectral centroid	Zero crossing rate	Tempo mean	Tempo SD	Note onsets /sec	Modality	Key clarity
Transc.	**0.447**	**0.461**	**-0.504**	0.095	0.034	0.146	0.208	0.247	0.218	0.246	-0.223
Peace.	-0.087	-0.090	0.122	0.218	0.303	0.190	-0.018	0.382	-0.343	-0.253	**0.437**
Power	0.177	0.076	**-0.405**	-0.096	-0.148	0.041	0.092	-0.197	0.344	0.115	0.043
Joyful A.	0.024	-0.110	-0.040	0.197	0.334	0.196	-0.207	0.041	-0.081	-0.354	**0.459**
Tension	0.006	-0.073	0.103	-0.054	-0.175	0.004	-0.031	-0.320	0.158	**0.440**	**-0.497**
Sadness	0.048	0.107	0.204	-0.035	-0.173	-0.048	0.165	-0.315	0.097	0.299	**-0.620**

Table 6. Mean standard deviations for each emotion (averaged over fifteen excerpts, and averaged over subjects who qualified for the criteria) for various criteria regarding musical experience and exposure.

Emotion	All subjects	Years of music education		Exposure to classical music		Familiarity with the *Eroica*		
		6 or less	7 or more	Infrequent	Frequent	Never heard	Somewhat familiar	Very familiar
Trans	0.997	0.953	1.065	0.923	1.053	0.968	0.925	1.013
Peace	1.003	1.003	1.010	0.977	1.013	0.923	0.957	1.079
Power	1.055	1.076	1.041	1.062	1.057	1.126	0.948	1.162
Joyful	0.961	0.922	1.004	0.937	0.972	0.911	0.968	0.922
Tension	0.985	1.019	0.955	0.942	1.021	0.991	0.982	0.981
Sadness	0.813	0.694	0.886	0.699	0.880	0.621	0.939	0.697
Av.	0.969	0.944	0.993	0.923	0.999	0.923	0.953	0.976

Table 7. Mean standard deviations for each emotion (averaged over fifteen excerpts, and averaged over subjects who qualified for the criteria) for various criteria regarding demographic and cultural background.

		Country of origin			Gender		Age	
Emotion	All subjects	Spain	USA	Japan	Male	Female	36 or less	37 or more
Trans.	0.997	1.028	0.882	1.084	0.9760	1.0210	1.020	0.965
Peace	1.003	1.008	1.017	0.984	1.0294	0.9888	0.964	0.933
Power	1.055	1.089	1.064	1.018	1.0397	1.0804	1.053	0.986
Joyful	0.961	0.940	1.146	1.024	0.8959	0.9985	0.810	1.016
Tension	0.985	0.998	1.076	0.921	1.0025	0.9715	0.854	1.055
Sadness	0.813	0.642	0.536	0.989	0.7521	0.8439	0.666	0.876
Av.	0.969	0.951	0.953	1.003	0.9493	0.9840	0.895	0.972

C. Participant Comments

In the online survey, a text box was included beneath each excerpt to allow subjects to include comments on the particular excerpt to which they just recorded their emotional responses. The comments section was optional. Table 8 is a summary of

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all the comments received for each excerpt. The comments are divided into those not regarding emotion (e.g. regarding the length of the excerpt), regarding emotion, and "reasoning" (user-given reasoning or explanations for why they recognized certain emotions, often based upon the musical content or instrumentation of the excerpt).

A common complaint was that several exceprts were too short. To ensure that subjects remained alert throughout all fifteen exceprts, excerpts were kept to under thirty seconds; however, this feedback indicates that longer excerpts may be necessary to sufficiently recognize an emotion. Another common comment was that the listening environment influenced listeners' ability to perceive emotions. For example, listening to music on low volume through headphones provides a weaker emotional experience than listening to a live performance in a concert hall.

Participants seemed to associate diminished chords with transcendence, quiet dynamics with peacefulness, and brass instruments with power, to name a few examples. However, it is evident that participants also frequently disagree with one another. For example, one participant described an excerpt as "suitable for a holiday morning" suggesting peacefulness, whereas another perceived tension. What one participant described as "peaceful," another participant said conveyed "a sense of urgency." The variety in comments regarding the same excerpts of music suggest major differences in how listeners perceive the emotional content of music.

VI. DISCUSSION

Limitations of this study, like many other studies in the field of music and emotion, lie in the question of the selection of the approach of emotional categorization, the choice of musical genre, and the selection of excerpts.

Some findings of this study are worth contemplating. One notable result in the correlations of musical descriptors with emotional ratings is the prevalence of "key clarity" as one of the musical descriptors that correlated significantly with emotional ratings (included in four out of six of the emotions). This seems to suggest that the ambiguity of key influences what emotions listeners recognize, more so than the actual modality (i.e. the degree of "minor-ness" or "major-ness") of the music. Another point to notice is that at least four MFCC coefficients correlated significantly with each emotion (except for "power" with which only one MFCC coefficient correlated

Table 6. Comments regarding each excerpt, given by subjects. If more than one person wrote an identical comment, (such as "the excerpt was too short") the number of people who gave that comment is notated in parentheses.

Ex	Not regarding emotion	Regarding emotion	Reasoning
1		"feels like resolving to something, but not sure what," "nicer than previous one (subject had commented about "tension" in previous excerpt)"	
2		"slightly sad but somehow gives power," "feels like something's not quite right," "nice but not strong enough to grab me"	
3	"too short"	"didn't do much emotionally," "imagined being a strained person, depressed, not knowing what to do," "liked this"	
4	"too short"	"powerful but not the single most powerful excerpt"	
5		"calming," "beautiful," "floating along all emotions"	
6	"too long" "too short" (wanted to see where leading)	"peaceful," "liked it," "some parts seem different from others emotionally; mainly joyful, but at the end some tension," "dynamic," "sense of urgency/hurried"	"gradual crescendo, playfulness of half-step and stress-release motif"
7	"too short" (3)	"strong enough to be emotionally influenced", "very strong emotion," "felt tense"	
8		"enjoyable," "nicely energetic," "pretty"	
9		"mixed signals, no one clear emotion"	
10	"too short"	"joyful, happy" (2), "peaceful, pretty," "playful with a hint of an unknown undercurrent"	
11	"low volume" (2)	"perhaps sadness, not sure," "felt sadness and tension, but felt as if had taken courage to confront the problem; I felt more powerful and determined"	
12	"may have felt transcendence if hearing in a concert hall"	"feels like spring," "building towards resolution or happy ending"	"diminished chords led to feeling of grandeur", "associate the dynamic (small energy) with peacefulness"
13		"feel 'conflict' rather than 'tension,'" "nice"	"sounds more solemn than sad, because of soft dynamic level and minor tonality", "strong sounds of violin", "background strings really pushing the tension meter"
14	"lack of musical experience makes me feel like I'm missing something"		"jubilant, running strings with fugal lines; love it!", "tension in strings builds up with punctuation of power in horns"
15		"suitable for a relaxed, holiday morning," "musical tension in some moments, sounds dramatic," "felt a little bit of tension"	

significantly). This suggests that timbre has an important influence on emotion recognized in listeners, which points to the importance of orchestration in classical pieces such as Beethoven.

To place a heavier focus on individual emotions, the correlation between RMS mean and RMS standard deviation with transcendence ratings suggests that listeners experience feelings of "transcendence" when listening to loud music of greatly altering dynamic. Furthermore, transcendence and power are similar in their positive correlations with low energy rate, indicating that they both share some brightness in sound.

Why did subjects who listen to classical music more infrequently agree more upon their emotional responses, compared to subjects who listen frequently to classical music? Secondly, why did younger subjects agree more on their emotional responses than subjects of the older generation? A possible explanation for the first question is that listeners with frequent exposure to classical music associate their own biases, interpretations or memories to classical music. These personal "interpretations" tend to diversify more. On the other hand, listeners with less frequent exposure to classical music rely on first impressions, which may be more agreed upon.

A plausible answer to the second question could be that due to the increasing prevalence of the internet, people of younger generations are more exposed to similar music, more so that people of older generations. Another, possibly more likely, explanation is the younger subjects have less experience with music, and thus are naïve listeners. Naïve listeners may rely on surface-level musical cues (such as rhythm or modality) to experience emotion, whereas more experienced listeners pay attention to a wider range of musical cues and thus their responses are more divergent.

The user-generated comments give rise to philosophical considerations surrounding the emotional experience of listening to music. The first point is the universality vs. cultural specificity of emotional responses to music. There is a common belief that music is the "universal 'language of the emotions'; that is… the suggestion that expressiveness can be recognized cross-culturally". However, as Davies (2001, p. 37) puts it, culture plays a surprisingly influential role in how one perceives, and emotionally reacts to, music.

> "Until one appreciates the belief systems that determine the significance of the social settings in which emotions are situated, and then recognizes the connection of music with all this, it will not be a simple matter to read off expressiveness from foreign music."

A point to take into consideration is that differences in how individuals emotionally respond to music is affected not only by their cultural upbringing, but by other demographic factors, such as age. As observable in the comments (Table 8), individuals can have nearly opposite emotional reactions to the exact same excerpt of music. While it is known that all cultures have some form of music (i.e. the appreciation of music is a cultural universal), the emotional appraisal of music is not necessarily the same across cultures—music may not necessarily be a "universal language of emotions."

The last point to mention, which perhaps applies not only to emotions recognized in music, but to emotions in all aspects of life, is that emotions are rarely, if ever, straightforward. Some comments received included, "paradoxical (tension and peacefulness)" or "tinge of sadness (even though "joyful activation"). The often paradoxical combinations of contrasting emotions that music conveys is perhaps a reflection of emotions experienced in everyday life. Music reflects the complexity, many shades of grey, of emotion, that we experience in real life.

VII. CONTRIBUTIONS AND FUTURE WORK

The present study contributes several findings to the field of music psychology: musical descriptors that correlate with real listeners' emotional responses to music (specifically excerpts from Beethoven's Third Symphony), quantifiable measurements and correlations between these descriptors and emotional ratings. The focus was on specific measurable audio descriptors that can be automatically extracted from audio.

Furthermore, we contribute findings regarding what elements of musical experience/exposure and demographic /cultural background influence how listeners respond emotionally to the same clips of music. Subjects with less frequent exposure to classical music agree more than subjects with frequent exposure. Younger subjects agree more than older subjects. Such findings might say something about how people perceive music and respond to it emotionally.

Future work could examine the association between emotional responses and musical descriptors in a wider range of musical genres. The present study focused on a limited set of excerpts from only one symphony by Beethoven. It would be worthwhile to see whether these correlations found in this study also apply to other classical pieces and other genres of music, or world music. An extension of this study would also benefit from collecting responses from a larger group of people with a wider range of cultural backgrounds.

Many music listeners would agree that music and emotion are intertwined and strongly related, and yet to quantitatively prove the relationship between these two rather intangible forces is a challenge—even more so when the relationship differs between listeners, depending on their cultural or musical background, or even just individual preferences. This study has been an attempt to take a step towards a more concrete understanding of how music can influence emotions. There are still many more paths in the field of music and emotion research to be examined, and deepening our understanding of how exactly we are emotionally moved by the sound of music may have many yet unexplored uses.

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Temporal dynamics and modeling of musical emotions using a multi-component approach

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ABSTRACT

Background

Musical characteristics, such as tempo, mode, loudness, pitch, timbre, and so on, are inherent properties of the musical structure, and their influence on emotional responses to music has been shown [1], [2]. On the other hand, there is a large amount of studies establishing the relationship between physiological changes and musical emotions during music listening [3], [4]. Music by its nature unfolds in time and therefore, musical emotions are time varying. In addition, the change of musical structure over time affects different emotional components including self-reported, behavioral and physiological responses. The dynamic relationship between musical structure, felt emotions and physiological responses is fundamental to deeper understanding and modeling of musical emotions. However, how the time course of emotions are affected by musical features as they develop in time still remains unclear.

Aims

The present study seeks to identify and investigate the dynamic relationships between acoustic features, physiology and affective states. A multivariate approach was used including continuous measures of emotions from subjective, expressive and physiological responses from listeners.

Method

Twenty-eight non-musicians students from SUTD were recruited as participant (14 males and 14 females). Participants were asked to listen to two overtures taken from Classical music (William Tell by Rossini and Prince Igor by Borodin) and rate their emotional experience while listening to each piece continuously on a 2 dimensional emotion space indicating their level of arousal and pleasantness. During the experiments, EMG facial zugomaticus, the electrocardiogram, the respiration rate and skin conductance were measured simultaneously to provide insight with regards to their emotional state. A total of 5 acoustic descriptors based on musical characteristics such as dynamics (rms energy), timbre (brightness), harmony (mode, key clarity) and rhythm (pulse clarity) were also extracted from the musical excerpts.

Results

Results indicate that variation in musical structure induced different subjective feelings and psychophysiological activations to listeners: Parts of the music with higher loudness and pulse clarity, induced higher sympathetic HRV activation, increased cardiorespiratory synchronization, higher levels of skin conductance and subjective ratings of arousal compared to calming sections of the pieces. On the other hand, parts with major mode, higher spectral brightness and lower pulse clarity, induced higher parasympathetic HRV activation, decreased cardiorespiratory synchronization, higher levels of zugomaticus facial activity and subjective ratings of valence.

Conclusions

The findings of this study provide information on the dynamic relationships of musical features and induced emotions in music listening using continuous measures of emotions from behavioral and physiological responses. The results of this study have both theoretical and practical implications. Theoretical implications for music psychology, to gain insight into the mechanisms of emotion induction by music, and practical implications for the improvement and development of multimodal music emotion feedback systems for music therapy applications, music retrieval systems and human-computer interfaces.

Keywords

Musical emotion, acoustic features, physiological responses, affective responses

Acknowledgment

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Conceptual blending and meaning construction: A structural/hermeneutical analysis of the 'Old Castle' from Musorgsky's 'Pictures at an Exhibition'

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ABSTRACT

Conceptual blending is a cognitive theory proposing the combination of diverse conceptual spaces for the creation of novel blended spaces. Musical conceptual blending can be intra-musical, pertaining to the combination of diverse structural elements for the creation of new melodies, harmonies or textures, as well as cross-domain, involving the integration of musical and non-musical spaces for the creation of novel analogies or metaphors. The present paper presents a structural and hermeneutical analysis of 'Il vecchio castello' from Modest Musorgsky's 'Pictures at an Exhibition' in an attempt to disclose both the intra-musical (combination of modal, tonal and coloristic harmonic spaces) and the extra-musical (contextual, symbolic and programmatic aspects) conceptual blending that the work incorporates. The analysis reveals that the piece comprises seven strophes of a song form that emerge from a common melodic core, through the dynamic evolution of harmonic spaces from diatonic modality to impressionistic/coloristic chromaticism and with the combinatorial use of ten harmonization concepts. The reductional/prolongational analysis provides input for two distinct Conceptual Integration Networks, the first describing the intra-musical blending of melodic harmonization and the second proposing the cross-domain blending of the musical and pictorial input spaces into a blended hermeneutical space that projects the work's narrative/programmatic/emotional potential. The proposed analysis shows how musical structure promotes meaning construction through cross-domain mapping. This research suggests that conceptual blending theory as an analytical tool can promote a richer structural interpretation and experience of Musorgsky's work.

I. Introduction

From a traditional musico-analytical perspective, Musorgsky's 'Pictures at an Exhibition' is a typical example of programme music. It refers to a series of paintings, and the imaginary affective exploration of their features. This programme, in keeping with 19th-century formalist distinctions between intrinsically musical features and extra-musical interpretations attached to them, is seen as somehow secondary and 'parallel' to the music.

In this paper we argue for a somewhat different interpretation, drawing on the theory of conceptual blending (Fauconnier & Turner 2003) and related work on metaphor & cross-domain mapping (e.g. Zbikowski 2002 & 2008, Spitzer 2003). Through a case-study analysis of the 'Old Castle', we explore instances of conceptual blending which go beyond the idea of a programme that is merely applied onto the musical work, and re-cast Musorgsky's composition as a dynamic, multiple-level integration of incongruous temporal, spatial and affective modalities.

A fundamental assumption for this investigation is the idea of a scored composition as an emergent structure, which can also be studied retrospectively. The ensuing analysis is therefore intended to provide a possible interpretation of how we listen to the 'Old Castle', how this process generates meaning that is neither purely musical nor exclusively pictorial or verbal, and how the elements that are central to this blended understanding of the work, are arguably themselves a result of structural blending.

A. Perspectives from Cognition and Philosophy of Mind: Conceptual Blending and Qualia

Fauconnier & Turner's Conceptual Blending theory (2003) is a step further from unidirectional theories of metaphor, most notably Lakoff & Johnson's (1980) Conceptual Metaphor Theory (CMT). CMT suggests that we map concepts across different domains, borrowing features from one source (e.g. painting) and applying them to a target (e.g. music), so that the attributes of the source domain are mapped onto those of the target (e.g. 'nuanced dynamics' or 'a dark tonality'). Blending, on the other hand, presupposes an equilateral, multi-directional relationship not only between different domains, but between *conceptual spaces*. These spaces may be contrastive or qualitatively different, and may only share some structural features between them. In that sense, we may also identify blends situated exclusively within the domain of music, e.g. between clashing chords or contrasting tonalities (Ox 2014, Kaliakatsos-Papakostas *et al* 2014), as well as blends combining properties of text, image and sound, e.g. in cinema or advertising (Cook 2001) or in recorded pop songs (Moore 2012).

Applications of conceptual blending in music analysis are still relatively few and rather general in nature. Cook (2001, see also an earlier attempt in Cook 1998) makes one of the first attempts to represent a music and moving image blend in his analysis of a Citroen car commercial, while Zbikowski (2002) provides one of the more detailed analyses to date of how text painting and programme music operate together on the basis of conceptual blending. While more recent authors (e.g. Schmidt 2012) have also proposed critical re-examinations of these analytical approaches, for the purposes of this paper, we will primarily rely on Zbikowski's paradigm, not only because it is the most analytically inclined example of current literature on blending in music, but also because of its closeness to the material under study (a complex programmatic work involving several layers of visualisation and meaning construction).

As 'the work' in this case is not merely a musical text, and the composer's relationship to the source material is more complex than the kind of one-directional representation or *ekphrasis*

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suggested e.g. by Bruhn (2000), we also refer to the qualitatively different, contrastive states that account for the piece's multiple dimensions as *qualia*. Though the properties of qualia have been the subject of extended criticism among consciousness theorists (most notably Dennett 1991), the idea of otherwise indescribable differences in consciousness between past and present, reality and dream, depiction and interpretation etc. is a useful way to conceptualize the deeper-level structures that permeate the composition.

B. Musorgsky's 'Pictures' and the 'Old Castle'

Musorgsky's 'Pictures at an Exhibition' is a well-known piano suite, inspired from paintings and architectural drawings by Viktor Alexandrovich Hartmann (1834-1873), a close friend of the composer, put on display during a posthumous exhibition of 400 of his works in February and March 1874 in St. Petersburg. The suite comprises 10 pieces and 5 promenades that function as preludes and/or bridges. It was written in one creative burst in June 1874 (Russ 1992; Oldani; Brown 2002: 229-241).

The suite, according to Russ (1992: ch. 1; see also Taruskin 2010: vol. 3, ch. 12) incorporates Musorgsky's key stylistic elements: nationalism, populism, anti-romantic realism and conscious distance from mainstream (Germanic) concepts of musical form, motivic development and harmonic structure. A narrative dimension has been identified and commented upon in all of Musorgsky's 'musical pictures' (Russ 1992: 31, Tarasti 1994: ch. 8), as if the composer focuses on someone or something within the picture and creates a story about it through music, thus forging an indivisible duality of psychological state/musical structure for each piece.

The 'Old Castle' is the second piece of the suite, entitled by the composer in Italian as 'Il vecchio castello'. The original watercolor painting has been lost or sold during the exhibition (Brown 2002: 230), but according to Stasov's description (Frankenstein 1939: 282), it was a depiction of "a medieval castle, before which stands a singing troubadour". Bibliographic references to the piece (Russ 1992: 37-38; Tarasti 1994: 214, 227-229; Brown 2002: 235) stress its modal Russian character, its siciliana rhythmic pattern and its melancholic mood, but do not include full or partial musical analysis. We cite two of these references, since they indirectly reflect the present analytical approach (italics by the authors): Eero Tarasti, in his semiotic analysis (1994: 214), refers to the piece as Italian pastiche, where "the 'old castle' alludes to the past, a *heterotopic* place, 'elsewhere' with respect to the musical narration", and David Brown mentions (2002: 235) that "the melody that runs throughout the piece is his [the minstrel's] song, a *blend* of Italian siciliana with Russian melancholy".

C. Research Aims

In Conceptual Blending Theory (Fauconnier and Turner, 2003), elements from diverse, but structurally related, mental spaces are 'blended', giving rise to new conceptual spaces that often possess new powerful interpretative properties, allowing better understanding of known concepts or the emergence of novel concepts. Conceptual blending allows the construction of meaning by correlating elements and structures from diverse conceptual spaces.

The present research's aim is the exploration of conceptual blending between the musical and pictorial spaces embedded in the 'Old Castle'. The inquiry was triggered by the piece's implicit heterogeneity regarding its modal/tonal content, a feature that seems to grow and expand while the music evolves from beginning to end, while constantly revolving around a stable rhythmic pattern and a common melodic core. The analysis will therefore pursue an explication of the multi-directional metaphoric relation between music and picture through structural music analysis and cross-domain mapping, as well as a description of its dynamic evolution. For this purpose, multi-level ontologies in music will be employed in multi-level blending through the basic operations of composition, completion and elaboration (Zbikowski 2002: 80).

II. Music Analysis

The piece can be considered, in accordance with Russ's description (1992: 37), an Italian "serenade ... [that] turns into a Russian song without words", where a diatonic modal melodic core unfolds differently in each stanza, evoking different harmonizations. The analysis that follows focuses on harmonic and prolongational structure, making references to rhythmic and textural aspects. Our choice for using prolongational analysis and revealing quasi-Ursatz schemas may seem at first inappropriate for music that consciously avoided mainstream harmonic and developmental theories and practices (Russ 1992: 9). However, the specific piece affords the application of such a methodology, albeit in an idiomatic way, due to its linear texture (see also Puffett 1990 and Russ 1990 for prolongational analyses of 'Catacombs' and 'Nursery').

A. Form and compositional concepts

The piece is in strophic song form, with a short introduction and seven stanzas of unequal length, as shown below:

Introduction (b. 1-8)
Stanza 1 (b. 9-18)
Stanza 2 (b. 19-28)
Stanza 3 (b. 29-37)
Stanza 4 (b. 38-50)
Stanza 5 (b. 51-69)
Stanza 6 (b. 70-95)
Stanza 7 (b. 96-107)

Ten main compositional concepts can be identified, employed in various combinations by Musorgsky for the composition of the seven stanzas:

1. Drone of tonic in the lower voice (omnipresent and constant throughout the whole piece)

2. Siciliana rhythmic pattern and subpatterns: , etc (the main pattern for the tonic drone and related subpatterns for the melody)

3. Diatonic modal harmony (diatonic voice-leading, free non-functional use of triads for melodic harmonisation in the context of the diatonic modes)

4. Diatonic tonal harmony (functional use of chords for melodic harmonisation in the context of major-minor tonality, diatonic voice-leading, tonal cadence schema: iv-V^7-i)

5. Chromatic tonal harmony (use of more dissonant chords, chromatic mixture, tonicizations, chromatic voice leading)

6. Chromatic coloristic/impressionistic harmony (free use of chromatic sonorities without tonal harmonic function)

7. Modal interchange (change of mode while keeping the same pitch center) and hyper-modulation (change of pitch tonal space)

8. Parallel harmony (diatonic or chromatic/real chord planing)

9. Scale of sensory dissonance (conscious use of intrinsic dissonance level for the choice of chords)

10. Fragmentation of musical texture (use of unconnected snippets / mosaic texture)

These concepts can be categorized –with categorical overlapping– as rhythmic (1, 2, 10), harmonic (1, 3, 4, 5, 6, 7, 8), textural (8, 10) and cognitive/schematic (9, 10).

