The 10th International Conference on Music Perception and Cognition

I C M P C 10

Abstracts

Edited by **Ken'ichi Miyazaki   Yuzuru Hiraga   Mayumi Adachi**
Yoshitaka Nakajima   Minoru Tsuzaki

ICMPC10 2008
Sapporo
APSCOM 3

25-29 August 2008
Sapporo , Japan

The main venue ● Hokkaido University
The additional venue ● Glass Pyramid "Hidamari" at Moerenuma Park

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Keynotes

Organization Processes in Music Perception

Jun-ichi Abe; Hokkaido University, Japan

K-1

Some sequences of tones are perceived as musical events, i.e., as coherent melodies, whereas others are not. Why is this? Needless to say, listeners' minds are responsible in some way. But how do our brain mechanisms make such distinctions? For listeners — whether they may be music experts (musicians) or novices (non-musicians), and regardless of their musical culture, — two organizational processes are essential for the perception of a stimulus tone sequence as a melody: one process involves metrical organization and the other is a process of tonal organization of a stimulus tone sequence. If metrical organization is successfully carried out in accordance with a listener's metrical schema, the result is that a coherent temporal structure is assigned to a stimulus tone sequence; psychological time units such as "beat" and "meter" are perceived. Likewise, if a tonal organization is successfully executed in accordance with a listener's tonal schema, then a coherent tonal relationship is assigned that relates constituent pitches within a sequence of tones. In turn, this confers a sense of "key" or "tonality" upon the sequence. Conversely, if both of these two kinds of organization are not successfully carried out, then tones would be perceived as a random-like sequence or a jumbled sequence of notes. In this talk, I discuss some general properties of these organization processes in music perception.

Japanese Voices — A Video Archive of Singing Styles and Techniques in the Japanese Language

Ichiro Nakayama; Osaka University of Arts, Japan

K-2

This is an introduction of *Japanese Voices — A Video Archive of Singing Styles and Techniques in the Japanese Language (Nihongo o Uta, Uta, Utau* 日本語を歌・唄・謡う), a DVD set about Japanese vocal music that I recently published. The feature of this archive is that the performers from both traditional, contemporary and western style genres of Japanese song sang a set phrase in their own respective métier. I'd like to give an overview on the characteristics of Japanese vocal music, referring to those scenes from the DVD set.

The Origins of Rhythm in Movement

Laurel J. Trainor; McMaster University, Canada

K-3

We tend to think of music as based in the auditory modality, but we see the movements of musicians, we play our instruments using our sense of touch and proprioception, and we feel the rhythm in our bodies. In a series of studies, we have shown that body movement shapes how we hear rhythm. In particular, moving on every second versus on every third beat of a rhythm pattern with more than one possible metrical interpretation disambiguates the perceived meter. The vestibular system appears to be crucial for this interaction as differential galvanic stimulation of the vestibular nerve alone influences metrical interpretation. Young infants are not able to self-locomote, but they do experience considerable daily correlated multisensory input as parents walk with them and rock them while singing and talking. Movement affects metrical interpretation in infants similarly as in adults, suggesting that the movement and auditory systems wire together at an early age. Furthermore, infants enrolled in music classes for babies and parents that emphasize moving to musical rhythms show an earlier bias for the metrical structures of the rhythms of their culture. This suggests that experience is central in the development of auditory-movement pathways in the brain.

The ICMPC Series, and Some Current Research on Music Perception and Cognition

Diana Deutsch; University of California at San Diego, USA

K-4

This paper is in three main parts. The first part describes the circumstances surrounding the founding of the ICMPC series in the late 1980s, and the first two ICMPC

conferences, which were held in Kyoto and in Los Angeles. The second part describes some recent research by the author and collaborators. The first body of research concerns a new illusion, in which a spoken phrase is perceptually transformed to be heard as song, just through simple repetition. The second body of research concerns absolute pitch. It is argued, based both on published work and also a newly completed study, that exposure to tone language during the critical period for speech strongly influences the capacity to acquire absolute pitch for musical tones. The third body of research concerns a new illusion of pitch circularity, in which this is achieved with a bank of tones that each comprise a full harmonic series. This both extends the theoretical scope of pitch circularity and also has implications for the development of new music. Finally, developments in the field of music perception and cognition since the inception of the ICMPC series are considered.