B. Analysis of the seven stanzas

In this subsection an analysis of each stanza is presented, focusing on the compositional concepts employed and illustrated with two-level prolongational graphs.

Introduction and Stanza 1 (b. 1-18). The left-hand introduction and the first melodic stanza are purely diatonic, with their pitch content coming from the G# Aeolian mode, and with characteristic descending voice-leading (5-4-3-2-1 for the intro and 8-7-6-5-4-3 for the melody). The intro segment is also repeated as a codetta (fig. 1).

The concepts employed are: tonic drone, siciliana rhythm, modal harmony (G# Aeolian, descending diatonic voice leading).

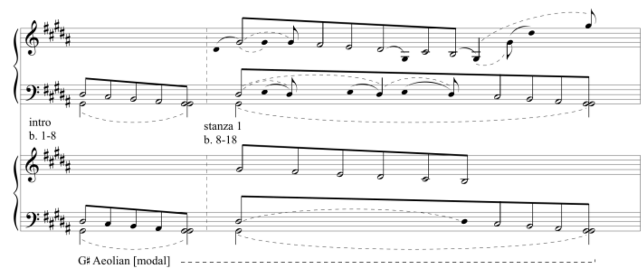

Figure 1. Score & prolongational analysis of Intro and Stanza 1.

Stanza 2 (b. 19-29). The second stanza starts similarly in the G# Aeolian mode, but 3 bars later the use of A natural denotes a modal interchange towards the G# Phrygian. The parallel $^6{}_3$ chords that introduced the modal interchange continue, creating a tonicization of the C# minor chord. This is subsequently used as a iv harmonic degree in G# minor tonality, leading to a V^7-i (fig. 2). Thus, although the main melodic line is the same (8-7-6-5-4-3), a hyper-modulation from the modal to the tonal system occurs (fig. 2).

Concepts employed: tonic drone, siciliana rhythm, modal harmony (G# Aeolian – G# Phrygian, descending voice-leading 8-7-6-5-4-3), tonal harmony (G# minor, cadence iv-V^7-i), modal interchange, hyper-modulation, parallel harmony (diatonic $^6{}_3$ chords).

Figure 2. Score & prolongational analysis of Stanza 2.

Stanzas 3, 4. (b. 29-37 & 38-50). The exploration of diatonic modes based on G# continues in these two almost identical stanzas (their only difference is that the fourth stanza includes the intro segment as a codetta). The stanza begins in G# Phrygian (A natural), interchanges to G# Locrian (A, D natural), returns to G# Aeolian and concludes in G# minor tonality. The expanded modal interchange concept introduces a mode not

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used in the Middle Ages, the Locrian, conveying a more Russian/19th-century profile to the stanza's modality (fig. 3).

Concepts employed: tonic drone, siciliana rhythm, modal harmony (G# Phrygian – G# Locrian – G# Aeolian, descending voice-leading 6-5-4-3), tonal harmony (G# minor, cadence iv-V^7-i), modal interchange, hyper-modulation.

Figure 3. Score & prolongational analysis of Stanzas 3 and 4.

Stanzas 5, 6 (b. 51-69 & 70-95). Stanza 5 begins in G# Aeolian, but then, when the melody ascends chromatically from G# to D#, chromatic harmony is employed for its harmonization. Initially, two tonicizations take place in A# major and C# major (through secondary diminished 7th chords). Subsequently, the two last melodic steps (Cx-D#) are harmonized with intrinsically dissonant non-functional chromatic sonorities (D#-F#-A#-Cx, E#-G#-D#), before reaching C# minor through an embellishing non-functional chord (E-G#-Cx), and finally arriving at a functional stable harmonization of D# (D# major chord). These non-functional coloristic/impressionistic chords have diminishing sensory dissonance levels, a parameter exploited by the composer in the transition from tension to relaxation: [D#-F#-A#-Cx] - [E#-G#-D#] - [E-G#-D] - [E-G#-C#]. The stanza closes with a cadence to G# minor tonality (iv-V^7-i), that also completes the background melodic voice-leading (5-4-3). This stanza greatly expands the concept of hyper-modulation, incorporating four distinct harmonic systems (modal, diatonic tonal, chromatic tonal, impressionistic), each pertaining to a different tonal pitch space / historical era (fig. 4).

Figure 4. Score & prolongational analysis of Stanzas 5 and 6.

Stanza 6 is almost identical, but with an extra element: the fragmentation of the musical texture by employing snippets of the previous stanzas (b. 87-95), having as a result the absence of the cadential pattern V^7-i at its end: the unresolved V^7 of b. 86 is prolonged until b. 95 (fig. 5).

Figure 5. Reductional analysis of Stanza 6.

Stanzas 5 and 6 incorporate almost all the compositional concepts: tonic drone, siciliana rhythm, modal harmony (G# Aeolian), chromatic tonal harmony (vii^{o7}-I, chromatic ascending voice leading, brief tonicizations), coloristic harmony (D#m^{7M}-E#$m^{7/-5}$), diatonic tonal harmony (G# minor, cadence iv-V^7-i), hyper-modulation, sensory dissonance scale, fragmentation.

Stanza 7 (b. 96-107). The last stanza returns to the initial melodic material, albeit with more chromaticism (chromatic voice-leading, altered diminished 7th chord for the tonicization of iv). Michael Russ (1992: 38) argues that this is a coda, but we will disagree, because this part contains the structural ending of the work, the only complete iteration of the piece's melodic

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core: the descending voice-leading schema (8-7-6-5-4-3-2-1) (fig. 6).

Concepts employed: tonic drone, siciliana rhythm, modal harmony (G# Aeolian), chromatic tonal harmony (descending chromatic voice-leading, altered chords), diatonic tonal harmony (G# minor, iv-V^7-i), perfect cadence with structural closure, hyper-modulation.

Figure 6. Score & prolongational analysis of Stanza 7.

C. Summary of compositional features

The preceding musical analysis has revealed that the 'Old Castle' is essentially the result of seven different evolutions of a common modal melodic core –namely a descending voice-leading linear structure–, through the dynamic evolution of harmonic spaces from diatonic modality to diatonic/chromatic tonality and impressionistic/coloristic chromaticism, with the combinatorial use of ten compositional concepts. The harmonic evolution is supported by the omni-present common element of the siciliana tonic drone, and occurs linearly, starting with diatonic modality in the 1st stanza, culminating with the use of all four spaces in the 6th stanza (through hyper-modulations) and closing with the tonal cadence in the 7th stanza and the completion of the melodic schema.

III. Conceptual Integration Networks

This section attempts to put the analysis results in context, drawing on Zbikowski's representation of conceptual blending in music. So, two different Conceptual Integration Networks (CINs) will be constructed, each with its own generic, input and blended spaces, and with reference to Fauconnier & Turner's (2003) typology of single-scope and double-scope blending networks.

A. "Intra-musical" structural blending

CIN 1 (Conceptual Integration Network 1) proposes that the piece's evolutionary musical structure is a result of the intra-musical blending of harmonic spaces through the concept of hyper-modulation. So, the Generic Space, to which both input spaces relate, is *Music-Song*; it is defined by parameters of melody, rhythm, harmony, hierarchy and musical texture. Input Space 1 is *Melody* (properties: modes/scales, structural pitches, melodic/linear cadences, interval succession/voice-leading, implied harmony, rhythm) and Input Space 2 is *Harmony* (properties: diatonic modality, diatonic tonality, chromatic tonality, coloristic harmony, hyper-modulation, parallel harmony, pedal notes/drones, harmonic rhythm). The combinations that the two input spaces afford yield the Blended Space, i.e. the musical structure of '*Il vecchio castello*', as an evolutionary succession of seven different melody/harmony amalgams produced by the combination of four harmonic spaces (fig. 7).

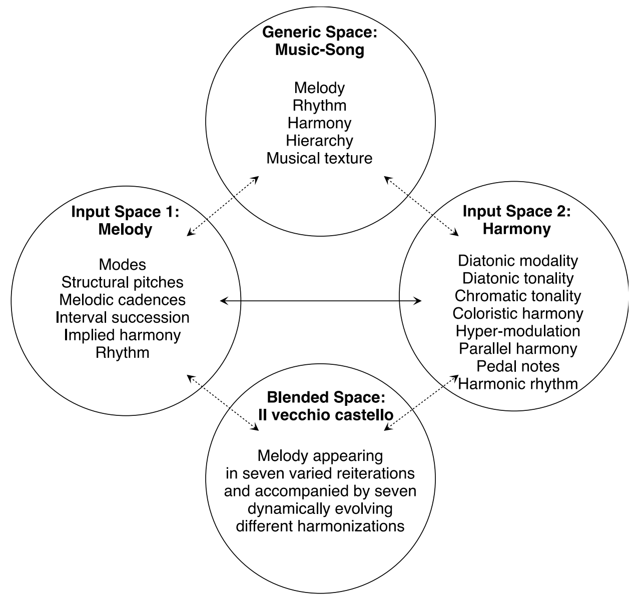

Figure 7. CIN 1: "Intra-musical" structural blending.

B. Cross-domain conceptual blending (meaning construction)

CIN 1 could be seen along the lines of Fauconnier and Turner's (2003) single-scope blending, where the re-framing of a concept (melody) through a different set of relations (harmony) results in changing instantiations of the concept. CIN 2 (Conceptual Integration Network 2) proposes a double-scope blending of the musical and pictorial input spaces into an integrated conceptual space, which projects the work's narrative and emotional potential and further promotes novel meaning construction. As Turner (2003) notes, double-scope blending is one of the most creative cognitive features associated not only with the conceptualization of everyday reality, but particularly with the formulation of artistic and scientific concepts. Double-scope networks involve the simultaneous elaboration of two contrasting input spaces, and the running of two previously unrelated scripts as one blend. Being in one place, in one time, and fully perceiving and interacting with the features of this place and time, while also simultaneously recollecting and exploring another place, at another time, is a typical example of double-scope blending.

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The Generic Space for CIN 2 involves *Contrasting Ontological States*, and it can be split into four contrasting generic sub-spaces: *Temporality*, *Spatiality*, *Affect* and *Qualia*, each producing a separate sub-CIN. Input Space 1 is the *Pictorial Space*, Input Space 2 is the *Musical Space* (or one of its constituents), and the Blended Space is '*Il vecchio castello*' as a perceived programmatic musical work.

CIN 2a: *Contrasting Temporality* (fig. 8). This CIN describes the contrasting temporality embedded in the piece, as a result of the contrasting harmonic spaces employed and the contrasting epochs they correspond to in the pictorial space (contrast between the depiction of the medieval castle in the past and its reception in a 19th-century 'present').

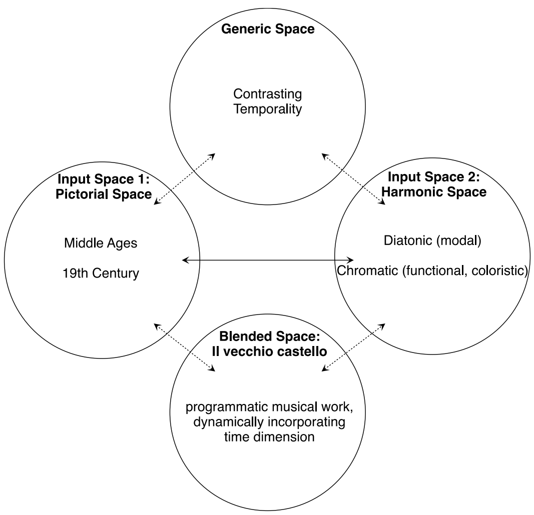

Figure 8. CIN 2a: Cross-domain blending - Temporality.

CIN 2b: Contrasting Spatiality (Geographic/national marker). This CIN (fig. 9) describes the embedded contrasting spatiality, expressed at the pictorial space by the depiction of an Italian castle observed in a Russian gallery and at the musical/melodic space by an Italian siciliana melody/rhythm implanted with Russian folk character and corresponding modality. Moreover, the Italian element is declared in Musorgsky's original Italian title, and the Russian vernacular element has been associated with a type of melismatic peasant song known as *protyazhnaya* (Russ 1992: 51).

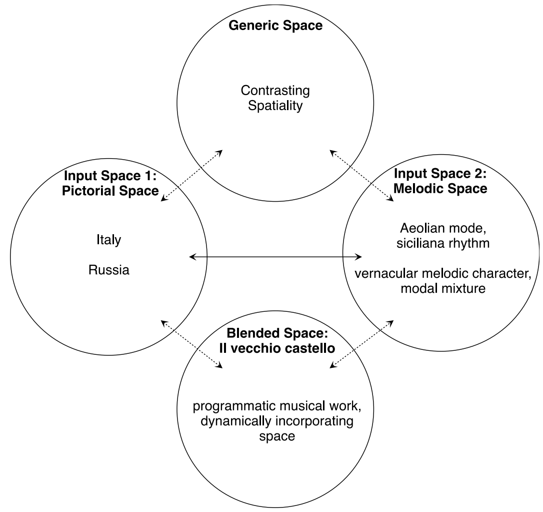

Figure 9. CIN 2b: Cross-domain blending - Spatiality.

CIN 2c: *Contrasting Affective States* (emotion). This CIN (fig. 10) describes the contrasting affects (emotions) that may be evoked by the blending of the pictorial and musical input spaces. 'Love' (expressed in pictorial space by the singing troubadour) can be experienced as 'Nostalgia for love', under the influence of the musical space, where a serenade gradually turns into a melancholic folk song.

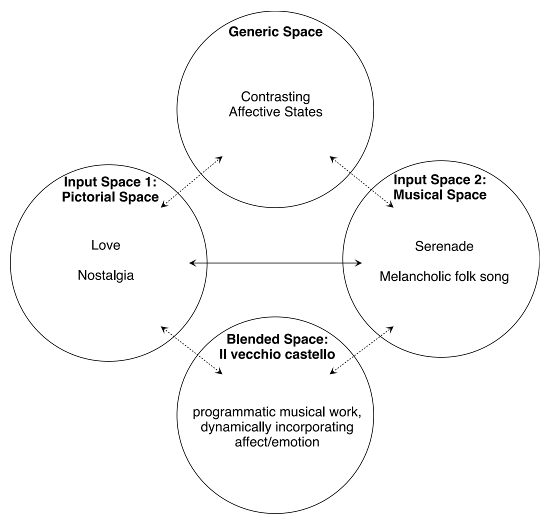

Figure 10. CIN 2c: Cross-domain blending - Affect.

CIN 2d: *Contrasting Qualia*. This CIN describes the different instances of subjective, conscious experience (formulated as *qualia,* after Goguen 2004) embedded in the music in latent form. The contrasting qualia, in this case, refer to two different kinds of psychological/consciousness states, which can be inferred in input Space 1 (pictorial). They are the state of real-time conciousness, and the state of dream/fading recollection, corresponding to the idealized "real" past and the imaginary "dreamy" present. These states are reflected in Input Space 2 (musical) as the juxtaposition of normal rhythmic flow of melody/form and fragmentary array of snippets or the

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contrast of simple strophic and dynamically evolving song form.

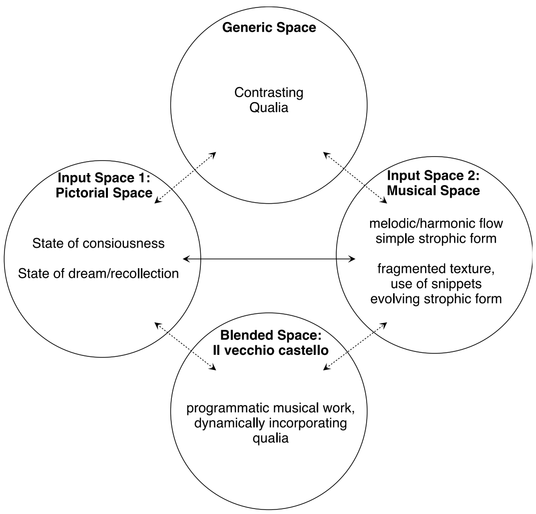
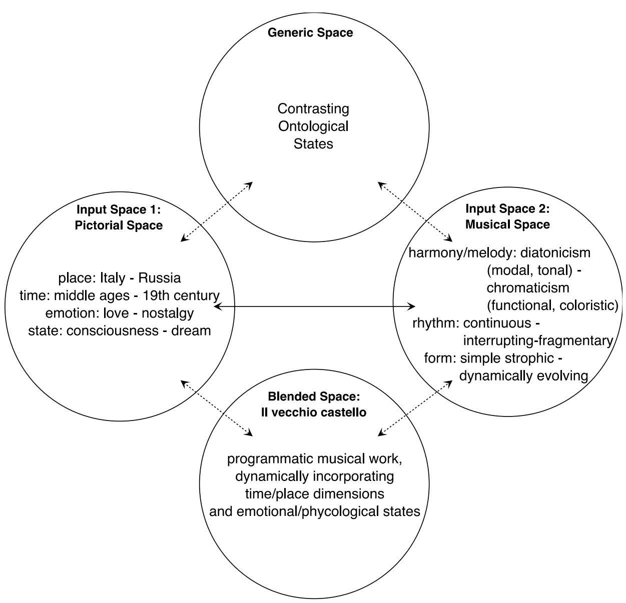


Figure 11. CIN 2d: Cross-domain blending - Qualia.

Overall, CIN 2 (Conceptual Integration Network 2) proposes meaning construction through double-scope conceptual blending and emerges as the union of its four constituent sub-CINs described above. This collective, multiple-scope, multiple-level CIN suggests that the contrasting ontologies embedded in the musical structure trigger contrasting ontologies in the projected "perceived/imagined" pictorial space, and that this cross-domain integration elicits a richer aesthetic experience for the listener.



C. Figure 12. CIN 2: Cross-domain blending.

D. Dynamic evolution

Moreover, a dynamic evolution of conceptual blending takes place as the piece progresses from the first stanza to the last, as if following a narrative path, through which the "real", representational drawing of the Italian castle with the love-singing troubador gradually becomes a "dreamy" abstraction of an old castle, vaguely remembered and evoked in another time and place. This occurs due to the blending operation of *elaboration*, which denotes an imagination-triggering process that stems from musical structure and constructs emergent emotions and meaning (fig. 13).

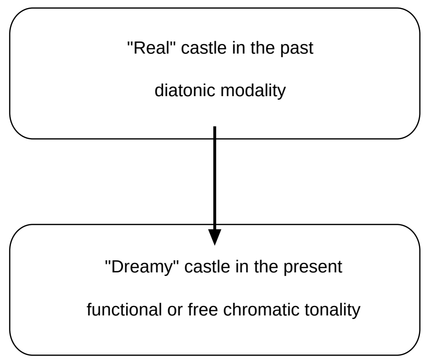


Figure 13. Dynamic evolution of conceptual blending.

IV. Meaning Construction - Conclusions

Conceptual blending in this case involves the use of harmonic, melodic, formal, textural and schematic elements that are not compatible with a simple depiction of a medieval castle. Through blending and cross-domain mapping, music precipitates the listener to "see" or imagine the castle gradually lost into the vortex of time, misty, dreamy, in an obscure place, and with the feeling of chivalrous love gradually transformed into melancholic nostalgia as the music unfolds.

Consequently, the *old castle* that one might see in the painting is very different from the '*old castle*' that our imagination creates while experiencing Musorgsky's piece, and this transcendence to a much richer aesthetic experience is feasible through the blending of the pictorial and musical conceptual spaces.

In effect, as we move from simple cross-domain mapping between music and image, onto the single-scope binding of melody and harmony (CIN1) and higher-level, double-scope blending functions (CIN2), it is possible even to explore the work as a process of cognitive integration (between melodic and harmonic elements, visual and auditory references) and dis-integration between contrastive, qualitatively different temporal, spatial and affective states. According to Bache (2005) dis-integration is one of the most important features of higher-level blending. We elaborate and "make sense of" blends only by consciously focusing on the differences between input spaces and thus acknowledging the terms on which a metaphor operates.

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A present-day listener is thus able to conceive of Mussorgsky's 'Old Castle' as an imaginary castle, a wordless song, a nostalgic reverie, a musical landscape, or all of these at once. This begs a bigger question regarding the levels of mediation (Stefanou 2004) involved in this metaphorical concept construction, from Hartmann's sketches up to Mussorgsky's score, and even more so, a performance of it. Further extensions of the present research could engage with the dimension of performance, and its role in the complex blending procedures suggested here. While it has not been possible to do so within the limited confines of this research, a focus on performance and listening would probably significantly enrich the Conceptual Integration Networks proposed above, and also help situate the analysis in terms of embodied meaning.

Finally, a broader issue could be raised by the very conceptualization of the work's features and the choice to represent them in two distinct types of networks. By distinguishing intra-musical from cross-domain conceptual blends, we do not wish to imply that meaning and structure are exclusively associated with one space or other. Quite on the contrary, we think that CIN1 and CIN2 could themselves become part of a multiple-scope blend, exposed by this categorization, and involving so-called intra-musical and extra-musical features. This separation is in itself the result of a conceptual metaphor (Spitzer 2003), by which "music" is equated with structure, and seen as a central locus, outside of which various other domains are tangentially involved in the production of secondary meaning. Hopefully, in this research we have also opened up a space for further problematization and relativization of the conceptual metaphor of intra- and extra-musicality, and further research can elucidate the particular terms on which it operates.

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A linguistic approach to the syntax of Early Music: Representation of the hexachord system by X-bar method as an excavation tool

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ABSTRACT

Background

Since 1969, Michel Foucault's method presented in his "Archaeology of Knowledge" has turned the attention of researchers to the issues of ever-increasing information and knowledge management in science and arts. As an analytical method, the Generative Theory of Linguistics attempts to apply its own methods to music discipline with the aim of explaining the musical structures as a language. Fred Lerdahl and Ray Jackendoff's studies of 1980s have been developed by David Pesetsky and Jonah Katz's "Identity Thesis" within the framework of the Minimalist Program of linguistics. These studies are concerned with the common practice in music.

Aims

The aim of the present study is to point out that while "GTTM" and "Identity Thesis" are genuine approaches to music in tonal tradition, they do not address the issue of early periods, i.e. what was the origins of tonal music, hence the question how did their theory work for the pre-tonal period? To answer this question, this study assumes Foucault's archaeological approach and uses Generative Theory's X-Bar method to analyze "early music" repertories. It proposes hierarchical relationships of the "hexachord system "as the theory of early music.

Main Contribution

For a first step to a novel analytical tool for the early music which also shows the first implications of a cognitive approach to it, present study consists of a synthesis of the musicology and linguistics aspects and the outputs of the theoretical basis are practiced in the repertory of Aquitanian Polyphony. As a conclusion of the study, main contributions to the relevant studies are the following:

- The study extends the boundaries of the GTTM (Generative Theory of Tonal Music) to the music of 12th century.
- X-Bar method of the Generative theory is practised to the repertories of the Aquitanian Polyphony.
- The tree representation of the GTTM is revised to the last developments of the Generative theory.
- As the main distinction of present study to David Pesetsky and Jonah Katz's "Identity Thesis", the conceptualizations of musical structures which take their essentials historical terms are described as the deep structures and these structures denoted the evidences of the implications of intervallic impacts which are revealed by Aniruddin Patel in his "Music, Language and Brain" study.
- While musical space are described as which they take place two Maximals, every individual notes are described in a conceptualized domain.
- A novel segmentation process are identified depends on the different textural structures of music as Monorhythmic Segmentation (MRS), Homorhythmic Segmentation (HRS) and Florid Segmentation (FS).
- Two analytical analogies between music and language are identified as Phonologic Level (PL) and Syntactical Level (SL).
- As a phonologic analogy, all the unique features of the "Gamut" are identified and practised to this study's analytical tool.
- As a synthesis, Michel Foucault's "Archaeology" and Noam Chomsky's "Generative" approaches are fused in a syntactical tool and practiced to the early music repertories.

Implications

Through this paper, we have presented a novel approach to the early music. This need arisen from the fact that in the evaluation process to the pre-tonal period, although there have been a lots of subjective interpretation form to discursive pieces, there has not been a preset tool to provide a consistent understanding for the individual corpus i.e. Aquitanian Polyphony, Montpellier Codex. To provide a contribution to bring a solution about these problems, present study's implications are following:

- All the essentials which are presented through the study are the components of a syntactical tool to early music.
- This new syntactical tool may be able to show the cognitive tendencies of the composers of the term, because it takes its essentials from Linguistics as a cognitive discipline.
- Historically, early grammar studies in Carolingian era and its permeating characteristics into the music structures in the emergence of Western Polyphony may redefine the ways of the compositional process of the Western Classical Music by inherited mindset of their creators and its evolutionary trajectories.
- A retrospective excavation of the minds of the composers via analyzing the signs that they left for us to decipher could show some new paths to the music analysis systems which consists of tonal tradition of the common practice era, too.
- This syntactical analysis tool may be able to be a preset analysis tool the early music repertories.

Keywords

Archaeology of Knowledge, Linguistics, Generative Theory, X-Bar Method, Early Music, Hexachord System , Gamut, Deep Structure, Surface Structure

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Being on stage: Capturing the experience of music performance

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ABSTRACT

Background

The performance of music is a very complex human activity. It requires accurate motor skills, an extraordinary memory, as well as the ability to communicate musical meaning to an audience. Various aspects of music performance – such as performance anxiety, memory, and motor skills – have been studied, often in isolation. Few studies, however, have tried to capture musicians' experiences on stage in their full complexity.

Aims

The present study aims to capture what performing musicians experience on stage, analyse its various components, and construct a theoretical model of how these components interact.

Method

Qualitative in-depth interviews of approximately 60 minutes each were conducted with nineteen musicians teaching or studying at a European conservatoire. In the interviews, musicians were asked to describe a recent performance experience in as much detail as possible, to make a visual representation of their experiences on stage, and to answer questions about performing music in general. Various strategies of analyses were used to analyse the data and triangulate the findings.

Results

Interpretative Phenomenological Analysis (IPA) of the interview transcripts revealed that musicians' experiences on stage are complex composites of cognitive, perceptual, embodied, and affective components – fluctuating over time, and in relation to the music, co-performers, and audience. The notion of time perception (perceptual component), for instance, comprised the sensation of being in the moment while anticipating what is coming and reflecting on what has been. The physicality of performing (embodied component) was expressed in terms of playing-related movements, bodily presentation, and physical sensations related to the music or the act of performing. The concept of a musical narrative (cognitive component) with which the musicians identified through the recall of emotional life experiences (affective component), to give another example, revealed a deeply felt belief in the meaning of music and the importance to share this with an audience.

Conclusions

The findings of this study provide new insights into the various components involved in music performance, and give a comprehensive view of what performing musicians experience on stage.

Keywords

Music performance, Performing musicians, IPA

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The effect of repetition and expertise on liking and complexity in contemporary music

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ABSTRACT

Aesthetic perception of music has been extensively researched in the last decades. Numerous studies suggest that listeners find a piece of music more or less pleasant according to its complexity. Experimental results show that complexity and liking have different relationship according to the musical genre examined, and that these two variables are also affected by other factors such as familiarity to the music and expertise of the listener. Although previous experiments have examined several genres such as *jazz*, *pop*, *rock* and *bluegrass*, surprisingly, no study has focused on contemporary music.

In this paper, we fill this gap by studying the relationships between complexity, liking, musical training and familiarity in the case of contemporary music. By analysing this genre – which is usually underrepresented in music cognition – it is possible to shed some light on the correlation between liking and complexity in the case of highly complex music. To obtain data, a multifactor experiment was designed in which both music experts and novices had to provide scores of subjective complexity and liking for four 30-second long excerpts of contemporary music with different degrees of complexity. Empirical results suggest that liking and complexity are negatively correlated in the case of contemporary music and that listeners' expertise does not influence the perceived complexity of musical pieces, but it can significantly affect liking. This possibly indicates that experts have the musical knowledge needed to appreciate extremely complex music, while novices do not.

I. INTRODUCTION

Why does the majority of people listens to pop/rock music and not to contemporary music? At first glance, this question seems to be related to cultural habits only. Our society largely promotes pop music because of the huge profits it generates. Pop songs are everywhere on television and on the radio, and it is difficult for a person not to stumble upon the last hit. On the other hand, contemporary music is followed by a small niche of people and it is hardly aired even on classical music radio stations. However, what happens in our society might also be a reflection of basic cognitive processes related to the musical content of these two genres. Obviously, people listen to the music they like. Numerous studies (e.g, Vitz, 1966; Berlyne, 1971; Heyduk, 1975; Walker, 1980) suggest that listeners find a piece of music more or less pleasant based on its complexity. Listeners do not like music which is overly complicated, like most of contemporary music, because it is difficult to understand. On the other hand, listening to music which is too simple is boring. Therefore, people prefer music of intermediate levels of complexity like pop/rock music (Orr & Ohlsson, 2001).

Several studies support this *inverted-U hypothesis* (Vitz, 1966; Crozier, 1974; North & Hargreaves, 1995; Orr & Ohlsson, 2001). Vitz (1966) found that the aesthetic assessment for a series of tones increases along with complexity until it starts declining when the melody becomes too complex. Likewise, North and Hargreaves (1995) discovered that pop songs of moderate complexity are preferred by listeners to songs that are perceived as too simple or too complex. However, there are some studies in the literature that contradict the inverted-U hypothesis. Russell (1982) and Smith and Melara (1990) found a negative correlation between liking and complexity. In both studies, simple musical excerpts were preferred to complex fragments. Although less frequent than the experiments which support the inverted-U hypothesis, these results might suggest that liking and complexity have different relationships depending on the musical style analysed and on other factors such as familiarity to the music proposed and level of expertise of the listener. Until now, a number of genres have been examined in controlled experiments. For instance, Orr and Ohlsson (2001) focused on *jazz* and *bluegrass*; North and Hargreaves used both pop songs (1995), and *new-age* music (1996). Both classical music and *avant-garde jazz* were tested by Hargreaves (1984).

All studies which attempt to find a relationship between liking and complexity face a great challenge, i.e., defining musical complexity. Complexity is a fuzzy concept difficult to measure. To simplify this notion it is possible to divide complexity into two separated concepts: *objective complexity* and *subjective complexity* (Hargreaves, 1984). The former refers to the objective amount of complexity carried by a musical piece based on its properties. Previous studies measured objective complexity relying on the tools of information theory (Vitz, 1966), or by performing feature analysis (Steven & Latimer, 1991). Subjective complexity, on the other hand, is the amount of complexity experienced by people while they listen to a musical piece (Steven & Latimer, 1991). Subjective complexity is a function both of objective complexity and of the musical background of the listener. Regarding the musical background, a piece that is perceived as simple by a listener who grew up listening to Western music can be experienced as extremely complex by a listener who spent her life in an African musical environment. The opposite is obviously true as well. Although it is difficult to predict subjective complexity on a theoretical basis, there is a simple strategy to measure it: asking listeners to rate complexity in a scale while they listen to music (North & Hargreaves, 1995; Orr & Ohlsson, 2001).

A major concern to address when studying the relationship between liking and complexity is the type of musical stimuli

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used during the experiments. For example, Vitz (1964; 1966) used computer-generated melodies and Smith and Malera (1990) used chord progressions. These kinds of stimuli lack several of the musical strategies adopted by musicians to nuance their performances such as *rubato* and *rallentando.* Therefore, the musical result might be mechanical and lack ecological validity. This problem was solved by North and Hargreaves (1995) who used 30-second long pop music excerpts, and by Orr and Ohlsson (2001) who used short improvisations expressly created by jazz and bluegrass musicians for their experiments.

Although important, complexity is not the only factor which influences liking. Repetition plays a central role both for subjective complexity and for perceived pleasingness (Hargreaves, 1984; Tan, Spackman & Peaslee, 2006). Stevens and Latimer (1991) found that repeated hearings of musical excerpts increased their liking and decreased their subjective complexity. An experiment conducted on elementary school children confirmed that repetition plays an important role in liking (Moskovitz, 1992). Children were divided into two groups. The experimental group listened to repeated excerpts drawn from baroque, classical, romantic and atonal music with slow tempos; while the control group listened to the same music with both slow and fast tempos. The experimental group significantly exceeded the control group in its choice of slow-tempo music. Therefore, repetition had a relevant impact on children's preference for slow music. Not only repeated hearings influence liking and complexity, but also repetition of musical fragments within a piece. Ollen and Huron (2004) found that listeners prefer compositions where musical passages are repeated early. In another experiment (Margulis, 2013), people listened to pieces in an unfamiliar style. Apart from the original version, they listened to a second rendition which was altered by researchers who inserted several times in the piece the same musical passage drawn from the piece itself. Listeners found the version with several repetitions more interesting and enjoyable than the unaltered piece. All these empirical studies suggest that repetition is central for musical preference.

Liking and complexity is also a function of the expertise of the listener. However, it is not yet clear whether or not complexity and repetition have a different effect on liking depending on expertise. For example, Orr and Ohlsson (2005) found that for expert listeners the inverted-U relationship between liking and complexity cease to exist in the case of jazz music. However, North and Hargreaves (1995) examining pop music could validate the inverted-U hypothesis both for experts and non-experts. Specifically, they found that the "optimal complexity" for experts is higher than that for novices. The same result was reached by Steven and Lantiner (1991). Therefore, it might be speculated that a qualitative different aesthetic response between trained and untrained listeners depends on the musical style analysed.

In this paper, we examine the relationships between subjective complexity, liking and repetition in contemporary music, a style which is underrepresented in music cognition. Differences between the liking behaviours of music experts and non-experts are also studied. We chose contemporary music because no previous study we are aware of considered this genre, and because it could provide useful information about the correlation between liking and complexity in the case of highly complex music. Indeed, if an inverted-U correlation between liking and complexity was to be found, this would support its general validity across musical genres. Furthermore, few studies consider altogether the effects of repetition, complexity and expertise on liking (Stevens & Latimer, 1991; North & Hargreaves 1995). In their work, Steven and Latimer (1991) used musical stimuli expressly composed for the experiment which lacked ecological validity; and the study by North and Hargreaves (1995) focused only on pop music. Considering complexity, repetition and expertise altogether is a necessary approach to have a global picture of the liking behaviour of people.

Based on the research we have introduced, we propose the following research hypotheses:

a. Multiple exposures to a contemporary composition lower its level of perceived complexity both for experts and novices.
b. Experts find contemporary pieces less complex than novices do.
c. Experts like contemporary pieces more than novices do.
d. Listeners (i.e., experts and novices) who listen to a piece of contemporary music multiple times like it more than people who listen to it only once.
e. In the case of experts, liking and complexity for a contemporary piece of music follow an inverted-U curve.
f. In the case of novices, for a contemporary composition there is a negative correlation between liking and complexity.

The experiment we set up is designed to verify these four hypotheses. Are complexity and liking correlated in contemporary music? Does repetition affect complexity and liking? Do music experts and novices behave in different ways?

II. METHODS

In this section, we provide details about experimental design, participants, materials and procedure.

A. Design

In the experiment, participants listened to four excerpts of contemporary piano music and were asked to provide a score for subjective complexity and liking. The fragments were chosen so that they had different levels of complexity. To evaluate the objective complexity of musical passages, we used an approach based on feature analysis already employed by Stevens and Latimer (1991). With this strategy, the global complexity could be derived from the level of complexity of several musical features such as *tonality*, *sounds per bar*, *rhythm perceived speed*, *cohesion*, *melody* and *variation*. The *tonality* feature depends on key centres and harmonic progressions. *Sounds per bar* considers the overall number of

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chords in a bar. *Rhythm* is a temporal feature that relates to the regularity of the durational patterns. *Perceived speed* is a function of the interaction of metre with rhythm and sounds per bar. *Cohesion* refers to the unity of a piece based on the homogeneity of harmonic and rhythmic patterns. The *melody* feature relates to the magnitude of intervals. *Variation* refers to variation in pitch, rhythm and harmony. Each feature could get a value from 0 to 3, that represents a categorical assessment for the feature. For example, in the case of *sounds per bar*: "0" indicates two or less sounds per bar, "1" designates three to four sounds, "2" refers to five to eight sounds, and "3" indicates more than eight sounds. The overall score for complexity was obtained by summing all the values for each feature. Of course, this measure does not guarantee a perfect assessment of the objective complexity of a piece of music, but it provides an operational measure which can be used to effectively control the independent variable *objective complexity*.

To account for the effect of repetition on subjective complexity and liking, we prepared four excerpts which contained four repetitions of the same initial 30-second long fragments. As a consequence, there were two groups of four stimuli: one with the original 30-second long musical passages and the other with the same fragments repeated four times. We divided subjects into music *experts* and *novices* based on their musical training. To be regarded as *experts*, participants had to have studied music for more than eight years. *Novices* had no previous musical training.

To summarise, the experiment had three independent variables (i.e., *expertise*, *repetition*, *piece*) and two dependent variables (i.e., *subjective complexity* and *liking*). An account of all the variables and their levels is provided in Table 1.

Table 1. Considered variables and their corresponding levels.

Variable	Levels
Expertise	Expert, Novice
Repetition	Repeat, Non-repeat
Piece	A, B, C, D
Liking	7-point scale
Subjective complexity	7-point scale

Two levels for the factors *expertise* and *repetition* produced four independent experimental conditions: *novices*/*repeat*, *novices*/*non-repeat*, *experts*/*repeat* and *experts*/*non-repeat*. In each condition, participants had to listen to all four pieces. Participants in the level *non-repeat* of the factor *repetition* listened to the original 30-second long fragment for each of the four pieces, whereas subjects in the level *repeat* listened to the stimuli with each fragment repeated four times. Therefore, the complete design involved three factors: *expertise*, *repetition* and *piece* – with repeated measures on the latter. To avoid possible order effects, fragments were played back randomly. The experiment was conducted on the Internet.

B. Participants

105 participants took part in the experiment. Of these, 41 were novices, 23 had between one and eight years of training and 42 were experts. Of these three groups, we used the results of novices and experts only. To find participants, we posted messages on social networks and on online communities of musicians, music lovers and psychology students. The mean age of subjects was 32.7 (*SD* = 11.3).

C. Materials

Table 2. List of contemporary piano pieces from which the 4 considered excerpts have been extracted.

Code	Piece
A	*Fur Alina*, by Arvo Part (1976)
B	*Romance*, by Toru Takemitsu (1949)
C	*Variations op.27 no.2*, by Anton Webern (1936)
D	*Piano Sonata no.1*, by Pierre Boulez (1948)

In the experiment, we used four 30-second long excerpts (i.e., A, B, C, D) of contemporary piano music with different levels of complexity. A list of the pieces from which musical fragments were extracted is given in Table 2. The order of objective complexity of the four passages found with feature analysis was $D > C > B > A$. Of course, this is not a perfect measure of complexity, but it gave us an idea of the amount of information carried by each excerpt. We chose real compositions rather than creating *ad hoc* fragments, to guarantee ecological validity for the study. At the same time, only piano music was employed so that participants were exposed to fragments with similar timbre. If ensemble music had been used, it would not have been possible to control the amount of time played by each instrument; therefore stimuli would have presented radically different timbre. The audio of the four compositions were extracted from Youtube videos[1] and edited with Cubase 5. In the editing process, we isolated four 30-seconds long passages, and arranged a second track for each of the four fragments, which consisted of the same passage repeated four times. Each repetition was separated from the previous one by four seconds of silence. We chose four repetitions so that listeners could familiarise with the music without getting bored by it. All eight excerpts employed in the experiment can be found at the following website: http://helios.hud.ac.uk/scommv/storage/escom15.zip.

We used two 7-point scales for rating *subjective complexity* and *liking*. In the case of complexity, a score of "1" indicated that an excerpt was "no complex at all", while a score of "7" that it was "extremely complex". For aesthetic assessment, "1" meant that a participant "did not like a piece at all", whereas "7" indicated that she "liked a piece very much".

We developed a dedicated website to host the experiment, which was made up of two parts: an interface and a database.

[1] http://goo.gl/XnDJFD, http://goo.gl/ksRdfe, http://goo.gl/e2zubQ, http://goo.gl/akV7IP.

The interface was necessary to provide information to participants, allow them to play music and provide their evaluations. The database was used to store the subjects' answers.

D. Procedure

The experiment comprised four steps. When participants initially accessed the website of the experiment, we provided them with instructions. An introductory text explained that they were going to listen to four excerpts of music, and that they both had to rate the complexity of those pieces and had to indicate how much they liked each fragment. We assured participants that no musical skills were needed to take the experiment, and that results would remain anonymous and would be used only for research purposes.

After reading the instructions, participants could move to the next webpage of the experiment where they listened to the musical passages and rated them for complexity and aesthetic value. Each excerpt was rated immediately after it ended.

In step three, participants provided personal details about age and years of musical training. Finally, in step four, they accessed a debriefing page, in which we clarified the aim of the experiment and provided our contacts, in case subjects were interested to learn more about the research.

III. RESULTS

In this section we present the results of the performed analysis.

A. Subjective Vs Objective Complexity

We used the Pearson's product-moment coefficient to look for a correlation between the ratings of complexity provided by participants and the values of objective complexity obtained with feature analysis. The two sets of scores correlated strongly and positively $r(5) = 0.951$, $p = 0.049$. The order for the complexity of fragments provided by subjects was the same as that found with objective complexity measures: $D > C > B > A$.

B. Effect of Expertise and Repetition on Complexity

A three-way mixed-groups ANOVA was performed to understand the impact of *expertise*, *repetition* and *piece* on *subjective complexity. Expertise* and *repetition* were considered as between-subjects factors, whereas *piece* was the within-subjects independent variable. As expected, there was a main effect of *piece* on *complexity* $F(3,237) = 90.4$, $p < 0.001$, which was consistent with the previous results on correlation between subjective and objective complexity.

The interaction between *piece* and *expertise* was significant: $F(3,237) = 3.40$, $p = 0.019$. The effect size was small (partial eta squared = 0.041). As Figure 1 suggests, the only time in which there was a significant mismatch in the judgment of complexity between novices and experts was fragment *D*. Contrary to what expected, experts found fragment *D* more complex (M = 5.9, SD = 0.97) than novices did (M = 5.1, SD = 1.36): $t(81) = 3.11$, $p = 0.03$, two-tailed.

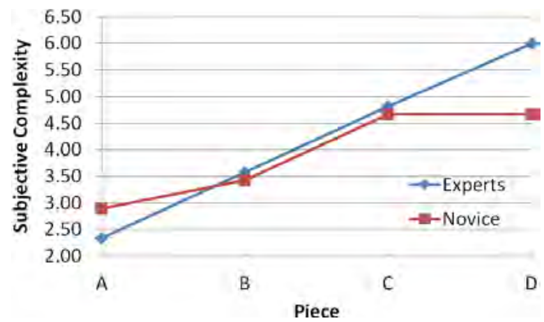

Figure 1. The *Subjective Complexity* perceived by Experts and Novices across all the considered pieces with repetition.

The interaction between *repetition* and *piece* on *complexity* was significant: $F(3,237) = 3.42$, $p = 0.018$. Once again, the effect size was small (partial eta squared = 0.041), and there was one simple effect only. Specifically, a significant difference between the complexity measured in fragment *C* in the case of *repeat* (M = 4.7, SD = 1.4) and *non-repeat* (M = 4.01, SD = 1.4) was discovered: $t(81) = 2.03$, $p = 0.046$, two-tailed.

C. Effect of Expertise and Repetition on Liking

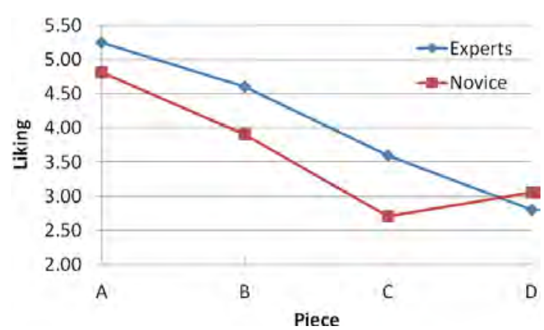

Figure 2. The *Liking* of Experts and Novices across all the considered non-repeated pieces.

To gauge the impact of *expertise*, *repetition* and *piece* on *liking* we used a three-way mixed-groups ANOVA with *expertise* and *repetition* as between-subjects factors and *piece* as the within-subjects factor. The only effect we could find with this test was the main effect of *piece* on *liking*: $F(3,237) = 39.0$, $p < 0.001$. The effect size was strong (partial eta squared = 0.33). As shown in Figure 2, both experts and novices tended to like *A* more than *B*, *B* more than *C*, and *C* more than *D*; except for novices who liked *D* more than *C*.

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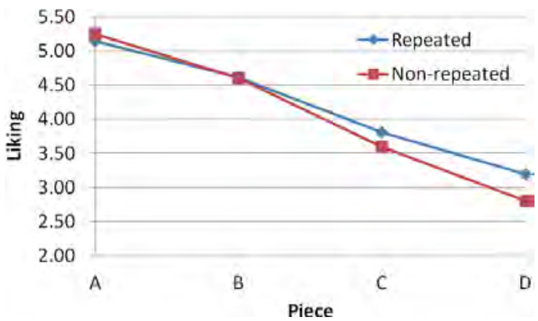

Figure 3. The *Liking* of Experts across considered pieces with and without repetition.

A between-subjects ANOVA confirmed that experts and novices expressed significantly different ratings for *liking*. Indeed, the main effect of *expertise* on *liking* was significant: $F(1,79) = 14.8$, $p < 0.001$. As can be inferred from Figure 3, *repetition* appeared to have no impact at all on *liking*.

IV. DISCUSSION

As in the study by Stevens and Latimer (1991), a strong correlation was found between the measures of subjective complexity obtained from the ratings of the participants and those of objective complexity obtained with feature analysis. This correlation will allow us to draw conclusions about the relationship between *liking* and *complexity*, because the four chosen fragments effectively represent four distinct degrees of complexity; and therefore can be used as an indirect measure of complexity.

Both for novices and experts, no evidence was found that multiple exposures to a contemporary composition lower its level of perceived complexity. In fact, the only simple effect identified in the case of fragment *C* shows that participants found the *repeat* level more complex than the *non-repeat* level. This seems to imply that – for contemporary music – multiple hearings allow listeners to recognise all the subtleties of a composition, which might result in an increase of *subjective complexity*. However, this argument cannot be generalised due to the lack of evidence. The absence of a main effect of *repetition* on *complexity* contradicts the findings obtained by Latimer and Stevens (1991). A possible explanation might be that four repetitions are not enough to decrease the perceived complexity in the case of contemporary music compositions.

Contrary to what expected, experts did not find contemporary pieces less complex than novices did. Indeed, there was no general difference in perceived complexity between experts and novices. This fact seems to imply that subjective complexity – at least in the case of contemporary music – does not depend on musical training. The only significant difference was for piece *D* that was recognised as significantly more complex by experts. A plausible explanation for this phenomenon might be the fact that experts are equipped with the musical knowledge needed to acknowledge the complexity of extremely complex music, while novices are not.

As expected, liking ratings of experts were significantly greater than those of novices (see Figure 2). Considering the fact that scores of subjective complexity were not statistically different for experts and novices, we should ascribe the difference in liking to musical training only. It is probable that the greater familiarity of experts with contemporary music led them to provide scores for liking that were significantly higher than those provided by novices. This supports the general hypothesis that familiarity with a musical style is a key aspect for liking.

Contrary to our initial research hypothesis, both for experts and novices *repetition* had no impact on *liking* (see Figure 3). However, this is perfectly in line with the lack of effect of *repetition* on complexity. Indeed, the reason why an increase in the ratings of liking was expected when fragments are repeated was due to the decrease of perceived complexity in the case of repeated fragments. Since the latter phenomenon did not happen, the former could not possibly occur as well.