3PM3-R01 : Young Researcher Award Winners' Papers
Room 1, 17:30 – 19:00 Wednesday 27 August 2008, Oral session

Effect of Expressive Intent, Performer Expertise, and Listener Expertise on the Perception of Artistic Individuality in Organ Performance

Bruno Gingras, Tamara Lagrandeur-Ponce, Bruno L. Giordano, Stephen McAdams; McGill University, Canada

`3PM3-R01-1`

This study investigated the perception of artistic individuality in organ performance. Six organists, three of whom were prize-winners at national competitions, each recorded two "mechanical" and two expressive interpretations of a chorale setting by Scheidt (1587–1654). In a subsequent perception experiment, twenty non-musicians and twenty musicians listened to these recordings and grouped together performances they thought had been played by the same organist. Twenty-eight participants (70%) performed significantly above chance level, demonstrating that most listeners can recognize specific performers even on an instrument with a limited range of expressive parameters such as the organ. There was no significant difference in the performance of musicians and non-musicians. Participants were less likely to group together expressive performances from different performers than mechanical ones. Participants' performance was significantly higher for prize-winning organists than for non-winners, suggesting that the performers' level of expertise is linked to the perception of artistic individuality.

Stimulating Music: Combining Singing with Brain Stimulation to Help Stroke Victims Recover Speech

Bradley W. Vines [1], Andrea C. Norton [2], Gottfried Schlaug [2]; [1] University of British Columbia, Canada; [2] Harvard University, USA

`3PM3-R01-2`

It is strange to think that singing might help a stroke victim speak again, but this is the secret of Melodic Intonation Therapy (MIT), a speech therapy that emphasizes musical aspects of language. We investigated the potential for transcranial Direct Current Stimulation (tDCS) to augment the benefits of MIT for Broca's aphasia patients. tDCS is a non-invasive technique that modulates neural activity. We used tDCS to stimulate the right inferior frontal gyrus, which is thought to contribute to singing, and to recovery from aphasia. The stimulation coincided with an MIT session, conducted by a trained therapist. Participants' language fluency showed greater improvement with real tDCS + MIT, compared to sham tDCS + MIT. These results provide evidence that combining tDCS with MIT may enhance activity in a sensorimotor network for articulation in the right hemisphere, to compensate for damaged left-hemisphere language centers.

5AM1-S01 : APSCOM3 General Meeting & Symposium: The Latest Research Trends in Asia-Pacific Regions
Space 1, 9:15 – 10:45 Friday 29 August 2008, Oral session

The Latest Research Trends in Asia-Pacific Region

Sun-Hee Chang[1], Catherine Stevens[2], Emery Schubert[3], Shin-ichiro Iwamiya[4], Kyungil Kim[5], Qian Zhang[6], Shibin Zhou[7], Eddy Chong[8]; [1]Seoul National University, Korea; [2]University of Western Sydney, Australia; [3]University of New South Wales, Australia; [4]Kyushu University, Japan; [5]Ajou University, Korea; [6]Central Conservatory of Music, China; [7]Capital Normal University, China; [8]Nanyang Technological University, Singapore

APSCOM3

The Symposium is organized as a plenary session for the 3rd triennial International Conference of the Asia-Pacific Society for the Cognitive Sciences of Music (APSCOM3), which is held as a joint meeting with ICMPC10. The purpose of this symposium is to discuss the research trends and progress made in APSCOM member societies since ASPCOM2, which was held in 2005 in Seoul (Korea). In particular, the symposium provides an opportunity for researchers in the Asia-Pacific region to meet one another especially those who are new to ICMPC and ASPCOM meetings. We welcome representatives from the Society for Music Psychology of China (SMPC) who will outline research trends and SMPC activities. SMPC will review the field of music psychology in China evolving in the context of music education curricular reform and explaining its characteristic rapport with the ancient Chinese thoughts of music. SMPC is exploring an international cooperation network to meet their needs caused by the rapid expansion of the field in China. A Singaporean delegate will also join to share his research interests with the society members as an observer. Representatives from the Australian Music & Psychology Society (AMPS), the Japanese Society for Music Perception and Cognition (JSMPC), and the Korean Society for Music Perception and Cognition (KSMPC), will report on current research activities and research groups and future directions within their own society as well as in international communities.

The Construction and Development of Music Psychology in China

Qian Zhang[1], Shibin Zhou[2]; [1]Central Conservatory of Music, China; [2]Capital Normal University, China

5AM1-S01-01

The education of music psychology began along with the introduction of the concept into China. According to the education of music psychology in China in the past 20 years, a system of the education has been founded, master and doctor degrees are offered in some universities. The research fields are enlarging and probing deeply. On the solid foundation of Chinese traditional music-psychological ideas, new technique and achievements are more and more combined to enhance the research level of the subject.