Figure 2 suggests that there was a clear negative correlation between *liking* and perceived *complexity* in the case of expert listeners. In other words, the more complex a piece it is, the less it is liked. This goes against the general accepted inverted-U hypothesis, but it is in line with other studies (Russell 1982; Smith & Melara 1990). The lack of an ascending leg which could support the inverted-U hypothesis in our study might be due to the small number of fragments used (i.e., 4). Indeed, it could be that all of the chosen fragments are already too complex, and that what we see in Figure 2 is the descending leg of the inverted-U curve. However, fragment *A* is extracted from an extremely low complex composition which belongs to *minimalism*. In that regard, it is difficult to find a contemporary music piece which is radically less complex than *A*. On the other hand, we suggest that for intrinsically complex musical genres, like contemporary music and *avant-garde jazz*, we should rely on negative correlations of liking and complexity rather than on inverted-U relationships. This is the case because even the simplest musical instances of these genres might be enough complex to result interesting. As a consequence, in these genres the ascending leg of the inverted-U curve is practically nonexistent.

A similar negative correlation between complexity and liking is suggested by Figure 2 for novices as well. However, in this case it is interesting to notice that *D* – which is the most complex fragment – has a liking rating which is greater than that of *C*. This can be explained by the fact that there is no significant difference in the subjective complexity of *C* and *D* considering the ratings of novices and ignoring those of experts. This seems to support the idea discussed above that musical training is needed in order to recognise the complexity of highly complex pieces.

The experimental design has some limitations that should be overcome in future studies. First, we used only four fragments. Although this seems enough to understand the effects of repetition and expertise on complexity and liking, it has probably weakened the results obtained with regard to the relationship between complexity and liking. Furthermore, 30-second long fragments might be too short for participants to

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form an idea for the scores of complexity and liking. However, the use of such short fragments was necessary, since the experiment was held online. In the future, we will propose an improved version of this experiment to confirm the results of this study which goes against the literature. In the new research, we will have a lab-based experiment with a greater number of fragments, which will be longer.

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Composer and performer in collaboration: Interactive processes involving non-guitarists composers and guitarists

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ABSTRACT

This study discusses composer-performer collaboration in cases involving composers who do not play the instrument they are composing for. The aim is to characterize the interactive process involving non-guitarists composers and guitarists. Eleven semi-structured interviews were conducted, between December 2013 and August 2014, with professional musicians: three non-guitarists composers and eight guitarists. Categorical analysis was undertaken and obtained data was organized according to recurring terms and subjects. This analysis pointed out that composers are interested in bringing new ideas to the guitar while performers are concerned in making the composers' ideas idiomatic, whether playable or not. Moreover, the results suggest an overall concern with modes and levels of understanding and communication involved in the collaboration process.

I. INTRODUCTION

This study discusses composer-performer collaboration in cases involving composers who do not play the instrument they are composing for. The aim is to characterize the interactive process involving non-guitarists composers and guitarists, presenting new information on different aspects of the composition process, as well as on communication strategies frequently adopted in composers-performers collaborations. The content is organized into two parts: 1) the theoretical background of composer-performer collaboration and composition for guitar by non-guitarist composers; and 2) the description of this specific research, addressing collaborative processes involving non-guitarist composers and guitarists. The latter involved eleven semi-structured interviews, conducted between December 2013 and August 2014, with professional musicians: three non-guitarist composers and eight guitarists. Categorical analysis was undertaken, establishing 12 categories organized according to recurring terms and subjects. Each category was registered in a graph of occurrences, which shows the different levels of relevance for each interviewee. Moreover, each category is discussed taking into account excerpts of the interviews.

II. BACKGROUND

A. Composer-Performer Collaboration

Composer-performer collaboration is a recent area of study; composer Lukas Foss, in 1963, was probably "the first author to write about the new relation between composer and performer" (Domenici, 2010, p. 1142). In addition, Domenici states that there is a "lack of documentation and studies dedicated to this phenomenon" (*ibidem*, p. 1142), which suggests that there is a need for more research and theoretical studies. This might be due to the fact that, until the first half of the 20th century, a musical composition was characterized as "some kind of intellectual property to be delivered securely from composer to listener" (Cook, 2001, ¶6). The performer's only aspiration would be "transparency, invisibility, denial of his personality" (Goehr *apud* Cook, 2001, ¶5). This outlook reflects the emergence of the autonomous artwork concept (Goehr, 1992). Domenici points out that "the belief in the text as the reification of the composer's intentions demands from the interpreter a submissive attitude regarding both the text and the performance traditions associated with it" (Domenici, 2012, p. 172). Composers such as Schoenberg and Stravinsky defended a hierarchy between the composer and the performer; the latter was, according to Schoenberg, "totally unnecessary except as his interpretations make the music understandable to an audience unfortunate enough not to be able to read it in print" (Newlin *apud* Cook, 2003, p. 204). This view has changed in the last 50 years as "the collaboration between composers and performers has become common practice" (Domenici, 2010, p. 1142). This occurred specially due a change in the performer's role when collaborating with composers, as Smalley points out:

> During the earlier part of this century it was generally composers who demanded extensions of instrumental technique, with the result that their compositions were frequently declared to be unplayable. Now there exists a whole new school of performers who, not content with merely reproducing after the event, as it were, are playing an active part in the development of new music (Smalley, 1970, pp.81-82).

Furthermore, the author adds:

> the composer and performer are now in the process of drawing more closely together than, perhaps, they have ever been in the history of music. I feel certain that it is in the nurturing of this relationship that the core of future developments in music will lie (*ibidem*, p. 84).

Moreover, during the 20th century, we witnessed a separation in Western musical practice, in which composers are only composers and performers are only performers. There is, therefore, a high degree of expertise on each area. Hence,

> the development of extended techniques and even the creation of new manners of instrumental playing are directly linked to the close relation of composers specialized in composition and performers specialized in performance. Nowadays, the fact that musicians rarely develop an expertise in both virtually requires

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that innovation relies on collaboration (Ray, 2010, p. 1313).

The composer and performer specialization pointed out by Ray, as well as the change in the role of the performer in collaboration with composers, drew the attention of researchers such as Ivanovic (2014), Silva (2014), Morais (2013), Ishisaki & Machado (2013), Marinho & Carvalho (2012), Rosa & Toffolo (2011), Domenici (2011), Carvalho & Marinho (2011), Östersjö (2008), and Borém (1998), who addressed their own collaborative experiences, analyzing interaction procedures, communication strategies and creative results. These studies discuss two main issues: 1) collaboration as a basis for the validation of an interpretation; and 2) the transposition process of the composer's ideas (during the composition process) to the characteristics of the instrument.

B. Non-guitarist Composers

Until the early 20th century, composers of guitar repertoire were always performers as well. There was no music for guitar written by non-guitarist composers. Thus, guitar music was perfectly idiomatic. It was during the 20th century that non-guitarist composers began writing for the guitar (Zanon, 2006), but almost always with assistance from a guitarist. The first important work written by a non-guitarist is the *Homenaje pour le tombeau de Debussy* by the Spanish composer Manuel de Falla, written in 1920 (Dudeque, 1994, p. 85). Zanon (2006) and Sorrentino (2009) mention that the Uruguayan composer Eduardo Fabini and the Italian composer Ottorino Respighi were the first non-guitarist composers to write for guitar during the first decade of the 20th century: Fabini wrote, in 1903, the *Mozartiana* while Respighi wrote, between 1900 and 1909, the *Variazioni* (Sorrentino, 2009, p. 149). Unfortunately their guitar works are rarely performed, and remained unknown for many years. Thus, the *Homenaje pour le tombeau de Debussy* can be considered the first guitar work - written by a non-guitarist composer - that had a significant impact for the repertoire. Manuel de Falla's work for guitar is a "micro masterpiece of only two pages" (Zanon, 2006, no page) and the importance of Manuel de Falla for the instrument "does not lie on his pioneering significance, but on its original conception" (*ibidem*).

On the problematic of writing for guitar as a non-guitarist composer, Berlioz states in his instrumentation treatise that "it is almost impossible to write well for the guitar without being able to play it" (Berlioz, 1948, p. 145). His statement prevailed during the 19th century (Zanon, 2006). Nowadays it is possible to say that, "though Berlioz penned these words over a century-and-a-half ago, their relevance regrettably continues to persist today" (Godfrey, 2013, vi). Depending on how the voice-leading between the chords is done, guitar music can sound totally different from what the composer initially imagined, especially because of the chosen fingering. This is nearly impossible to be known beforehand by someone who does not play the instrument (Barrueco, 2009). Therefore, the guitar requires the composer to study it (Zanon, 2006). It is "useless to write beautiful music with two passages that do not work, making it impossible to play" (Santos, 2012, p. 96).

There are studies that focus on minimizing some of the difficulties which may arise during the composition process by non-guitarist composers. Several authors have written on the guitar's idiomatic features, and this bibliography can be classified into two different categories: 1) studies that discuss the characteristics of the guitar, presenting thorough explanations of its usage: Godfrey (2013), Kachian (2010), Viana (2009), Ulloa (2001), Gilardino (2010, 1999, 1996, 1994); 2) orchestration treatises that mention the guitar (with basic information regarding guitar writing): Blatter (1997), Adler (2002), Berlioz (1948). This bibliography, despite its relevance for composers (at least in theoretical terms), is not enough, since it does not ensure that composers will be able to write without making basic technical errors.

Several non-guitarist composers mention the difficulties they had when trying to compose for solo guitar: the author of the most important guitar sonata written in the 20th century, the Argentinian Alberto Ginastera, states the following: "Although I had been encouraged by a number of musicians to compose music for the guitar from the time that I was a student, the complexity of the task delayed my creative impulse" (Ginastera, 1978, no page). The Brazilian composer Ronaldo Miranda explained the composition process of his *Appassionata*:

> I had never written for guitar before and had my limitations and fears. I was afraid of composing for that instrument. Whoever plays the piano thinks that the guitar can play almost everything in the same manner, but it cannot. The solution is to condense the language. There are many limitations: one uses only the treble clef (for melody and accompaniment), it sounds an octave lower than it is written and it requires a lot of attention with the strings, with the things that can (or cannot) be done [...] the issue of the limited range bothered me a lot, especially because the piano has a huge range and I am used to it. I had to deal with these limits, with these characteristics (Miranda, 2008, p. 91).

The Brazilian composer Ricardo Tacuchian also commented on the problem of writing for guitar as a non-guitarist composer: "the guitar is a tricky instrument for the non-guitarist composer. For this reason, despite my large experience in writing for it, I always ask a guitarist whom I trust to check the piece before publishing" (Tacuchian, 2012, p. 106).

From these testimonies, it is possible to note that the composer-performer collaboration can be considered the most practical approach for non-guitarist composers who want to write for the instrument. Mostly because "guitar composition can be an exceptionally tedious activity for the non-guitarist composer" (Godfrey, 2013, vi).

Thus, two modalities of collaboration have been unfolding since the beginning of the 20th century: 1) the direct collaboration during the composition process and 2) the revision of the score after the composition process.

On the collaboration process, Viana (2009) states:

> For non-guitarists composers/arrangers, the technique of writing for guitar is, at first, and in certain respects, somewhat mysterious. The multiplicity of effects and

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> playing manners [...] require the composer/arranger to rely on a good guitarist for demonstrating, as well as for the final revisions of the score (Viana, 2009, p.7).

On the other hand, when composers who do not play the guitar write for the instrument with no collaboration with a performer, new possibilities can emerge, since these composers do not limit themselves to preconceived ideas on what is and is not possible to do with the guitar. With the new possibilities established by these composers, "many technical restrictions from the past are now overcome, in part, due to the demands and imagination of these composers, as well as to the effort of the performers to solve new requirements" (Ulloa, 2001, p. 1). Thus, "guitar idiomatic writing by non-guitarist composers/arrangers not only becomes possible, but also brings new expressive possibilities according to the musical personality of each composer/arranger" (Viana, 2009, p. 8).

III. RESEARCH ON INTERACTIVE PROCESS INVOLVING NON-GUITARIST COMPOSERS AND GUITARISTS

A. Methods

Eleven semi-structured interviews were conducted, between December 2013 and August 2014, with professional musicians: three non-guitarists composers and eight guitarists. These participants are professors in Brazilian universities and have significant experience with collaborative processes. Interview invitations were sent to active Brazilian non-guitarist composers who published works for solo guitar involving collaboration with performers. Interview invitations were also sent to the performers who collaborated with these composers during the composition process. Since some composers collaborated with more than one performer, the number of performers interviewed is higher than the number of composers. In addition, 3 composers did not respond to the interview invitation, while the same happened with 2 performers. It is worth mentioning that, during the interviews, 3 non-guitarist composers who fit the research's profile were mentioned by the performers. These composers were contacted but did not respond to the interview request.

Topics addressed in the interviews included: interaction procedures; the performer's role in the collaboration process; composing for guitar as a non-guitarist composer; describing situations in which collaboration was essential; transmitting/learning guitar features. Categorical analysis of the answers was undertaken and obtained data was organized according to recurring terms and subjects. Meaningful categories were classified according to their frequency.

A total of twelve categories with 5 occurrences or more were singled out. These included, ordered by frequency: 1) adaptation of non-idiomatic sections; 2) communication strategies; 3) performer's intervention level; 4) composition for guitar by non-guitarists composers; 5) promoting the creation of new works; 6) composer's receptiveness for suggestions; 7) transmitting/learning guitar features; 8) correction of unplayable sections; 9) later revisions; 10) interaction modalities; 11) composition/ arrangement study by the performer; 12) differences between interacting with guitarist composers and non-guitarist composers (see figure 1).

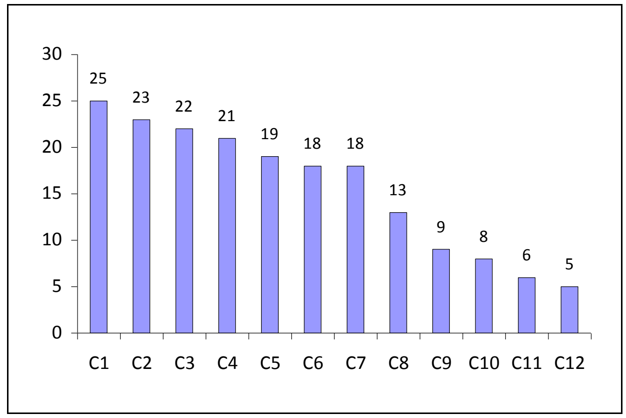

Figure 1. Categories ordered by frequency (C = category).

When two or more categories had the same number of occurrences, the one with more interviewees commenting on it was considered more relevant. It is worth noting that: 1) if the categorical analysis had included performers only, the final result would be very similar. The only important change would be in the 8th category (correction of unplayable sections) which would have become the 4th category; 2) if the categorical analysis had included composers only, then the result would include major differences: the leading categories would be the 4th and 6th, followed by the 5th and 7th (see figure 2).

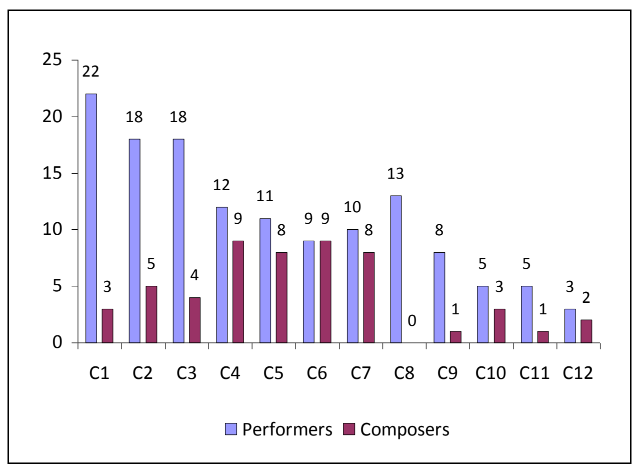

Figure 2. Categories ordered by frequency (composers and performers separated).

Taking into account the difference in results, it could make sense to separate the interviewees into two groups, since they played different roles in the collaboration process. On the other hand, this separation would not take into account the fact that some of the interviewed composers are also performers, and some of the interviewed performers are also composers. Moreover, the interviewed guitarists who are also composers

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have acted as composers in collaborations with performers who play other instruments. Although there is a difference in the categories order when separating the interviewees into two groups, it seems correct to keep them all into one group because they are, essentially, musicians talking about collaboration.

B. Results

1) Adaptation of Non-idiomatic Sections. This category addresses concerns about making music suitable to the guitar, specifically in cases where the music is playable but not idiomatic. It is interesting to note that some performers have a lot to say on this subject while others have made no comments. We do not find these extreme differences in composers' interviews (see figure 3).

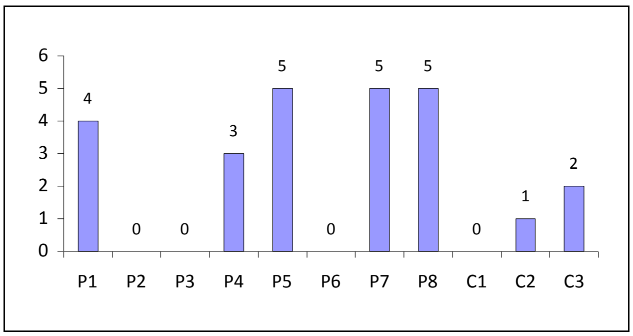

Figure 3. Graph of occurrences: adaptation of non-idiomatic sections (P = performer; C = composer).

The adaptations mentioned by the interviewees are related to the need for better sonorities, for more comfortable positions for the left hand, and for minor adaptations, which are almost imperceptible to listeners, but provide more fluency in playing.

> There were some chords at the end that had to be played with the left hand only. It was one note on the fifth string, another on the fourth and the other on the third string. The note on the third string did not sound well with the others. There was a big imbalance. Then the composer changed this part (Performer 4).

This reference discusses an adaptation required in order to obtain a more balanced sonority in terms of dynamics. It is also interesting to point out the procedures adopted by performers to deal with these adaptations, as it reveals their process of decision making:

> My arrangement process is like this: I start a first version that tries to follow as accurately as possible the original text. Then, like a sculptor, I start to remove notes that do not help the execution until I get a more organic result (Performer 7).

We can understand why performers make such adaptations: "It is preferable to cut a note to get a better phrase, or add a note to make the music blast. With those little things you can spice up the interpretation" (Performer 8).

In accordance with the performers' point of view, we found composers' narratives that corroborate the adaptations of non-idiomatic sections:

> I write the whole piece, consulting the treatises, the books and the methods when I have doubts. When the piece is finished I consider it as a draft version. I call a friend to read it. He/she can find chords that are possible to play, but the hand position is very uncomfortable. That is the kind of thing that only a guitarist sees. The non-guitarist composer does not see this. Playing the chord in another position is much easier and the result is the same (Composer 3).

This category demonstrates the intention of both composers and performers in making music playable and suitable for the guitar, and also in exploiting thoroughly the instrument's potential.

2) Communication Strategies. This category includes respondents' description of the communication strategies adopted during the collaboration. The following graph presents a more balanced distribution of occurrences when compared to the previous category, except for Performer 1, who demonstrated a marked concern about communication strategies (see figure 4).

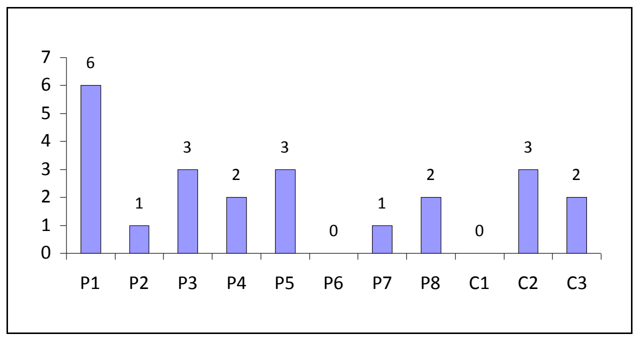

Figure 4. Graph of occurrences: communication strategies.

Frequently, a collaboration process starts with a technical dialogue in order to inform the composer about the possibilities and limitations of the guitar: "With non-guitarists composers, the first step is, very often, a technical dialogue on what can and cannot be executed" (Performer 5). This is an effective strategy that helps composers to avoid common mistakes. It also provides information about new possibilities and techniques: "He [the performer] offered to give me some better information on the possibilities of contemporary guitar. Then he spent an afternoon here with me playing stuff and showing possibilities" (Composer 2).

Another interesting strategy is to demonstrate new techniques and new playing possibilities used by other composers in existing repertoire: "I have demonstrated the differences when using or not using the fifth finger [of the right hand], exemplifying its use in traditional works of Brazilian guitar literature" (Performer 3).

Finally, it is worth to note that these strategies also included statements on the performer's role in the collaboration process: "I try to understand what the composer wants in order to serve as a support tool, and help him/her to achieve his/her goal without interfering in his/her way" (Performer 1).

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3) Performer's Intervention Level. This category includes references that classify performers' intervention according to levels: from minor corrections to major alterations. This category's graph (see figure 5) also shows a better distribution of occurrences when compared to the first one. Moreover, we can see that the category drew the attention of both composers and performers, but performers mentioned it more often.

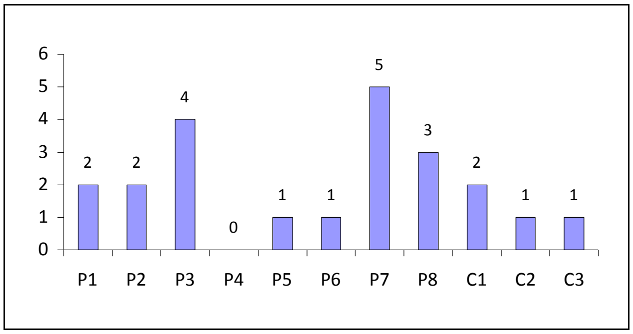

Figure 5. Graph of occurrences: performer's intervention level.

In this category we have, on one hand, references to pieces that basically did not required adaptations: "the results were guided by creations of sonorities. I practically did not have to correct anything because the composer knew how to 'play' with the guitar" (Performer 6).

On the other hand, there are statements indicating that major changes were required: "The piece is great, but it has a problem: the third movement would have to undergo major adaptations in order to work well" (Performer 7). Situations like this may occur when the composer is not familiar with the guitar, as the next statement points out: "I must say that over time the intervention level became lower because the composer increasingly dominated the métier of the instrument" (Performer 5).

4) Composition for Guitar by Non-guitarists Composers. In this category, respondents commented on the problems regarding composition for guitar by non-guitarist composers. Their comments help us to understand why this is a difficult activity for the non-guitarist composer, how they deal with the instrument, and what are the common mistakes. This is the first category which drew more attention from composers than from performers (see figure 6).

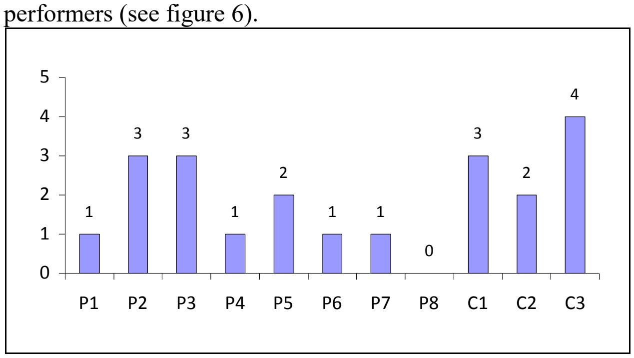

Figure 6. Graph of occurrences: composition for guitar by non-guitarist composers.

It is not uncommon to find unplayable sections in pieces written by non-guitarist composers: "The piece that I worked more in the creation process was my father's piece. He did write quite impossible things for the instrument" (Performer 1). Some problems faced by non-guitarist composers were explained by the interviewees: "It is very difficult to write for guitar. The instrument does not help, since it is at the same time melodic and harmonic, and since the same note can be played on three different strings (sometimes four)" (Performer 6). These difficulties, in some cases, inhibit composers from writing for the instrument: "One of the composer's resistances was due to the difficulty to understand the logic of the guitar's fretboard" (Performer 2).

As some composers mentioned, difficulties can arise from the use of the piano to write music:

> Generally, the biggest difficulties were due to the overuse of guitar's high positions. As a schooled pianist, I could not stick to the guitar's extension, projecting melodic lines, arpeggios and counterpoints to the highest possible register. The performer made me realize this exaggeration and the technical difficulty of these tessiture extrapolations (Composer 1).

This is a common problem: "Often the composer is thinking about the piano and the playing on the guitar is not as immediate as he/she imagines it to be" (Performer 5). Frequently, using the piano as a support to write for the guitar leads to unplayable sections when the musical ideas are transposed to the latter.

5) Promoting the Creation of New Works. This category includes references to how and why performers instigate composers to write for the guitar and how composers see the demand of new works for the instrument. Once again we see a category that drew more attention from composers than performers, especially from Composer 3 (see figure 7).

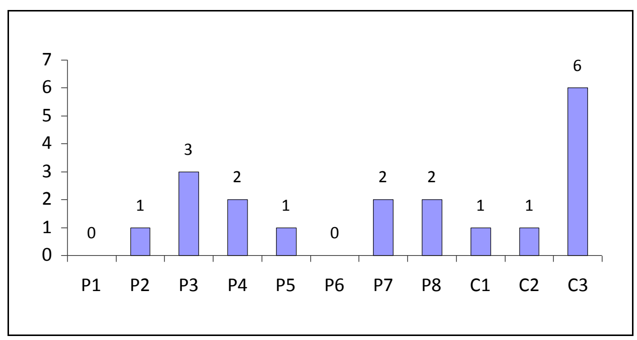

Figure 7. Graph of occurrences: promoting the creation of new works.

Encouraging non-guitarist composers to write for the guitar helps to expand the repertoire possibilities, since these composers bring new ideas from their particular way of viewing the instrument. Consequently, their ideas encourage performers to find new ways of playing. For this reason "it is essential to encourage non-guitarists composers to write for the instrument" (Performer 7). It is worth mentioning that performers are

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generally engage in promoting the creation of new works: “I keep pressing other composers to write for the guitar. I hope to convince more composers to write for the instrument” (Performer 4). Another performer expressed her feeling of fulfilment from engaging composers to write for the guitar: “this is something I have accomplished: to encourage the composer to write” (Performer 8).

This demand for new works seems to induce composers to overcome their resistance: “He insisted so much that I ended up writing a piece for guitar” (Composer 3). This is particularly noticeable when performers are interested in recording or publishing as well: “After a while he asked me to write a piece for a collection that he was doing at Max Eschig in Paris” (Composer 2).

6) Composer’s Receptiveness for Suggestions. This category includes interviewees’ discussion on composers’ receptiveness for suggestions during the collaboration process. It presents information on how performers see composers’ reactions to their suggestions as well as how composers deal with performers’ suggestions. As the following graph shows, this category drew more attention from composers than from performers (see figure 8).

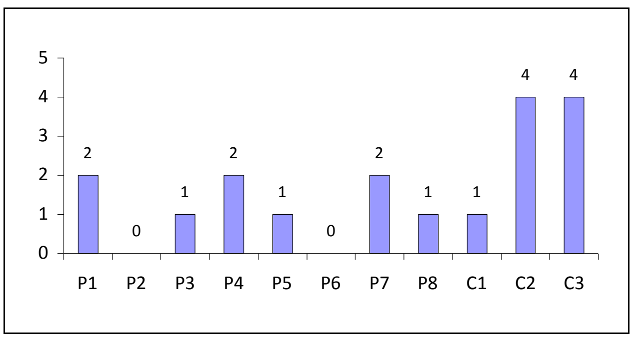

Figure 8. Graph of occurrences: composer’s receptiveness for suggestions.

This category displays a dichotomy: “Some composers are more open [to suggestions] while others are less. Some composers accept contributions within their own compositional process while others do not” (Performer 4). This kind of testimonies came from both performers and composers: “Most of the time I agree [with the suggestions]. Sometimes I do not, but most of the time the final decision is the guitarist’s decision. The important thing is that my basic idea does not get distorted” (Composer 3). Although we see such dichotomy, the interviewees only reported specific moments involving positive feedback: “Somethings I suggested to him that, because of the musical effect, it would be more interesting to use harmonics than real sounds. He liked the result and changed to harmonics” (Performer 1). The same positive feedback was also expressed by composers: “It was a very useful assistance because then I started to have a deeper knowledge of the instrument's possibilities. So I used this knowledge in later pieces” (Composer 2).

7) Transmitting/Learning Guitar Features. This category refers to the performers and composers’ approach to transmitting/learning characteristics of idiomatic writing. Four participants did not comment on this topic (see figure 9). This decrease is noticeable on all following categories.

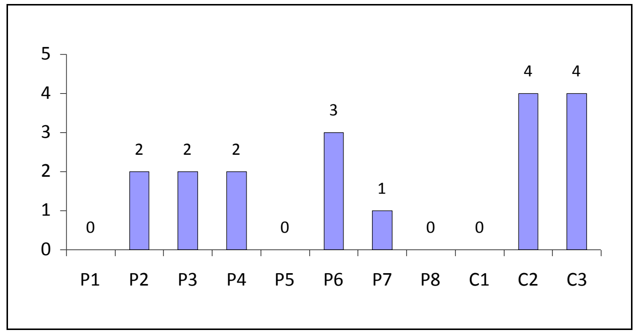

Figure 9. Graph of occurrences: transmitting/learning guitar features.

It is interesting to see the variety of methods used by the respondents. Composers, when working in direct contact with performers, try to understand the guitar’s characteristics: “He [the composer] asked for very specific things like to take the guitar to his home to show some techniques and demonstrate how the guitar’s tessiture and positions work, what is possible and impossible to be played” (Performer 2). We also see how composers find their own manner to demystify guitar writing: “I became acquainted with to the literature and obviously learned a lot from the resources used by the great composers from the past and the present” (Composer 3). Some performers chose a theoretical approach to transmit the characteristics of their instrument:

> One of the things I did was to give the composer a table with a drawing of the guitar’s fretboard and the note’s location in the score. I explained to him how the positions work on the guitar and how much the hand covers when in first position, in second position and so on (Performer 4).

Others performers prefer a practical approach: “To give some guitar lessons to the non-guitarist composer. It's the only way to avoid having to literally rewrite the work” (Performer 6).

8) Correction of Unplayable Sections. This category refers to unplayable piece sections that required alterations by the performer. It addresses unplayable chords, counterpoint, accompanied melodies, and arpeggio patterns that present unsustainable notes due to position shifts, unreachable notes that would require impossible extensions for the left hand, simultaneous notes to be played on the same string.

Whereas composers did not mention this subject at all, it had a fairly even distribution of occurrences among performers (see figure 10).

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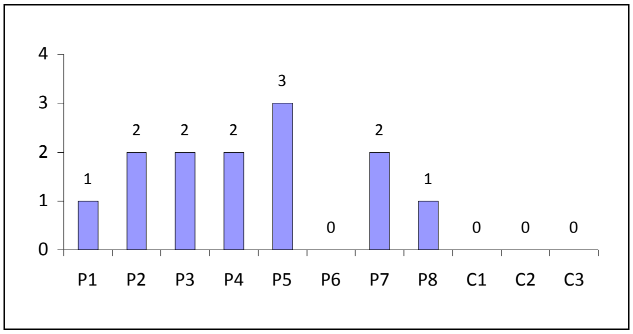

Figure 10. Graph of occurrences: corrections of unplayable sections.

Performers' concerns about the topic can be demonstrated by the following statement: "Generally, this parameter - the playability – is acted on by the guitarist/collaborator, whereas he/she interferes rarely in other areas" (Performer 7). This statement makes us believe that this interviewee sees this category as the core of a collaboration process. It is corroborated by the next statement, from a different respondent, which refers to a situation that happens very often, according to his opinion: "Very often the six-note chords are not playable because one note is not reachable" (Performer 5). Hence, performers' concerns on the topic are justified, mostly because unplayable sections are quite frequently found in works by non-guitarist composers: "He did write quite impossible things for the instrument. Basically we worked on trying to find various alternatives" (Performer 1).

9) Later Revisions. This category addresses the need for new revisions to the score, during the preparation for performance, at the point when the collaboration process is already finished. It is worth to mention that this category was not considered as a part of the next category (interaction modalities) since, at this point, the score is normally already published.

Although this topic was addressed by both composers and performers during the interviews, the occurrence graph shows the composers' lack of interest on the subject (see figure 11), which is understandable since it refers to a period when performers are working by themselves.

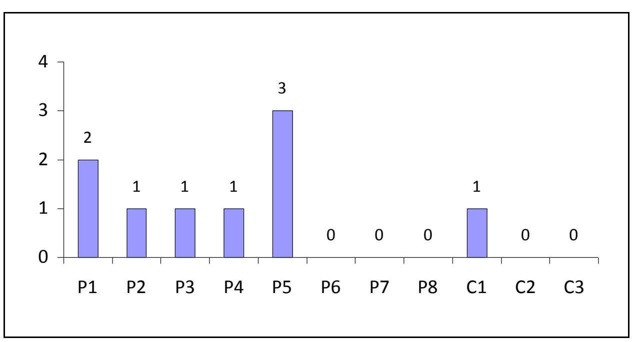

Figure 11. Graph of occurrences: later revisions.

Interviewees comment on the need for a maturation process involving later revisions: "In fact, a work will always mature with time, and that also happens with technical issues, because you discover better ways and the fingerings change by consequence" (Performer 3). This concept of maturation is also pointed out by other interviewees:

> There is always room for more work. The process undergoes maturation. When it comes closer to the moment of play the piece you begin to notice things that you did not realize six or seven months ago, because you start to have a closer relation with the piece (Performer 4).

Some performers achieve good results quite early and the final version of the score is finished before the premiere: "It is always a constant review. But I notice that when I am already playing the piece, it generally does not require further revisions" (Performer 1).

10) Interaction Modalities. This category refers to different manners of collaboration. It addresses: 1) full collaboration during the composition process; 2) simple revision of the score after the composition process; and 3) series of conversations, prior to the composition process, intending to demonstrate the instrument possibilities.

This category drew the attention of all composers, but less than half of the performers mentioned it during the interviews (see figure 12).

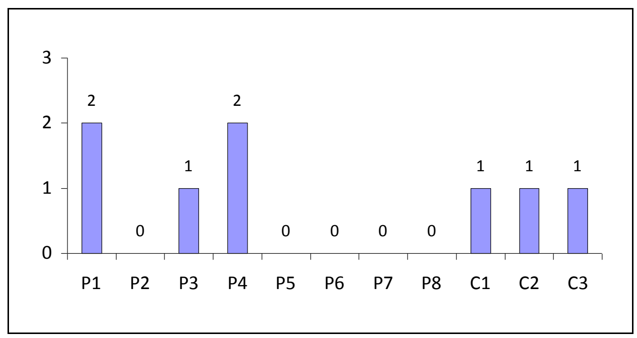

Figure 12. Graph of occurrences: interaction modalities.

The different interaction modalities were mentioned by some interviewees, as the following except shows: "I think it is important to collaborate with different composers and in different types of collaboration" (Performer 4). Unfortunately, this interviewee did not identify any type of collaboration in particular, but another interviewee did: "I had an interaction with the composer during the composition process and/or reviewing of the work" (Performer 1). This statement mentions the existence of two different modalities of collaboration, one of then adopted by Composer 1: "I agreed to write a piece for solo guitar […] expecting an important advantage: his [the performer] technical assistance during the compositional process" (Composer 1). The third kind of interaction, mentioned at the beginning of this category, was chosen by Composer 2: "He spent an entire afternoon giving me a contemporary classical guitar lesson, showing lots of

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possibilities. Then, I wrote the piece and when it was ready, I showed it to him. There was no continued assistance" (Composer 2).

11) Composition/Arrangement Study by the Performer. This category refers to the importance of the study of composition or arrangement by the performer in order to better understand the composers' activity.

This topic was not planned as an interview question, but was mentioned spontaneously by some respondents. It was addressed by both composers and performers, but with few occurrences (see figure 13).

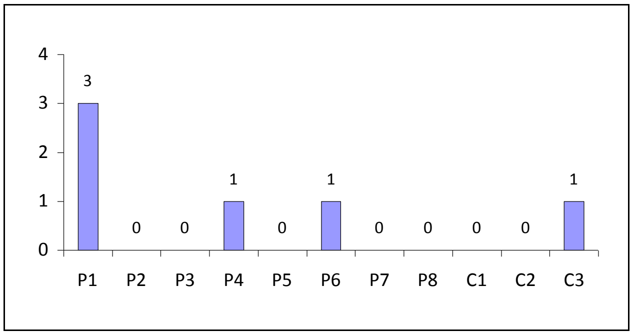

Figure 13. Graph of occurrences: composition/arrangement study by the performer.

According to the few interviewees who commented on this category, performers can be better prepared to collaborate with composers if they study composition: "All guitarists should exercise the practice of composition so that they can understand the big difficulties of this matter and so that they can advise composers" (Performer 6). In accordance, we see a testimonial that validates the previous claim:

> I noticed a difference in the way I face the interaction with the composer. I thought it got better after I started to dedicate myself to the composition, because I try to understand not only the instrumental question, but also the compositional effect that the composer wants (Performer 1).

This is not only a performer's point of view, since composers also consider that, in a collaboration, performers can learn more about the process if they understand the composers' activity: "I think that the player also learnt a lot with me because I conveyed him the composer's view" (Composer 3).

12) Differences between Interacting with Guitarist Composers and Non-guitarist Composers. This category addresses differences between collaborating with guitarist composers and non-guitarist composers. Although this category was one of the main issues underlying this research, it was rarely mentioned by the interviewees (see figure 14).

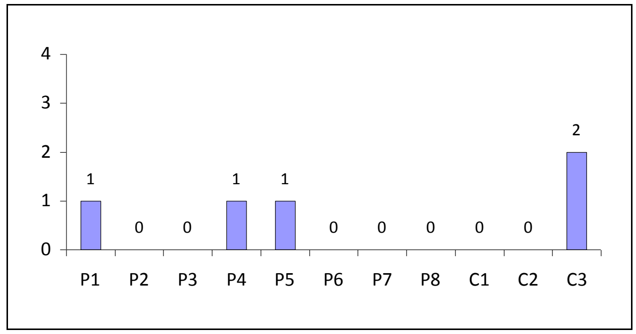

Figure 14. Graph of occurrences: differences between interacting with guitarist composers and non-guitarist composers.

The low relevance of this category was unexpected. It seems that participants identify differences between non-guitarist composer and guitarist composer in the composition process, but when it comes to collaboration, their focus lies on other issues presented in all previous categories. Those participants who have discussed this category claim that:

> There's a big difference if the composer plays the guitar, as you are then in an equal relationship, since one knows what the other is talking about. It's very different from working with a composer who does not play the guitar and is writing for guitar for the first time (Performer 4).

One of the performers interviewed identified the differences between these 2 groups of composers:

> Normally the composer who plays the guitar has a more precise technical/mechanical idea regarding what sound he wants on the guitar. Composers who are not guitarists often have an idea in mind that, depending on their relationship with the instrument, cannot be executed fully (Performer 5).

IV. DISCUSSION

The categorical analysis pointed out some unexpected results: a greater emphasis on "adaptation of non-idiomatic sections" when compared to "correction of unplayable sections", revealing the relative amount of importance that composers and performers give to idiomatic compared with playability concerns. It indicates that composers are interested in bringing new ideas to the guitar while performers are concerned about making the composers' ideas idiomatic whether playable or not. In addition performer focus not only on making music playable and suitable for guitar, but also on exploiting thoroughly the instrument's potential. Moreover, the discussions about "later revisions" indicate that performers look for better solutions until the very last moment and, in some cases, their search become a never-ending process.

The high relevance of "communication strategies" and "performer's intervention level" suggests an overall concern with modes and levels of understanding and communication involved in the collaboration process, showing their focus on conducting a structured collaboration process, and not relying on intuition only. The strategies adopted are applied to the collaboration process in order to allow composers to better adapt their musical ideas to the instrument's characteristics.

The surprising low interest in "differences between interacting with guitarist composers and non-guitarist composers" shows that the participants' main interests lie on other issues of the collaboration process. We can conclude that there are differences between guitarist composers and non-guitarist composers when it comes to the composition process, since the composition for guitar is not an easy task to master. When it comes to the collaboration process, however, this research suggests that it does not matter if performers interact with guitarist or non-guitarist composers, since this difference will mostly affect the composition process, and has low effect on the collaboration process.

ACKNOWLEDGMENTS

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Sounds of intent in the early years: A framework of musical development

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ABSTRACT

Background

Sounds of Intent in the Early Years (*SoI-EY*) is a research project that explores the musical development of children from birth to five years. It is a recent strand of the wider *Sounds of Intent* project, which was set up in 2002 to investigate the musical abilities and engagement of children and young people with learning difficulties (see for example, Vogiatzoglou, Ockelford, Welch and Himonides, 2011). At the heart of both projects is a framework of musical development, grounded in theory and research that is intended to be of value to practitioners and academics working in the field. The original *SoI* framework, currently used by practitioners in the special educational needs sector, sets out three domains of musical engagement (reactive, proactive, and interactive), spanning six levels of development. The six levels range from a child who seemingly makes no response to sound or music, nor creates sounds intentionally, alone or with others (Level 1), to a child having the skills and knowledge of a culturally aware, technically advanced and expressive performer (Level 6). *SoI-EY* investigates the relevance of the original *SoI* framework in the context of 'neurotypical' musical development, as a model to be used with *all* children in the early years. Evidence is drawn from existing literature on musical development in the early years (for example, Hargreaves, 1986; Moog, 1968; Papoušek, 1996; Tafuri, 2008; Trehub, 2010), 'zygonic theory' – a psychomusicological theory of how music 'makes sense', which also underpins the original framework (Ockelford, 2013; Ockelford and Voyajolu, 2016) and observations of children engaged in musical activity.

Aims

1. To explore the relevance of the *SoI* framework of musical development intended for children and young people with learning difficulties, to *all* children in the early years

2. To provide an early years version of the *SoI* framework

3. To assess the musical development of a group of children using the framework.

Method

One-hundred-and-twenty-five observations of 58 children (25 boys and 33 girls) aged 10 weeks to five years engaging with music were taken in the form of video recordings within a Children's Centre in London. These 'snapshot' observations are of children engaging in musical activity, either on their own or with peers, spontaneously or within more structured adult-led groups. The video observations are analysed and coded using the original *Sounds of Intent* framework to determine whether the types and levels of engagement with music can be framed within the existing model and to identify areas of potential mismatch.

Results

A preliminary *SoI-EY* framework of musical development has been created. Of the six levels of musical development, according to the observations made and the literature reviewed, levels 2 through 5 of the original appear to be applicable within the early years context. The three domains of musical engagement (reactive, proactive and interactive) are also present.

In-depth review of the video data showed that individual children within the study demonstrated musical engagement at different levels within a single observation period, in some instances within the same activity. In some cases younger children demonstrated more advanced musical engagement than those who were older, although in general, an increase in age corresponds with higher levels of the *SoI* framework.

Conclusions

Sounds of Intent in the Early Years provides the first iteration of a framework from which practitioners and parents can gauge their children's level of musical development and so support them effectively. Taking into account the findings that younger children in some instances demonstrate more advanced musical engagement than those who are older and that levels may 'overlap' as children demonstrate musical engagement at more than one level simultaneously, it was considered most appropriate to regard the *SoI-EY* framework as related to *stage* rather than *age*. Two further research projects are underway, one of which will apply the framework with a larger sample of children in centres throughout England and a second, which will observe children's musical development longitudinally (rather than as snapshots in time).

Keywords

Musical development, early years, Sounds of Intent, music education

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Perceived sadness, beauty, and liking: Exploring the interconnections

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ABSTRACT

Background

The 'paradox' of pleasurable sadness has attracted significant research interest in the field of music psychology in recent years. How and why are some listeners able to draw profound pleasure from a seemingly negative emotion such as sadness – in the context of music? Juslin (2013) proposes that the enjoyment of music-induced sadness could be explained simply in terms of pleasure drawn from aesthetic beauty, or 'mixed emotions'. In Juslin's words, "It is not that the sadness *per se* is a source of pleasure, it only happens to occur *together* with a percept of beauty" (Juslin, 2013, p. 24). Indeed, previous work has shown that perceived sadness and beauty tend to be highly correlated – at least in the Western music tradition (*r* = .59; Eerola & Vuoskoski, 2010). However, it remains unclear to what extent 'liking' and 'perceived beauty' are conceptually distinct, or whether the conclusion "people like sad music because they find it beautiful" is an example of circular reasoning.

Aims

We aimed to elucidate the interconnections of sadness, beauty, and liking in the context of music listening. To this end, we aimed to find music examples where levels of beauty and sadness would vary as independently as possible.

Method

Nineteen musically trained participants heard 27 short film music examples (approx. 15-20 s each), where perceived sadness and beauty were varied as independently as possible (high, moderate, and low levels of both; 3 x 3 x 3 examples). These 27 excerpts were selected from a pool of 419 film music excerpts used in previous studies. Participants rated the excerpts in terms of liking, perceived beauty, and perceived emotion (tenderness, peacefulness, sadness, movingness, scariness, happiness, and positive and negative valence) using visual analogue sliders.

Results

As averaging across participants or excerpts would have been highly problematic, we used the raw ratings of all participants in all analyses (but adjusted the p-values to reflect n = 19). Although care was taken to select music excerpts were levels of sadness and beauty would vary as independently as possible, the two concepts were still somewhat correlated; r = .26, p = ns. Liking and sadness were not significantly correlated; r = .18, p = ns. Liking and beauty were highly correlated (r = .81, p < .001), while movingness was strongly correlated with both sadness (r = .59, p < .01) and beauty (r = .48, p < .05). When movingness was controlled for, the correlation between beauty and sadness became non-existant; r = -.04, p = ns. Liking ratings for the 9 highly sad excerpts were best predicted by ratings of beauty and movingness (R^2 = .74; *p* < .001).

Conclusions

Despite our best efforts, we did not manage to tease perceived sadness and beauty entirely apart, which suggests that the two concepts are inherently correlated in the Western music tradition. Beauty and liking were very strongly correlated, and liking ratings for highly sad excerpts were best explained by perceived beauty and movingness. However, partial correlations revealed that the association between sadness and beauty was driven by 'movingness'. Thus, although perceived beauty appears to account for a great deal of listeners' enjoyment of sad music, it appears that beauty itself has an essentially emotional component – being moved. Indeed, it might be too early to conclude that sadness itself is not a source of pleasure in the context of music listening (cf. Juslin, 2013), as perceived sadness is what moves us most.

Keywords

Music and emotion, sadness, beauty, liking

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The role of empathy in the enjoyment of sad-sounding music

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ABSTRACT

Background

Not everyone enjoys listening to sad-sounding music. However, those who do may have something else in common as well. By investigating individual differences in the enjoyment of sad-sounding music, we may not only uncover the personality factors that are associated with the pleasure drawn from sad music, but we can learn about the underlying psychological mechanisms as well. One trait that has been implicated in several previous studies is dispositional empathy (e.g., Garrido & Schubert, 2011; Vuoskoski et al., 2012). In this presentation we will review empirical evidence from three studies, and discuss the implications of the findings.

Aims

The aim of this study was to review evidence for a reliable, positive relationship between dispositional empathy and the enjoyment of music-induced sadness.

Method

In total, 310 participants took part in three listening experiments. The first of these experiments investigated the enjoyment of sad-sounding music, the second experiment investigated the susceptibility to music-induced sadness, and the third investigated the subjective emotional responses evoked by sad music. Instrumental, unfamiliar music was used in all three experiments. The enjoyment of (and the subjective emotional responses induced by) sad-sounding music were measured using rating scales, while the susceptibility to music-induced sadness was measured indirectly using an implicit evaluation test. Dispositional empathy was measured using the Interpersonal Reactivity Index (Davis, 1980).

Results

Dispositional empathy – especially the subscales Empathic Concern and Fantasy – was associated with both the enjoyment of sad-sounding music and the susceptibility to music-induced sadness. Empathic listeners' emotional responses to sad music could be characterized as "aesthetic sadness".

Conclusions

Empirical evidence accumulated from three experiments suggests that there is a link between empathically experienced sadness and enjoyment. Previous research has shown that music is able to represent a 'virtual person' of sorts (Watt & Ash, 1998), and that sad-sounding music can serve as a surrogate for empathic social contact with a friend (Lee, Andrade, & Palmer, 2013). As empathic people have a stronger tendency to empathize and resonate with those undergoing negative emotions, the same might hold true for sad-sounding music as well. Furthermore, empathic people may find it intrinsically pleasurable to engage in vicarious experiences – especially in aesthetic contexts.

Keywords

Music and emotion, sadness, dispositional empathy, enjoyment, liking

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Is music listening able to evoke affiliation?

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ABSTRACT

Background

Evolutionary theories regarding the origins of music have suggested that a fundamental adaptive characteristic of music may be its capacity to promote group cohesion and social bonding (e.g., Brown, 2000; Cross & Morley, 2008). Indeed, recent empirical investigations have revealed that music-related, participatory activities such as musical group interaction and tapping in synchrony with a partner are able to promote empathy and affiliation (Rabinowitch, Cross, & Burnard, 2012; Hove & Risen, 2009; Valdesolo & DeSteno, 2011). It may be that music-making – like other synchronized activities – foster social bonding and affiliation by stimulating motor resonance and self-other overlap (cf. Hove & Risen, 2009). However, it is not yet known whether these effects are limited to musical activities involving active interpersonal participation, or whether activities such as solitary music listening could also produce similar effects.

Aims

The aim of this study was to investigate whether just listening to music could evoke empathy and affiliation in listeners. As previous research has shown that certain actions such as explicitly mimicking the actions of an outgroup member can reduce prejudice against the outgroup more generally (Inzlicht et al., 2012), we hypothesized that if music listening is indeed able to evoke empathy and affiliation, listening to music from a particular culture might also reduce prejudice and increase affiliation towards members of that culture more generally. We also hypothesized that participants with high dispositional empathy would be more susceptible to the affiliation-inducing effects of music listening.

Method

Sixty-two participants listened to either Indian or West African popular music (with non-English lyrics) matched in terms of liking, approachability, and perceived valence and arousal. The Indian popular music track was *Harjaiyaan* (Trivedi, 2014; duration 4 min 47 s); and the West African popular music track was *Wililé* (Diawara, 2011; duration 4 min 50 s). After the music listening, participants completed an Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998); a timed sorting task measuring implicit affiliation with Indian relative to West African people. The IAT stimuli consisted of 12 black-and-white facial pictures of Indian and West African people, and 16 words (8 positive and 8 negative). Dispositional empathy was measured using the Interpersonal Reactivity Index (Davis, 1980). Participants were also asked to describe (in an open text field) what they were thinking about while listening to the music, and to rate how much they liked the music they heard.

Results

An ANCOVA revealed that there was a significant interaction effect of dispositional empathy and the type of music listened to (Indian vs. West African) on the participants' IAT scores. Participants with high dispositional empathy scores were more likely to display an unconscious preference for the ethnic group to whose music they were exposed than those with low dispositional empathy scores. Liking ratings for the music tracks were not related to the IAT scores. A follow-up analysis revealed that participants who spontaneously engaged in culturally relevant imagery during the music listening also showed a more marked unconscious preference for the ethnic group to whose music they were exposed. This effect was independent from dispositional empathy.

Conclusions

This study has demonstrated that listening to a track of music from a particular culture can increase affiliative attitudes towards facial images representing members of that culture, especially in listeners with high dispositional empathy. The fact that high dispositional empathy made participants more susceptible to the musical manipulations suggests that the observed findings cannot be explained solely in terms of priming or knowledge activation effects. Furthermore, the observed effects were not related to differences in liking for the musical pieces. Although it has previously been shown that making music and tapping in synchrony with others can promote empathy and pro-social behaviour, the present study is the first to demonstrate that simply listening to music without explicit semantic meaning is capable of evoking similar effects. We argue that this effect can be explained by affective and motor resonance with the music.

Keywords

Music listening, affiliation, empathy.

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Phonatory strategies of vocalists at singing diatonic scales with various dynamic shaping

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ABSTRACT

Background

Professional vocalists have to cope with different musical tasks at wide pitch and dynamic range while pronouncing the text and maintaining control over the overall timbre of their voice. According to the source—filter theory of voice production, the acoustical properties of the voice depend on the working regime of the vocal folds, as well as on the shape of the vocal tract, which acts as the resonator (Sundberg, 1987). It is possible to produce the voice at the same pitch and loudness with different phonatory characteristics, although to maintain the stability of phonation these characteristics must stay within certain limits defined by the laws of physics (Titze, 1994). Produced glottal source power depends on glottal adduction and is greatest at closed quotient values somewhere between Qx = 0.4 and Qx = 0.5 (Titze, 1994). Closed quotient depends also on the laryngeal mechanism, and its value tends to be higher in the case of the chest voice compared to the head voice (Henrich, et al., 2005). Howard (1995) has reported that in the case of female singers Qx tends to increase for pitches higher than B4 with training, but Sundberg (2013) claims that professional singers avoid such "automatic" changes of phonation.

Aims

The aim of this work was to investigate the phonatory strategies of professional vocalists when singing ascending and descending diatonic scales with various dynamic-shaping tasks.

Method

Professional singers and singing students sung diatonic scales at different tonalities over their voice range using different vowels. Three dynamic tasks were used: (1) sempre *f*, (2) crescendo from *p* to *f*, and (3) diminuendo from *f* to *p*. A glottogram (EGG), reflecting the laryngeal activity of the singers, was registered with a laryngograph, and the acoustical signal was also recorded.

Results

Different singers used different phonatory strategies which were expressed: (1) by the pattern of how the value of the contact quotient (Qx) measured by the EGG changed in response to the ascending and descending pitches of the scale; (2) on how the value of Qx changed in response to the increasing or decreasing sound pressure level; (3) on how different voice registers were used. In many singers the Qx value also depended on the vowel used.

Conclusions

Singers tend to use their individual phonatory strategies quite consistently. Some strategies are more common and may depend on the training and the expertise of the singer.

Keywords

singing, phonation, dynamic shaping, EGG, closed quotient.

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Background music influences the evaluation of moving emotional facial expressions

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ABSTRACT

Background

In our daily lives, emotions are often influenced by music either voluntarily (e.g., MP3 player, concerts) or not (e.g., musical background in shopping centres, neighbour's party) (Sloboda, Lamont & Greasley, 2009). Several studies investigated how music, as an auditory input, influences the evaluation of emotional words and faces. (Steinbeis & Koelsch, 2010; Vermeulen, et al. 2010, Weisgerber et al., in preparation). Furthermore, these researchers usually used emotional words and static emotional face expressions (EFE) as stimuli. Nevertheless, our facial expressions are not static but change in valence and intensity. In the present experiment, we used an affective priming paradigm, i.e. different affective music samples (happy and sad music) were presented as a musical background for affective faces presented as targets (happiness and sadness).

Aims

The goal of this study was to investigate if music may help people to refine emotion identification in a more ecological setting.

Method

We created 108 videos of facial expression morphing where faces changed from neutral to 100% of emotion and vice versa (Stimuli from the Radboud Faces Database, Langner et al., 2010). The music extracts were chosen from the database from Vieillard & Peretz, 2010. Participants were exposed to three conditions (congruent, baseline and incongruent music-EFE combinations). They were asked to press the space button when they thought that the facial emotion expression was at 50% of the expressed emotion.

Results

We observed a cross-modal facilitation effect, i.e. a more accurate evaluation when the musical primes and the to-be-evaluated targets shared the same emotional content (congruency). Concretely, on average participants were significantly closer to the 50% threshold in the congruent condition (59%) versus 70% in the incongruent condition. We also found that, in the congruent music condition, participants were more accurate to 50% of the emotion expression when it appeared from neutral to emotion (54%) than when the emotion expression disappeared (61%).

Conclusions

In conclusion, these observations ascribe an important role to music for the competence of identifying emotions. Furthermore, this study showed that congruent music helps to enhance precision in emotion identification but interferes in emotion disengagement in moving facial expression.

Keywords

music, emotion identification

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Functional brain connectivity and the effects of music on the brain: An introduction to network neuroscience techniques and methods for music research

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ABSTRACT

Background

Network Science, based on graph theory, is a rapidly emerging analysis method for studying complex systems in terms of their components and the interactions between them. Embracing the brain as a complex network now offers a fuller understanding of how structural connectivity can lead to dynamic function. Within the brain, music affects an intricate set of complex neural processing systems. These include structural components associated with sensory processing as well as emotional and functional elements implicated in memory, cognition and mood fluctuation. Because music affects such diverse systems in the brain, it is an ideal candidate for analysis of unique individual responses using a network science approach. Network techniques are robust statistical procedures that can be successfully applied to neuroimaging data collected in real-time. Analyses can reveal patterns of both structural and functional brain connectivity. Based on the intricate brain systems affected by music, a network neuroscience approach provides a promising new method for studying individualized dynamic responses to music in the human brain.

Aims

This workshop aims to provide an overview to network science techniques and methods and how they may be successfully applied to neuroimaging data for analysis. Included in this workshop is an overview of a network science approach to the brain as well as current techniques and analysis methods. Also included in this workshop are more recent experimental results on the effects of music listening on functional brain connectivity and the Default Mode Network. This workshop includes two components. First, an overview of new network science techniques and a network analysis approach for understanding functional brain connectivity. Included in this section is how network techniques may be applied to neuroimaging data for analysis. Second, recent results emerging from the application of these techniques and the effects of music listening on functional brain connectivity.

Main Contribution

This workshop provides state-of-the art information about the emerging field of network neuroscience as applied to musical experiences in the brain. Included in this workshop is an overview of graph theory techniques and an introduction to a network neuroscientific approach and methodology. Researchers will have the opportunity to learn how these emerging techniques may be applied to fMRI data to reveal patterns of both structural and functional brain connectivity. The methods and techniques offered in this workshop present an opportunity for music researchers to pursue questions that may further advance the field of neuroimaging music research and deepen our scientific understanding of the effects of music on the brain. As a rapidly emerging area within brain research, this workshop also includes more recent results on how listening to different types of music changes both structural and functional brain connectivity. These results suggest that network science techniques are a promising new approach to understand the effects of music on the brain.

Implications

Network Neuroscience is a rapidly emerging analysis method for understanding how structural brain connectivity leads to dynamic brain function. Network analysis can be successfully applied to neuroimaging data collected in 'real-time' and reveal patterns of changes in both structural and functional brain connectivity. Implications for practice of these techniques include promising scientific advancements in our understanding the effects of music on the brain. Recent results and promising implications from the application of these techniques to in vivo fMRI data acquired during music listening experiences are discussed.

Keywords

Brain Connectivity, Graph Theory, Neuroimaging, fMRI data, Music, Default Mode Network, Memory, Emotion, Complex Brain Networks, Structural and Functional Brain Networks, Functional Connectivity, Music Preference

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Affective calibration of a computer-aided composition system by listener evaluation

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ABSTRACT

Background

Affectively-driven algorithmic composition (AAC) is an emerging field combining computer music research and psychological approaches to music cognition (Mattek, 2011; Williams et al., 2014). AAC systems attempt to communicate or induce specific emotions in the listener by creating novel music. Using biophysiological readings to determine emotional induction in tandem with AAC provides a possible mechanism for reactive, feedback-driven systems that might reliably induce affective states in the listener in accordance to their own preferences and physiological responses. Here we report on a listener evaluation of one such system under development.

Aims

- To evaluate the composition of novel, affectively-driven music by an AAC system
- To investigate the inter-relationships between various musical features and their subsequent influence on listeners' affective responses to music generated by the AAC system
- To determine the widest range of affective responses that might be targeted by the AAC system

Method

Music has been shown to induce physical responses on a conscious, and unconscious level (Grewe, Nagel, Kopiez, & Altenmüller, 2005, 2007). Such measurements can be used as indicators of affective states. A prototype AAC system designed to attempt to induce specific affective states in the listener – the distinction between emotional communication and emotional induction in listeners is well documented in music psychology (Gabrielsson, 2002; Kallinen & Ravaja, 2006; Scherer, 2004) – was prototyped and evaluated in a series of listening tests. A series of affective mappings (musical features with emotional responses) were drawn from literature and implemented in an artificial intelligence driven AAC system. These mappings utilize sixteen 'modes of operation' which correspond to a time series of musical features with varying ratios, intended to evoke particular affective states on the 2-Dimensional circumplex model of affect (wherein *valence* represents positivity of the affective state, as plotted on the horizontal axis, and *arousal* represents the intensity of the state, plotted on the vertical axis) (Russell, 1980). The prototype AAC system uses these musical feature mappings to inform the generation of new music as a polyphonic piano score, aiming for a variety of affective targets in the 2-D space. This new material is generated by means of a 16-channel feed-forward artificial neural network (ANN). The generated pool of material is then further transformed according to the affective mapping, which gives control over five musical sub-features: *tempo, mode, pitch range, timbre*, and *amplitude envelope*. Specific variations in each of these musical features are used to imply different affective states in the generated material according to a 4x4 cartesian grid across the 2-D space. Co-ordinates with higher arousal generally include a larger pitch spread (range of notes), faster tempo, and harder timbres, whilst co-ordinates with higher valence generally utilize a major key. In this system, a cartesian coordinate of (*arousal [1:4]*, *valence [1:4]*) is used to refer to a given ratio of the five musical features. For example a co-ordinate of (1, 1) would refer to the lowest corner of the space (low *valence* and low *arousal*). This co-ordinate would force the transformation algorithm to create stimuli incorporating a slow tempo, a minor key, a *soft* timbre (on a piano, the timbre of the performance can be manipulated using dynamics markings, where perceptually *harder* sounds are achieved with louder performance dynamics), an amplitude envelope with considerable legato, and a spread of pitch values which are comparatively lower than those of the rest of the generated pool. The complete stimulus set is shown in Table 1.

Table 1 Stimulus set showing musical feature matrix

Stimulus #	Timbre	Key	Pitch spread	Tempo	Envelope
1-16	*Soft*	Minor	Low	Slow	Legato
17-32	*Soft*	Chromatic	Medium	Slow	Legato
33-48	*Soft*	Major	High	Slow	Legato
49-64	*Medium*	Minor	Low	Medium	None
65-80	*Medium*	Chromatic	Medium	Medium	None
81-96	*Medium*	Major	High	Medium	None
97-112	*Hard*	Minor	Low	Fast	Staccato
113-128	*Hard*	Chromatic	Medium	Fast	Staccato
129-144	*Hard*	Major	High	Fast	Staccato

A tri-stage listener evaluation was then used to inform two levels of subsequent adjustment to the feature mappings until a broad spectrum of emotional responses was achieved.

Results

The size and spread of affective responses was gradually increased by deliberate manipulation of the ratio of musical features in the affective mappings, until the mean listener responses showed a wide variety of affective states could be achieved by the mappings, as indicated in Figure 1.

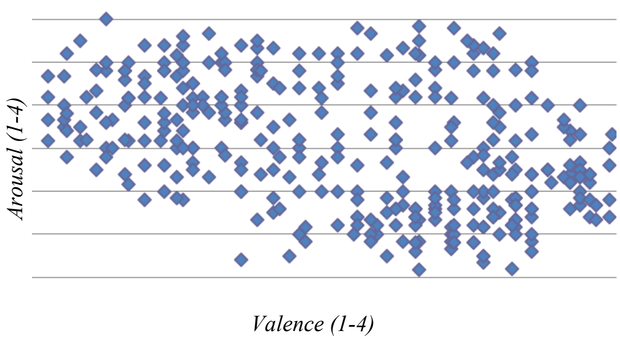

Figure 1. Mean listener responses to final stimulus set after selective manipulation of ratios of musical features in affect transformation matrix. Note uniform spread with the exception of the far left of the space (low arousal, low valence) and the top right of the space (high arousal, high valence).

Conclusions

Listener evaluation of an AAC system confirmed that affective targeting via novel musical material is possible by means of an underlying matrix of musical features. Should such a system be adaptable to real-time control by means of biophysiological estimates of affective state, a feedback driven AAC system could be created for continuous monitoring and induction of target affective states in the listener (e.g., for therapeutic means). In this work the particular ratio of these features has been explored and adjusted in response to listener evaluation but the complex nature of the inter-relationship between these musical features, and the subsequent affective responses remains the subject of considerable further work.

Keywords

Emotion, Affect, Artificial Intelligence (AI), Affective Algorithmic Composition (AAC)

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A lexicon of audio quality

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ABSTRACT

While many listeners can determine varying levels of audio quality what is not always clear is what criteria has been used in the decision-making process. A subjective listening test has been undertaken in which participants rated the audio quality of 62 samples of commercially available popular music, from 1982 to 2013. In addition to providing a five-level quality rating for each audition the participant was asked to choose two words to describe sound attributes on which quality was assessed. This paper details an analysis of these words gathered. Over all samples and participants, 255 unique words were used. By representing the data as a network graph, the relationships between words, ratings, songs and participants can be examined. A number of metrics are introduced to score each word according to quality, expertise and objective signal features of the audio samples. We find evidence to suggest that the words used to describe high-quality and low-quality audio samples are significantly different and that experts and non-experts draw from different sets of words. We find that the words used vary across objectively defined dimensions and multidimensional scaling indicates pairings of words which were used to describe similar conceptual attributes.

I. INTRODUCTION

When we listen to our music collection we can observe that the quality of these recordings can vary greatly. This judgement can be based on a variety of factors, both subjective and objective. For example, older recordings, made with more primitive equipment may be judged as lower quality due to the presence of excessive distortion, limited bandwidth, limited dynamic range or lack of spatial envelopment. Conversely, modern recordings may be judged as lower quality due to the presence of artefacts caused by lossy compression or a lack of dynamic range caused by aesthetic decisions. Therefore the nature of quality-perception can be complex, even before one considers subjective issues such as musical taste and song-familiarity, which have been shown to have significant influence on the perception of quality in recordings of popular music (Wilson et al. 2015).

Audio quality has been described as the result of an assessment of the perceived auditory nature with respect to its desired nature (Jekosch 2004). Due to the varied nature of possible audio stimuli, audio quality has been considered to be constructed of a number of further sub-categories, such as timbral quality and spatial quality (Letowski 1989) or technical/spatial/timbral/miscellaneous quality (Berg & Rumsey 2003). A recent investigation, which involved only the categorization of words and no auditory stimuli, produced the following four categories of words describing quality – defects, space, timbre and a fourth group termed ‘quality’, which included the terms ‘stability’, ‘realism’, ‘fidelity’ and ‘dynamics’ (Le Bagousse et al. 2014). Studies of specialised lexica have also been undertaken, such as that of analogue dynamic range compression (Ronan et al. 2015).

II. EXPERIMENT

The aim of this paper is to analyse the words used to describe the quality ratings given to a set of audio examples. The audio stimuli were 62 examples of commercially available popular music, released between 1983 and 2013. Each sample was cut to a 20-second section (so that quality ratings would apply to the entire section) and centred on the second chorus (for relative consistency between songs).

In this experiment, 22 participants took part (4 female, 18 male). The participants were categorised into two groups, based on their level of expertise in fields relating to acoustics and audio, which yielded 13 experts and 9 non-experts. The mean age of participants was 24.2 years, varying from 19 to 39 years. Mean test duration was 40 minutes (std.dev = 11 minutes). The experiment took place in the listening room at University of Salford, a room with negligible background noise. Further description of the experimental set-up can be found in previous literature (Wilson & Fazenda 2014). For each sample, each participant was asked four questions;

1. How familiar are you with this song?
2. How much do you like this song?
3. How highly do you rate the quality of this sample?
4. Choose two words to describe the attributes on which you assessed the audio quality?

Only questions 3 and 4 are considered in this paper. Analysis of objective quality ratings has been presented and discussed in previous work by the authors (Wilson & Fazenda 2014), which also discussed briefly the variation in word-usage across three objective categories related to the level of distortion in the audio signal. A more complete analysis of objective and subjective data from this experiment is currently under review (Wilson et al. 2015). This work presented herein is a more detailed analysis of the responses to question 4 than has been presented elsewhere.

III. ANALYSIS METHODS

For each audition, each participant was asked to provide two words to describe attributes on which quality was assessed, which allowed for a larger corpus to be gathered than if a single word had been requested. This section describes the analysis methods which were applied to this data.

A. Pre-processing

Once all data had been gathered, missing values were replaced with the term ‘blank’ which could then be removed from further analysis. Spelling was corrected and terms

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deemed to be equivalent were collated (such as 'compressed' and 'over-compressed'). This resulted in 255 unique terms, over 2669 instances.

A term-frequency matrix was generated using the R statistical computing environment along with the 'tm' package (Meyer et al. 2008). From this term-frequency matrix it can be seen that the three most frequently occurring words account for approximately 14% of all instances, while the top 20 terms account for approximately 54% of all instances. This shows that many terms are only used a small number of times. This relation between term-frequency and term-rank is found in larger examples of linguistic corpora (Zipf 1949) and will be exploited later to determine the most relevant words to analyse.

B. Network Graphs

In order to inspect the relationships between the words used and the individual audio samples, participants and quality ratings, a series of network graphs were constructed. For each network a list of nodes and edges was created. This data was saved as a .CSV file and imported into Gephi, an open-source software for exploring and manipulating networks (Bastian et al. 2009). Graph layout, as shown in Fig. 2, 3 and 4, used the ForceAtlas2 algorithm (Jacomy et al. 2014) to position the nodes relative to one another. Three graphs are described; for each graph, the size of each node is proportional to the degree of the node (the number of connections) and the thickness of lines between nodes indicates the weight of the edges (the number of times that connection is used by participants).

1) Term Network. Here edges are drawn between individual terms and so the list of edges is simply the list of the participants' responses, i.e. for a given song, a certain participant may have used the terms "compressed" and "loud" – this input describes a single edge, between the nodes labelled "compressed" and "loud". As the complete graph contains 255 nodes, a subset of this graph is shown in Figure 1.

2) Term-Quality Network. Here edges are drawn between pairs of terms (as above) and also between terms and any of the five quality ratings which were awarded. For example, if the term "distorted" is used to describe a sample which was rated 2/5 by one participant and used to describe a sample rated 1/5 by another, or for another sample, then edges are drawn from the node labelled "distorted" to the nodes labelled "1" and "2". In Figure 2 the quality ratings are shown in red, while words are shown in blue.

3) Term-Participant Network. This network shows the words used by each of the 22 participants. The experts are shown in yellow, the non-experts are shown in red and the words are shown in blue. Edges are drawn between a participant and a word, the weight of the edge referring to how many times that participant used that word.

C. Metrics

In order to characterise the words in an objective manner, a series of metrics are introduced.

1) Normalised quality-score. The normalised quality-score of each word is given by the following equation, where N_Q is the number of times the word is used to describe a quality rating equal to Q and N_{total} is the total amount of times the word is used. All ratings are normalised to the range 1 to 5, the same range as the quality ratings.

$$\sum_{Q=1}^{5}\left(\frac{N_Q}{N_{total}}.Q\right)$$

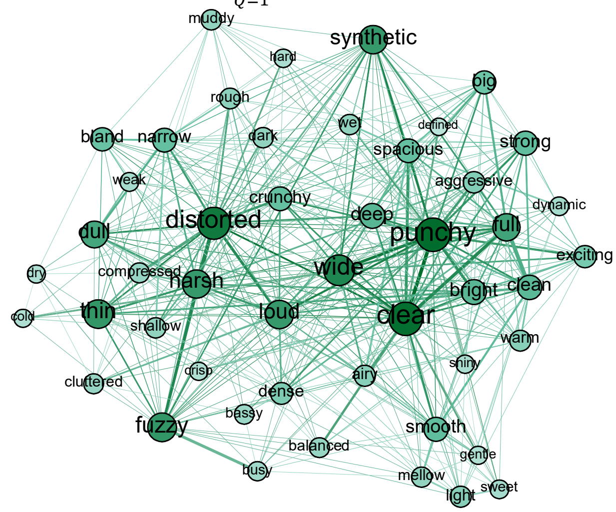

Figure 1. Term network showing the words with degree > 10. Terms which are frequently used together are located closer to one another than terms which are rarely used together.

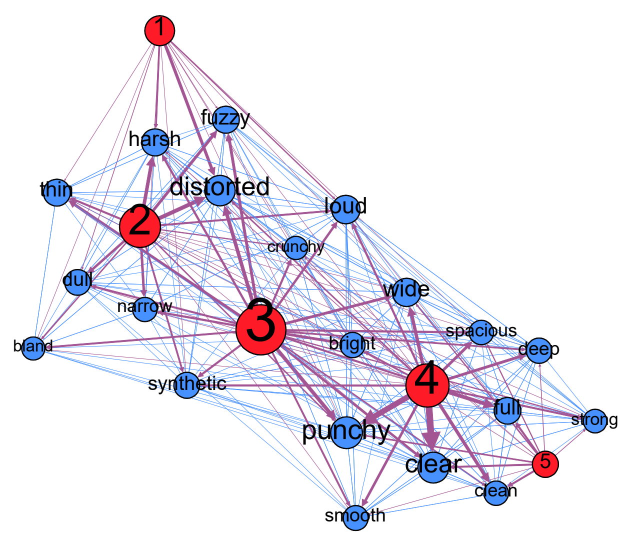

Figure 2. Term-Quality network, showing the 20 most frequently-occurring words. Terms used to describe specific quality ratings (in RED) are shown close to those ratings.

2) Normalised expertise-score. Similarly, the normalised expertise-score of each word is given by the following equation, where S_i = 1 for expert listeners and S_i = -1 for non-expert listeners. An expertise score of 1 indicates that a word has only

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been used by the expert group while a score of -1 indicates that a word has only been used by members of the non-expert group.

$$\sum_{i=1}^{22}\left(\frac{N_{S_i}}{N_{total}}.S_i\right)$$

3) *PCA-score.* This score investigates how certain words were used to describe certain songs, and determines a score based on the objective parameters of these audio signals. For all audio samples, a set of objective signal features was extracted which was then subject to principal component analysis (PCA) (Wilson et al. 2015). The first three dimensions explain approx. 78% of the total variance in the extracted features. Dimension 1 can be described by amplitude-based features, with positive values referring to louder, more compressed samples and negative values referring to quieter, more dynamic samples. Dimension 2 describes signal bandwidth, where positive values have greater high-frequency extension. Dimension 3 refers to a spectral tilt; positive values indicating treble and negative values indicating bass.

For each of these three principal components a score is obtained, similar to the previous metrics. This allows all words to be positioned in the feature-reduced space used for audio analysis, using the scores of all audio samples on each principal component. Here N_A is the number of times a word is used to describe sample A, and N_{total} is the total number of times the word is used. $dim1_A$, $dim2_A$ and $dim3_A$ are the scores for sample A on each of the first three dimensions of the PCA space. For each word, the scores are determined as follows.

$$dim1score = \sum_{A=1}^{62}\left(\frac{N_A}{N_{total}}.dim1_A\right)$$

$$dim2score = \sum_{A=1}^{62}\left(\frac{N_A}{N_{total}}.dim2_A\right)$$

$$dim3score = \sum_{A=1}^{62}\left(\frac{N_A}{N_{total}}.dim3_A\right)$$

IV. RESULTS

For all these metrics, words which are infrequently used will achieve scores heavily weighted by the few instances on which

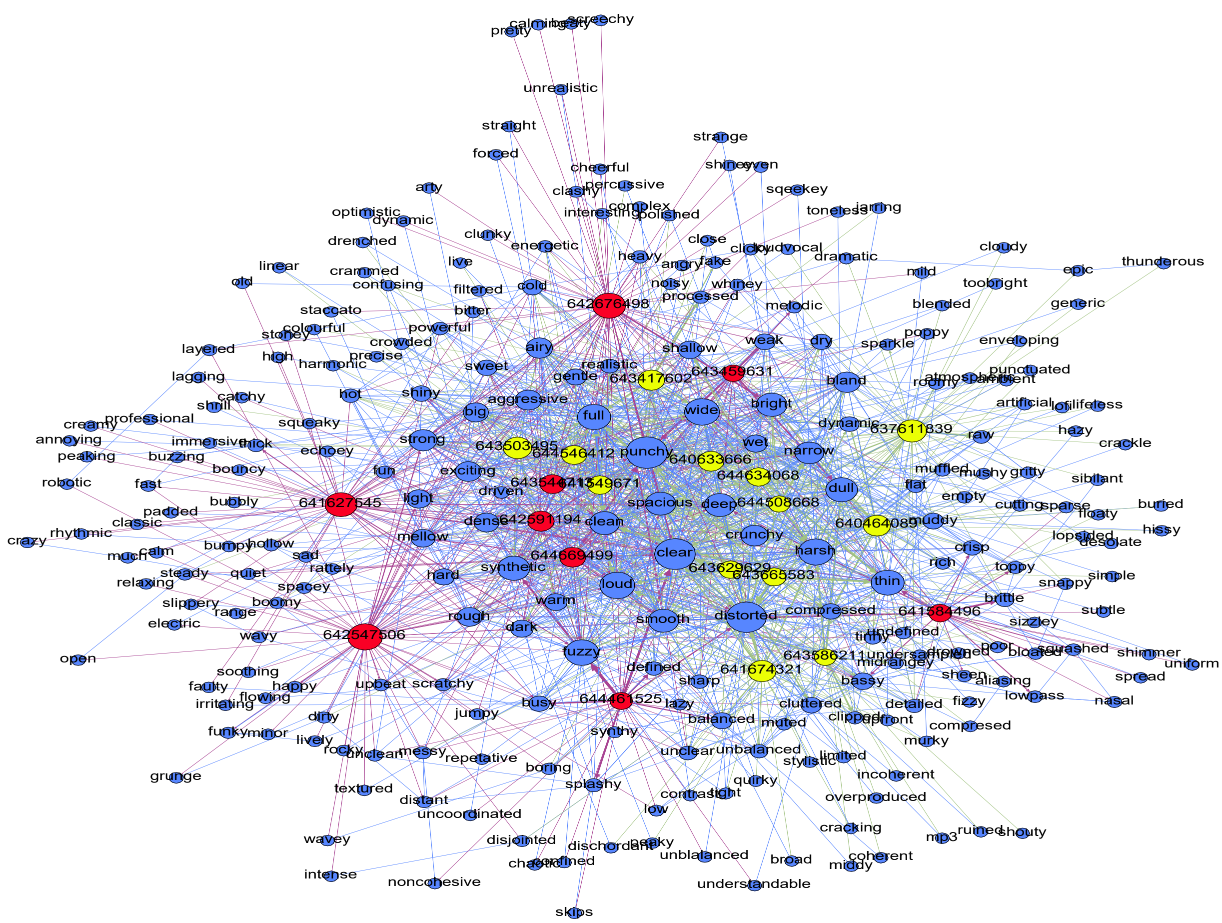

Figure 3. Term-Participant network, showing all words and participants. Experts are shown in YELLOW and non-experts in RED. Frequently used terms are located towards the centre of the graph and infrequent terms are located at the exterior.

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they were used. Therefore, the following results analysis displays only a subset of the total set of words.

A. Quality scores

The 20 most frequently used words are shown in Table 1, along with the number of times used to describe each quality rating. A Chi-square test is used to determine whether there was significant variation in the usage of words across these five categories. This data indicates that there is significant variation as different words are used to describe different quality ratings ($\chi^2(76, N = 1441) = 2131.26, p = < .001$).

The normalised quality score for each of the top 20 words is shown in Table 2. This data shows the importance of distortion in the perception of quality, as audio samples described as distorted are awarded low ratings of quality.

B. Expertise scores

The normalised expertise score for all words was obtained. Words which were used by only a single participant were removed, leaving 96 words out of the initial 255. When used by only one participant a word has a score of either 1 or -1 and therefore would bias the interpretation of the following results. In order to keep the most agreed-upon words, all words used by only 2 or 3 participants were also removed, leaving 60 words which account for approximately 84% of all instances.

Table 1. Word usage varies according to quality rating. Values highlighted in bold and with < or > are significantly less than or greater than chance occurrence.

	Quality rating					
	1*	**2***	**3***	**4***	**5***	**TOTAL**
Distorted	**31>**	**43>**	37	**13<**	**2<**	126
Punchy	**1<**	**11<**	37	**63>**	13	125
Clear	**1<**	**4<**	**24<**	**77>**	**18>**	124
Full	0	**4<**	21	**41>**	**21>**	87
Harsh	**15**	**38**	23	**9**	0	85
Wide	3	**5**	28	**35**	10	81
Loud	**10**	18	25	22	4	79
Clean	**0**	0	**13**	**36**	**20**	69
Fuzzy	7	**28**	28	**4**	0	67
Synthetic	**1**	**18**	21	20	4	64
Spacious	**1**	0	20	**30**	**10**	61
Thin	6	**21**	**29**	**5**	0	61
Bright	**1**	9	**26**	17	7	60
Dull	**8**	**25**	20	**7**	0	60
Deep	**0**	**4**	15	**29**	9	57
Narrow	2	**25**	23	**6**	0	56
Smooth	**0**	**3**	18	**27**	7	55
Crunchy	**0**	10	**23>**	9	2	44
Strong	**0**	**2**	10	**21**	**9**	42
Aggressive	2	5	8	**18>**	5	38
…						
TOTAL	197	528	876	856	212	2669

Table 2. Quality score of the 20 most frequently-occurring words, indicating the importance of 'clean' and 'distorted'.

Word	**Quality score**
Clean	4.10
Full	3.91
Strong	3.88
Clear	3.86
Spacious	3.79
Deep	3.75
Smooth	3.69
Punchy	3.61
Wide	3.54
Aggressive	3.50
Bright	3.33
Synthetic	3.13
Crunchy	3.07
Loud	2.90
Narrow	2.59
Thin	2.54
Dull	2.43
Fuzzy	2.43
Harsh	2.31
Distorted	2.30

The histogram in Figure 4 shows the distribution of counts among the 60 remaining words. This distribution shows a skew towards higher scores, which suggests that the most agreed-upon terms are mostly used by the expert group, while the non-experts used more individual terms, with less agreement.

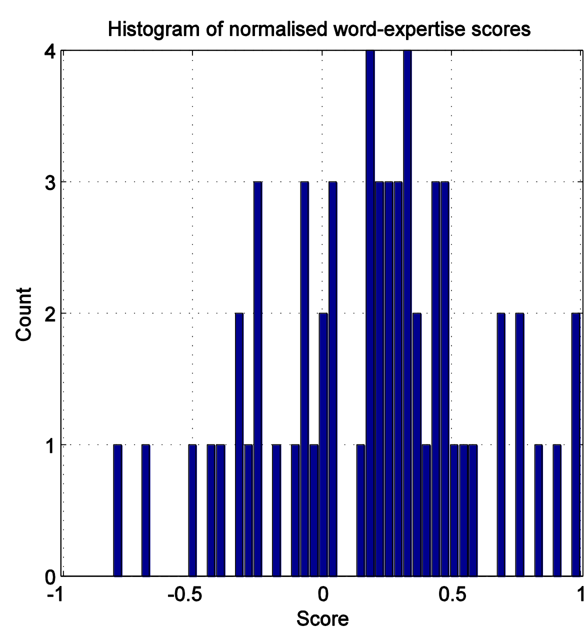

Figure 4. Histogram of normalised expertise score. When the words used by three or fewer participants are omitted, most

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remaining words have positive expertise scores, indicating they are favoured by experts.

C. Feature-based scores

Figures 5 and 6 show the 60 most agreed-upon terms positioned in the first three dimensions of the PCA space. The words ‘compressed’, ‘distorted’ and ‘loud’ have positive values on dimension 1 while ‘dynamic’ has a negative value, The words ‘bright’, ‘brittle’ and ‘harsh’ have positive values on dimension 2 which is related to high-frequency characteristics. The word ‘bassy’ has the greatest negative value of dimension 3 which is related to low-frequency characteristics. This shows agreement with the objective descriptions (Wilson et al. 2015).

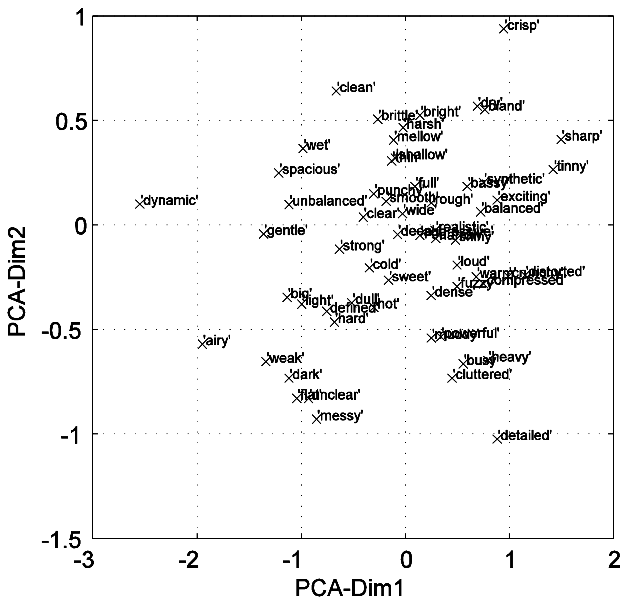

Figure 5. Scatterplot of normalised scores on PCA dimensions 1 and 2. Only the words used by 4 or more participants are shown.

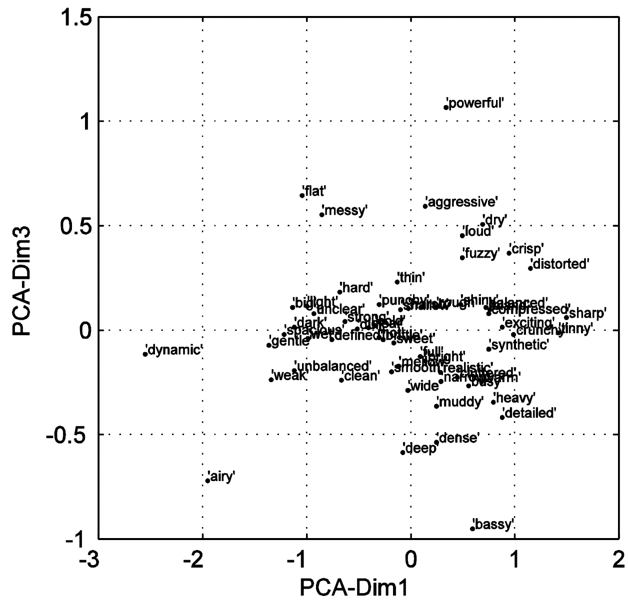

Figure 6. Scatterplot of normalised scores on PCA dimensions 1 and 3. Only the words used by 4 or more participants are shown

For dimensions 1, 2 and 3 the Euclidean distance between pairs of words is obtained. These distances are used to perform multi-dimensional scaling (MDS), in which words are positions to minimise the total strain in the graph. Positions of words in a two-dimensional MDS solution are shown in Figure 7.

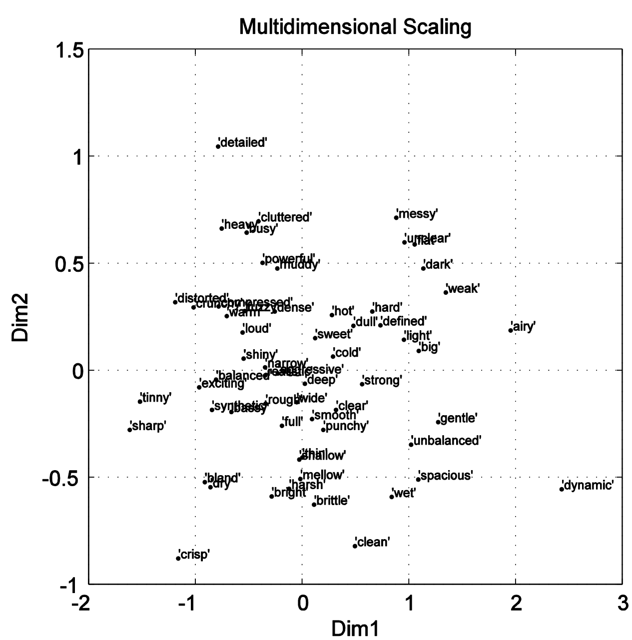

Figure 7. Results of multidimensional scaling, using Euclidean distances in PCA-space.

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V. DISCUSSION

The distribution of the expertise scores suggests that the two expertise groups used a different set of words to one another when assessing audio quality; the expert group used a smaller, more agreed-upon set of words, while the non-experts used a larger variety of individual terms. This suggests that expert users have been trained to identify certain aspects of an audio signal and describe them in a way that is understandable to other expert users. The word-usage patterns of the non-experts shows that these participants were more likely to use words which were not used by other participants, terms for which the meaning may not be as universally understood. In total, 62% of words were only ever used by a single participant.

Of the words used by over 4 participants, the five most associated with high expertise are ‘dynamic’, ‘muddy’, ‘cluttered’, ‘compressed’ and ‘tinny’. The five words most associated with low expertise are ‘busy’, ‘messy’, ‘mellow’, ‘brittle’ and ‘light’. While open to interpretation, the expert group appears to employ a subjectively more technical language. By contrast, the non-expert group refer to similar properties in a more abstract fashion. For example, one can consider ‘tinny’ to be equivalent to ‘brittle’ or ‘light’ and ‘busy’ to be comparable to ‘cluttered’ or ‘compressed’.

As the words were scored based on the principal components of the audio samples’ features, one can gain insight into the meanings of each word. Figure 7 suggests that, when based on objective features, the differences and similarities between pairs of words can be seen, for example, ‘cluttered’ and ‘busy’ are similar, as are ‘distorted’, ‘crunchy’ and ‘compressed’, among other pairings.

The word ‘distorted’ is the most frequently occurring word among participants in this study and is used significantly more often than chance in describing audio samples that were rated 1 or 2 stars, while significantly less often than chance for 4 and 5 stars. This suggests that the participants very often judged the quality of audio samples based on the level of perceived distortion. Similarly, the word ‘clean’ is never used to describe ratings below 3 stars and achieves the highest quality score. ‘Clean’ and ‘distorted’ were the only words which were used, at least once, by every participant. There is a notable distance between these two terms in the PCA-space, as seen in Fig. 5, 6 and 7. Based on the scores in Table 2, one can conclude that this clean/distorted dimension corresponds to a great change in the perceived quality of the audio sample.

The words ‘punchy’ and ‘clear’ are also frequently-occurring, suggesting that these words are familiar to participants and can be used to describe sound attributes of musical recordings which relate to audio quality. This result helps to justify recent research into the objective characterisation of these terms (Fenton & Wakefield 2012) (Fenton et al. 2014). The words ‘punchy’, ‘clear’, ‘full’ and ‘smooth’, which all have high quality scores, are closely located in Figure 7 which suggests that these words were used to describe songs which shared similar values of the objective features relating to high quality.

VI. CONCLUSION

An experiment was conducted in which participants listened to commercially available music samples, rated the overall audio quality and provided words to describe the sound attributes on which quality was assessed. It has been shown that word-usage patterns vary with respect to the quality ratings awarded, the expertise of the listener and the objective features of the audio sample they describe. From this, the various meanings of certain words can be explored. These results have provided valuable insight into the perception of quality in commercial music recordings, which can be used to inform the design of further subjective testing.

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Audience engagement in live concerts: The impact of enhanced access to performers and composers

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ABSTRACT

Background

In the light of decline of audiences for classical concerts (Eurobarometer, 213; SPA 2013), there is growing interest in understanding what audiences seek from live performance. Existing research documents in some detail the features of classical music performance conventions that act as barriers to audience engagement, particularly for non-attenders (e.g. Dobson, 2010). While much attention is given to increasing the accessibility of classical music in order to attract new (especially younger and more diverse) audiences, understanding and enriching the experiences of existing audiences is arguably of equal importance to classical music organisations, particularly in the context of artistic innovation and new music, often seen as challenging and risky.

Classical music performance conventions often restrict audience feedback to applause at the end of a piece, and the opportunities for a personal connection with performers can be limited. As noted by Radbourne, Johanson and Glow (2014) the nature of the audience's experience during performance is relatively neglected in research. However, a growing body of evidence points to a sense of connection with performers as a highly valued aspect of live performance to audiences, both established and new (e.g. Pitts & Spencer, 2008; Dobson 2010; Radbourne, Johanson & Glow, 2014). For artists, investigating this area holds more than academic importance, but has the potential to shape practice and to empower individuals and ensembles in their artistic decisions and development. Previous studies, in the programme which includes the study reported here, have shown the value of artist-audience exchange to performers and composers in a primarily educational setting, allowing them to gain direct feedback from audience members on artistically relevant issues (Dobson & Sloboda, 2014).

The present study extends this work to the professional classical concert scene, in collaboration with the chamber orchestra Britten Sinfonia, in the context of their 2013-4 season in concert halls in London and Cambridge, UK. The project focused on a series of specially designed engagement activities around two contrasting concerts, each including a commissioned work.

Aims

The project was part of a research programme that has the overall aim to explore ways in which dialogue may be opened up between audiences and music professionals (composers, performers, management). Key to this is that the research is situated in the context of live performance, and within a collaborative framework, to allow the exploration of questions that are directly relevant to the practice of the professionals involved. The specific research aim of the project reported here was to explore audience responses to a programme of enhanced engagement events over a period of time, rather than simply a one-off, and the impact on their concert experience, particularly of new music.

Method

In collaboration with Britten Sinfonia, we recruited 20 audience members and 22 Guildhall School music students as 'Audience Consultants'. They attended events organised around two concerts, showcasing newly commissioned work. Concert 1, coinciding with Benjamin Britten's centenary, concluded with his 'Serenade' for tenor, horn and strings. As well as a commissioned piece, it also included a large proportion of music by living composers, and was designed to lead thematically to the Serenade. Each half of the concert was conceived of as a single span and played without applause, with musicians entering and leaving the stage fluidly as needed. The concert was preceded by an open rehearsal and a panel discussion, which included the composer of the commissioned piece, the soloist-leader of the concert, an orchestral player and the orchestra's chief executive. Immediately after the concert participants completed a research questionnaire (quantitative and qualitative) capturing data on their experiences of the pre-concert events and the performance, along with their reflections on how the events impacted on their experiences during the concert. Questionnaire data were also gathered from 35 audience members attending the same concert programme at another venue, but in this case the panel discussion was replaced with a more standard pre-concert talk. Concert 2 followed a more conventional structure, with a commissioned work for winds partnered with two major classical works. It was followed by a post-concert discussion in which the Audience Consultants participated, with the composer, an instrumentalist, and the orchestra's chief executive. Reflective feedback on the project and the research results was gained at a seminar attended by the research participants, Britten Sinfonia personnel, and a range of interested parties from academic and industry.

Results

Thematic analysis of qualitative questionnaire data revealed three main themes expressing the perceived influence and value of the events for audience members' engagement in the live concert. 'Orientation' refers to people's navigation of the musical material through the performance, including their allocation of attentional resources, and aspects of memory. 'Connecting with the Process' describes participants' experiences of being taken on a journey, which included having access to performers' and composers' artistic processes and

themselves feeling part of the process through the sequence of events. 'Connecting with the People' describes the ways in which audience members related to the professionals involved, with their experience of the concert enhanced by their enriched insight into the personalities, relationships and collaborative dynamics at play. The audience especially valued hearing a range of different perspectives. Particularly important was the insight that the performances and the new works within them were the result of collaboration, and represented just one particular point in an overall artistic journey, rather than finished, perfect, unchanging articles. Data also illuminated participants' engagement with innovative aspects of programming and staging. Reflective accounts provided indications of impact, particularly for student participants, some of whom reported transformations of their own approaches to performance following their experience in the project as audience members. Challenges were also discussed relating to empowering audience members to offer their views, and the provision of similar engagement events in the context of demanding professional working lives.

Conclusions

The project gave rich insight into audience members' experiences, with direct relevance to professional artistic practice. The three themes of 'Orientation', 'Connecting with the process' and 'Connecting with the people' provide a potential framework for characterising audience engagement in a way that may inform artistic practice. While this is particularly relevant to the new music that was the focus of the project, it has wider applicability. The results are in line with the findings of Radbourne, Johanson and Glow (2014) that audiences consistently value a connection with the performers (and in this case, composers and management too). Dobson (2010, 123) suggested that strategies such as open rehearsals may be used as a 'bridge' for new audience members to give 'insights into how classical ensembles (and the works they perform) function, promoting classical performance as the result of a process of collaboration and interpretation, shaped by and reliant on the qualities of the musicians involved, rather than as a predetermined, static product'. Our results show that what may be beneficial for these new audiences is also beneficial for established ones in promoting deeper and more meaningful exchange between artists and audiences.

Keywords

Audience; new music; engagement; live performance

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Ear training – The development and application of an assessment tool

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ABSTRACT

Background

Over the last 100 years, many tests have been developed to measure various aspects of musicality (Seashore, Lewis & Saetveit, 1960, Gordon, 1989, Ullén et al., 2014). Most of these tests focus on the aspect of musical talent and rely on the paradigm of detecting small discriminations produced by musical stimuli.

Less research has been conducted on the assessment of musical skill or competence primarily influenced by practice and effort. Investigating the correlations between different musical skills, McPherson (1995) could use the Watkins-Farnum performance scale (Watkins & Farnum, 1954) for sight-reading; however, scales for improvisation or playing by ear had to be originally devised.

Since we lack the instruments for the objective measurement of musical skills, it is currently impossible to measure the long-term development of musicians or to conduct studies on the characteristics of musical skills.

Aims

We are currently developing and validating an assessment instrument for musical ear training. With this test, new questions in music education, musical development and expertise can be addressed.

Method

We have applied the tools of Item response theory, in particular, the Rasch model (Bond & Fox, 2007), to produce items for melodic, harmonic and rhythmic ear training. By means of this up-to-date test theory, material questions of validity and dimensionality can be addressed. Items for this test were engineered by experienced professors in music theory.

After three pre-studies, 81 items are currently being validated in an international online study (Reips, 2002) which investigates the influences of instrument, primary musical genre and other background variables (see https://soscisurvey.de/hoeren/). Participants were n = 393 people of different musical backgrounds.

Results

Sixty-six items fit the Rasch model and combine to produce a measure of ear training performance. Item difficulties are normally distributed. No differential item functioning (DIF) could be detected for people playing harmonic instruments, melodic instruments or who have studied music (Andersen LR-test n. s.). No influences on ear training skill were found for participant's age, gender, possession of absolute pitch or having learnt solmisation ($|r| < .1$).

Conclusions

Until now, it has not been possible to quantify a person’s skill in ear training. With this set of originally developed and scrutinised items, researchers can explore the importance of musical hearing for sight-singing, improvisation, playing music by ear and many more facets of musical life.

Keywords

Ear training, Assessment, Test development

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Congruity and diversity in conceptualizing improvisational expertise: The case of adaptors versus innovators

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ABSTRACT

Background

Improvisational expertise in jazz entails a mixture of musical knowledge, skills, and attitudes that is needed to improvise consistently and superiorly on a set of representative improvisational tasks (Wopereis, Stoyanov, Kirschner, Van Merriënboer, 2013). The composition of this mixture is not static, but subject to change due to the continuous evolution of jazz music. Since there is a persistent debate in the jazz field between those who want to operate within existing 'improvisational' frameworks and those who prefer to restructure these frameworks (cf. the 'jazz/not jazz-discussion'), we expect expert members of the jazz field to have different views on improvisational expertise as well.

Aims

This study explores this issue and specifically addresses the differences and similarities between more adaptive and more innovative jazz experts. The aim is to reveal conceptions of improvisational expertise within and between the two groups. This information is especially relevant for jazz instructors who design instruction for aspiring improvising professionals in the field.

Method

Twenty-four renowned jazz musicians, teachers, and critics participated in this study. They were categorized by creativity style (i.e. adaptor or innovator) using Kirton's Adaption-Innovation Inventory (Kirton, 1976, 2006). Both the adaptors and innovators completed Trochim's Group Concept Mapping (GCM) procedure to generate, categorize, and rate constituents of improvisational expertise (Kane & Trochim, 2007; Trochim, 1989; Wopereis et al., 2013). Multivariate data analyses including multidimensional scaling and a hierarchical cluster analysis resulted in a concept map for each group.

Results

The two concept maps show that both adaptors and innovators acknowledge the importance of basic musical skills and regulation skills for jazz improvisation. Interestingly the innovators underline the significance of artistic boundary crossing, risk-taking, and the creation of a personal voice, while the adaptors emphasize building and strengthening (a variety of) existing musical idioms.

Conclusions

More adaptive and more innovative musical experts within a group of jazz experts seem to have different views on improvisational expertise. For jazz educators this information is helpful for selecting, designing, and implementing instructional tasks for their musical curricula.

Keywords

Improvisation; Creativity style; Adaptation; Innovation

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The development of improvisational expertise in jazz musicians

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ABSTRACT

Background

Improvisation –a key to musical performance in genres like jazz, freestyle rap, and liturgical church music– is a complex musical skill that takes many years of intense practice to master. A previous study by Wopereis, Stoyanov, Kirschner, and Van Merriënboer (2013) suggests it requires a mixture of basic musical skill, creativity, affective involvement, regulation, responsivity, and risk-taking. These elements call for a high level of mastery and integration, without which there can be no acceptable, let alone high-class performance.

Aims

The aim of the present study is to reveal factors that affect successful and less successful improvisation expertise development (cf. Ericsson, Krampe, & Tesch-Römer, 1993). Two questions were investigated: 1) How do expert musical improvisers develop their improvisational expertise? And 2) Is there a developmental difference between elite and semi-elite professionals?

Method

Participants were 11 professional piano players. All had studied jazz and improvised music at conservatories in the Netherlands or Belgium. Six participants were elite improvising pianists (n=6; M_{age}=45.3, SD=4.0; 1 Female), five were semi-elite (n=5; M_{age}=44.0, SD=5.8; 1 Female). Participants were matched on sex, age, and conservatory class. The two groups appeared not to differ in their perceived musical and improvisational identity development trajectories.

Free narrative interviews were conducted asking the interviewees to describe their development as an improvising musician, following their timeline from birth till present. This timeline was presented on a large sheet of paper (594 mm × 841 mm), and interviewees were invited to mark time and describe critical activities, incidents, and persons on the way to becoming their present musical personalities. Interviews took about one and a half hour (cf. Sosniak, 2006).

To analyze the data a classification system was developed that included the following themes: skills and activities, knowledge base and other results, environment, self, and development. Within these categories processes of initiative, regulation, and support and feedback cycles could be discerned.

Results

The musicians passed through four main stages of development: (a) early years (basic musical skills); (b) introduction to jazz improvisation; (c) serious practice/focus on being a professional improvising musician; (d) being a professional (improvising) musician. Throughout these stages, both the elite and semi-elite musical improvisers (increasingly) engaged in intensive deliberate practice, play, and work. The early years of musical practice and play aimed at the acquisition of basic skills. Members of both groups for instance mentioned incidents that illustrate a remarkable development of aural skills during childhood (e.g., the ease to play music by ear in class). Radio broadcasts, recordings, and (home) concerts were marked as events that incited interest in musical improvisation. Especially the elite referred to such 'critical incidents' as trigger to enter jazz education at municipal music schools. All but one of the members of this group started formal jazz education between age 10 and 15. Deliberate practice increased during subsequent years in high school and accumulated after the decision was made to pursue jazz studies at the conservatory. For most semi-elites formal jazz tuition started later. They dedicated themselves to intensive deliberate practice after the decision was made to attend the conservatory.

Deliberate practice, play, and work proliferated from the moment the musicians entered the conservatory. However, findings on learning during conservatory training revealed group differences in intensity and type of individual and group practice. Elites explicitly mentioned the importance of extensive deliberate practice ('woodshedding') to create a knowledge base, necessary to play with others. For them 'playing together' was regarded a core constituent of learning how to improvise. They emphasized the significance of attending jam sessions, not only to learn group performance skills, but also to learn how to network. Elites adhered to the idea that a strong professional network affords opportunities for learning and work. While improvisational learning activities of the semi-elites mainly focused on learning the prevailing musical idiom (e.g., bebop), the elite musicians expanded 'idiomatic learning' towards the development of a personal voice. To pursue this goal, elites even initiated learning activities outside the conservatory curriculum. They continued their quest for a personal sound in the final developmental stage, which can be traced back to the (artistic boundary-crossing) compositional and improvisational activities put forward in the interviews. At all stages and for both groups environmental support for learning and development was high. Especially the elite received abundant support and positive feedback on improvisational expertise development by peers, parents, teachers, colleagues, and the field. This support helped them to persevere in improvisational learning and to scrape a living as a professional musician.

Conclusions

This study shows that the development of expertise in musical improvisation is a delicate mixture of drive and self-direction, individual and group practice, networking and opportunity seeking, and creation. Based on the activities mentioned by the musicians at all developmental stages it seems that the elites are more 'innovative' and the semi-elites are more 'adaptive'.

Theoretically this study contributes to our knowledge about expertise development in professions that are not regulated by external rules or legislation, but in which successful performance is defined by audiences, colleagues, and self. Studying improvisational expertise also shows the importance of self-directedness and seeking opportunities for learning. Further research must show whether this is closely linked to interactivity and risk-taking, which are imminent to this style of musical performance.

Keywords

Improvisation, Expertise, Musical development

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Conductors at cocktail parties: Attention and memory in musicians

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ABSTRACT

Background

Individuals with high working memory capacity are more flexible in attending to detail (Colflesh & Conway, 2007), for example, they excel at both divided and selective attention tasks such as verbal shadowing ("cocktail party phenomenon"). Working memory may benefit attention in at least two ways: by allowing more flexibility in divided attentional strategy and by enabling more effective inhibition when that is required in selective attention.

Although both capacities are essential for skilled performance in many areas, evidence for potential training and expertise effects is scarce. A study by Nager et al. (2003) has shown that musicians are more successful in spatial selective attention tasks, depending on their domains of expertise. Musicians and listeners use WM to extract tonal, harmonic, and rhythmic relationships that make any musical passage comprehensible. Divided attention enables these elements to be extracted simultaneously. Divided attention is challenged even more in listening to polyphonic music, where separable melody lines are presented simultaneously.

Music experts, not surprisingly, show superior performance in musical executive tasks. For instance, novices resort to switching between the different lines when they are asked to detect errors in two familiar melodies played at once, whereas trained musicians use a more integrative strategy (Bigand et al., 2000; Poudrier & Repp, 2013). In general, musicians show superior on-line temporal monitoring (Rammsayer & Altenmüller, 2006), even when the presentation is visual (Rammsayer et al., 2012). They also have higher working memory spans than novices for auditory, especially tonal material (Bennassi-Werke et al., 2012; Schulze et al., 2011; Williamson et al., 2010), although not necessarily for non-temporal tasks such as spatial WM (Hansen et al., 2013).

Less is known about the relationship between attention and working memory for auditory and visual stimuli among different types of highly trained musicians. Orchestral conductors need to focus their attention both on individual instruments and on larger sections of different instruments. In this study, we investigated their attentional flexibility by comparing them to equivalently trained pianists. For both professions, high working memory capacity is necessary for optimal performance, while the attentional demands are typically greater for conductors.

Aims

We hypothesized that conductors would have better overall task performance than pianists in all the attentional tasks, but particularly in divided attention, given the task demands of conducting. We expected WM and attentional performance to be correlated over individuals, and that conductor-pianist differences would be enhanced among the more trained professionals.

We were open to the possibility that the older age of the professionals would reduce the advantage of experience, perhaps resulting in no differences among students and professionals, or potentially resulting in even a larger difference among student conductors vs. pianists.

Method

Conductors and pianists (n = 30; 16 students and 14 professionals) took part in a series of musical working memory and attention tests. Pianists and conductors did not significantly differ in the total number of years of professional musical training, including other instruments (for all participants, M = 19.57, SD = 9.28) or the number of years they have worked in their domain (M = 11.17, SD = 12.45) or age. However, as intended, students and experts differed in all these respects (all $p < .005$).

In order to test for domain-specific capacities in selective and divided attention as well as working (WM) and long-term memory (LTM), a number of musical memory and attention tasks were devised that were based on existing tasks. In particular, we assessed memory spans for auditory and visual pitches and timing durations. Subsequently, in three dichotic attention tasks, participants were asked to detect small pitch and timing deviations from two melodic streams presented (a) separately: baseline, (b) together, while concentrating on only one stream: selective, or (c) together, while concentrating on deviations in both streams simultaneously: divided attention.

Results

Group differences in attentional flexibility were tested by employing signal detection analysis. A 2 x 2 ANCOVA for each of the three attention tasks, with musical Profession and Experience as factors and Age as a covariate, resulted in significant effects for both selective and divided attention in the timing deviation tasks. Conductors showed higher d-prime scores than pianists for timing deviations in the divided attention condition ($p < .005$, $\eta_P{}^2 = .30$). Professionals detected more targets than students in selective attention ($p < .05$, $\eta_P{}^2 = .19$) and divided attention ($p < .005$, $\eta_P{}^2 = .35$). Age as a covariate accounted for some of the variance in the divided attention timing task ($p < .05$, $\eta_P{}^2 = .23$).

Participants were relatively consistent in mastering the working memory tasks, independently of the material to memorize or the recall condition. In other words, those who succeeded in certain tasks were also successful in others

(correlations between tasks range from $r_S = 0.31$ to $r_S = 0.88$). We found no group differences between pianists and conductors for working memory capacity. Regarding the factor Experience, experts had slightly higher visual spans compared to students ($p < .05$, $\eta_P^2 = .18$). Age as a covariate accounted for most of the variance in this model ($p < .05$, $\eta_P^2 = .23$), since removing age resulted in no further differences between students and experts in visual tasks. However, age was not simply correlated to task performance, and higher age did not reduce visual WM span ($r_S = 0.22$, ns.).

Musicians with higher auditory and pitch WM were better in the selective attention task ($p < .01$), whereas divided attention was related to performance in visual musical WM ($p < .01$) and WM timing tests ($p < .05$). Participants' overall reaction time for correct responses in the selective attention condition was related to auditory WM ($p < .05$) and pitch tasks ($p < .05$).

Conductors had more precise long-term memory for timing than pianists ($p < .05$, $\eta_P^2 = .16$), and experts were more precise than students ($p < .05$, $\eta_P^2 = .16$). Age did not influence results.

Conclusions

Whereas conductors did not differ from pianists in baseline tasks and selective attention, they successfully detected more targets in the divided attention timing task. In other words, conductors showed higher flexibility in switching their focus of attention either to a single or two different streams. Conductors were also more consistent in long-term memory for timing, a skill particularly important in their profession. We also found evidence across professional domains for expertise effects such that experts outperformed students in selective and divided attention.

It seems worthwhile to investigate the time course for changes of attentional foci, for instance how quickly experts may switch from one channel to both channels in dichotic listening tasks. They may thus either fully concentrate on one source or, rather than "divide" their attention, be in a state of overall attentional awareness to allow for rapid switching between the streams of information, and then again focus on a stream that needs particular attention. This process may be called "attentional flexibility", as it describes the zooming in and out of the foci of attention and thus exemplifies an extraordinary adaption to the demands of complex and rapidly changing tasks.

Individuals with good attentional capacities had higher working memory spans for a variety of multimodal tests, and those with high WM perceived and processed targets in the selective attention more quickly, providing further evidence for a relationship between WM and attentional flexibility in domain-specific tasks for highly trained individuals. It remains a question for further research as to whether these skills are acquired by training, or required as a prerequisite for their profession.

Keywords

selective attention, divided attention, working memory, expertise, multimodal

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Engagement with performance and burnout among music performance students

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ABSTRACT

Background

Long hours spent practising and performing can take their toll, impairing the psychological and physical well-being of music students and thereby affecting their performance. Of various aspects of well- and ill-being, engagement and burnout, reflecting the attitudes towards music-making, seem to be prime candidates for further study. The interest in engagement stems from 'positive psychology' that centres on human strengths and optimal functioning. Engagement has been defined as a positive state of mind that involves vigour, dedication and absorption (Schaufeli & Bakker, 2004). Research has linked engagement to the lack of physical symptoms (Korunka, Kubicek, Hoonakker, & Schaufeli, 2009) and enhanced job performance (Bakker & Bal, 2010). Burnout is a multidimensional syndrome characterized by emotional exhaustion, devaluation and the sense of reduced accomplishment (Raedeke & Smith, 2001). Burnout has been associated with impaired physical health, musculoskeletal pain (Peterson et al., 2008) and decreased performance (Hillhouse, Adler, & Walters, 2000). In line with research showing differences in engagement and burnout experienced by employees across the world (Taipale, Selander, Anttila, & Nätti, 2011), it seems that students studying in different countries may differ in terms of their music-related well-being. Not much is known about the determinants of engagement and burnout in the context of music education. Basic Psychological Need Theory (BPNT; Deci & Ryan, 2000) has emerged as a useful framework to explain well- and ill-being in work, sport and dance environments. One of the central tenets of BPNT is that satisfaction of basic psychological needs: autonomy, competence and relatedness, affects well-being. Need satisfaction, in turn, is influenced by perceptions of the social environment. Numerous studies have confirmed the importance of competence and social relationships, and, to a lesser extent, autonomy, for optimal development in music. It therefore seems worthwhile studying the associations between need satisfaction, and engagement and burnout in music.

Aims

The study aimed to establish and compare levels of engagement and burnout among performance students at conservatoires in Australia and the UK. Another aim of the study was to test the usefulness of BPNT in explaining engagement and burnout in performance students. In particular, the relationships between perceptions of the social environment (i.e., autonomy and social support from the tutor, social support from other students and competitive atmosphere among students), need satisfaction (autonomy, competence, relatedness with regard to the tutor and relatedness with regard to other students), and engagement and burnout were studied. The study also explored the associations between engagement and burnout, and physical symptoms, musculoskeletal pain and practice strategies.

Method

The data were collected using a questionnaire combining several well-established psychological measures that were first adapted to the context of music. Engagement was captured using the Utrecht Work Engagement Scale - Student Survey (Schaufeli, Martinez, Pinto, Salanova, & Bakker, 2002). Burnout was measured via the Athlete Burnout Questionnaire (Raedeke & Smith, 2001). 146 performance students (N=146) at a single conservatoire in Australia (n=54) and various conservatoires in the UK (n=92) responded to the questionnaire. A series of t-tests and Mann-Whitney U tests were performed to compare the levels of engagement and burnout of students in the UK and Australia. R-Spearman's rho coefficients were computed to establish the strengths of associations between the variables of interest.

Results

While respondents tended to report moderate to high levels of engagement, burnout was rather low in the sample. There were no differences between students in Australia and the UK in terms of total scores on engagement and burnout. Students in Australia displayed higher levels of dedication, while the UK respondents scored higher on reduced accomplishment. Perceptions of the tutor as being socially and autonomy supportive, and social support from other students, correlated moderately to weakly with all need satisfaction. Moderate to weak positive correlations emerged between satisfaction of all needs and engagement. Associations between engagement and need satisfaction were strongest for need for competence. Burnout correlated with the satisfaction of all needs negatively and moderately, revealing the strongest correlations with competence and relatedness with regard to other students. Correlations between engagement and burnout, and practice, were weak or not significant, respectively. Burnout correlated positively and weakly with physical symptoms and musculoskeletal pain.

Conclusions

The sense of competence, and, to a lesser extent, relatedness and autonomy satisfaction may play a role in engagement among performance students. It seems that lack of satisfaction of competence and relatedness with regard to other students may contribute to the development of burnout. Longitudinal

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studies are needed in order to determine the directions of cause in the relationships between engagement and burnout, and need satisfaction, and in order to explore their possible effects on health and practice over time.

Shedding light on the potential determinants of music-related well-being in performance students, the findings of the current study can serve as a basis for advice for music tutors and musical institutions on enhancing engagement and preventing burnout in their students.

Keywords

BPNT, burnout, engagement, conservatoires, well-being

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The effect of music on forgiveness

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ABSTRACT

Background

Forgiveness is defined as a prosocial change in an individual's thoughts or emotions towards a transgressor. Research has shown that emotions have a mediating role in willingness to forgive. Moreover, apologizing increases forgiveness, especially when the transgressor offers a valid justification and emotional indicators of guilt or shame. Music has been shown to affect both emotion and cognitive appraisal of individuals and situations.

Aims

The aim of the present studies was to examine the effect of pleasant and unpleasant music on judgments of the severity of a transgression and willingness to forgive, with and without a justification for the perceived transgression.

Method

In **study 1**, 90 participants (39 males and 51 females, mean age = 24.83) were divided into 3 groups. Participants read a script describing a hi-tech employee who planned to renovate his house, and was promised a bonus by his boss, a promise then denied. Participants then either heard pleasant music, unpleasant music, or no music. Finally, they completed a questionnaire measuring the severity of the event, and willingness to forgive.

In **study 2**, 90 participants (34 males, 56 females) completed the same procedure, but were also given a second text describing the boss's apology and explanation, after hearing the music (or no music in the control group).

Results

In **study 1**, a significant effect for music was found on severity judgments: in both music conditions, the boss's action was evaluated as less grave than in the no-music group. No effect of music was found for forgiveness.

In **study 2**, a significant effect was found both for judgments of severity and for forgiveness: Participants hearing pleasant music judged the case as least severe, followed by the no music group the unpleasant music group. A significant effect was found for forgiveness: Participants hearing pleasant music were most likely to forgive, followed by the no-music group and the unpleasant music group.

Conclusions

Although music does not seem to affect the evaluation and forgiveness of a seemingly unfair act, results suggest it does influence the effect of an explanation of these actions on severity judgment and willingness to forgive.

Keywords

Forgiveness, music, emotion, apology

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Music and patriotism: The effect of "national" and "protest" music on right and left-wing individuals

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ABSTRACT

Background

Patriotism is defined as attachment to and pride in one's country. Along with political orientation and national identity, it is constructed through socialization and is influenced by psychological dispositions. Situational factors increasing mortality salience, or priming, may affect ideological shifts. Patriotism in Israel is generally high, with right-wing individuals scoring higher than left-wing individuals.

Alongside other factors and national artistic traditions, music plays a significant role in creating and maintaining a sense of national identity. It is often used as a means to influence attitudes towards national issues. In this context, two types of music may be distinguished: "national" music, which reinforces a sense of patriotism and group belonging, and "protest" music, which criticizes the state's ideology or practices.

Whereas there are theoretical works dealing with the role of music in the creation of national identity or resistance to policy, as well as studies on the effect of music on cognitive, emotional and behavioral aspects, no empirical studies have been conducted on the situational effect of music on patriotism.

Aims

The aim of the present study was to examine the effect of "national" and "protest" music on patriotism in left and right-wing participants. It was hypothesized that whereas "national" music would increase patriotism for both groups, "protest" music would decrease patriotism in left-wing participants, and increase patriotism in right-wing participants.

Method

96 participants took part in the study (43 males, 53 females, mean age = 29.57). The study was conducted online. Participants completed a political orientation questionnaire, and listened either to 3 "national" songs (n=31), to 3 "protest" songs (n=33), or no music (n=32). They then completed a patriotism questionnaire, and a questionnaire regarding attitudes and reactions to the music.

Results

Based on the political orientation questionnaire, participants were divided into right- and left-wing orientation. A two-way ANOVA was conducted with music (national, protest, no music) and political orientation (left, right) as independent variables, and patriotism and dependent variable. A main effect of political orientation was found, with right-wing participants scoring higher than left-wing participants ($F(1,89) = 52.34$, $p < .001$). No main effect for music was found. An interaction between political orientation and music was found ($F(2,79) = 3.56$, $p = .032$). For right-wing participants, protest music increased patriotism scores compared to the control group. For left-wing participants, the difference was not significant. Several main effects of political orientation and of music were found in reactions to the songs. In addition, several interactions were found between political orientation and music on reactions to the songs. Right-wing participants identified more with the national songs than the protest songs, and considered the protest songs as more political than the national songs. Protest songs increased evaluation of the importance of national cohesion in right-wing participants, and decreased it in left-wing participants.

Conclusions

Beyond its long term influence in constructing national identity, music also has immediate effects on cognitions related to attitudes towards political issues. Given the widespread use of music in propaganda, this study sheds light on the ways in which music can influence the salience of political attitudes. This study is the first to empirically show the effect of different types of music on patriotism.

Keywords

Patriotism, national music, protest music, political orientation