The gap between the education home and aboard exists in the structure of the knowledge, which needs the cooperation of the scholars from all the relative fields and explores the issues in music psychology. There will be a bright future of music psychology education.

Music Perception and Cognition Research in Australia

Catherine Stevens[1], Emery Schubert[2]; [1]University of Western Sydney, Australia; [2]University of New South Wales, Australia

5AM1-S01-02

This paper sketches activities concerning music perception and cognition research in Australia in the three years that have elapsed since the successful APSCOM 2 meeting in Seoul in 2005. We outline activities at society, conference and research group level. The recipients of the AMPS Graduate Student International Conference Travel Support Scheme are noted. The competitive Endeavour International Postgraduate Research Scholarship (EIPRS) scheme is described as a potential source of support for students in the Asia-Pacific region considering undertaking graduate research in Australia.

Research, Activity, and People in Music Perception and Cognition in Korea

Kyungil Kim; Ajou University, Korea
`5AM1-S01-03`
The purpose of this paper is to review the research related to music perception and cognition in Korea. To this end, the past, current, and future of relevant Korean research, activities, and researchers are outlined. Specifically, the research before the creation of the Korean Society of Music Perception and Cognition (KSMPC), the organization of the KSMPC and its activities and research thus far, and, finally, the future directions of the KSMPC are discussed. Introduction of the members to the KSMPC (Tables 1 and 2) provides insight into the research domains and historically representative activities in Korea.

The Japanese Society for Music Perception and Cognition

Shin-ichiro Iwamiya; Kyushu University, Japan
`5AM1-S01-04`
The Japanese Society for Music Perception and Cognition was founded in 1988. Since then, the SMPC has continued its efforts for collaborative exploration and development of this research field. The JSMPC organized the first ICMPC in Kyoto in1989. This paper includes brief introduction of history, activities and future of the JSMPC. As a recent topic of the JSMPC, a special issue of the Journal of Music Perception and Cognition (the official journal of the JSMPC) focused on Sound Design has been published. Now, the JSMPC is to host the tenth ICMPC in Sapporo in 2008.

Music Psychology Research in Singapore: A Report

Eddy Chong; Nanyang Technological University, Singapore
`5AM1-S01-05`
This paper presents the state of research in music psychology in Singapore. A brief history of the two tertiary institutions which could have embarked on this area of research in the last four decades — the period spanning Singapore's independence as a nation — makes clear the reasons for the nascent state of development. The handful of relevant research theses and journal publications are then listed against this historical backdrop.

1PM1-R01 : Symposium 1 : Music and Health: Empirical Investigations and Theoretical Constructs

Room 1, 13:00 – 15:00 Monday 25 August 2007, Oral session

Music and Health: Empirical Investigations and Theoretical Constructs

Laura Mitchell [1], Raymond MacDonald [1], Gianna Cassidy [1], Julie C. De Simone [1], Douglas Lonie [2], Eugenia Costa-Giomi [3]; [1] Glasgow Caledonian University, UK; [2] MRC Social and Public Health Sciences Unit, UK; [3] University of Texas at Austin, USA

SUMMARY-1

Aligned with the growing recognition of the potential benefits of music interventions on heath parameters are considerable advances in research that investigates the benefits of music on various health measures (Wosch and Wigram, 2007). This heightened interest is driven by both developments in research methodology (qualitative and quantitative) and the ever-increasing availability of music in everyday life (Pothoulaki, MacDonald and Flowers, 2006). However, despite this increasing interest there remains much to learn, from a health context, about the processes involved and the potential outcomes of music interventions (Mitchell, MacDonald, Serpell and Knussen, 2007).

This symposium presents a series of empirical research studies relating to the effects of both musical participation and music listening on health parameters. A number of important issues provide overarching themes for this symposium. For example the importance of musical preferences and the complex relationship we have with favourite music is developed in a number of preservations, while real-world experiences of music as a part of everyday activities is also tackled. The symposium also presents both quantitative and qualitative methodologies and mixed methods paradigms in bringing this research forward.

Raymond MacDonald will begin the symposium with a discussion of the key themes and recent literature. Laura Mitchell will discuss the growing literature on music listening for pain relief, and in particular whether cognitive style may be an important individual difference in the efficacy of and reactions to this intervention. Gianna Cassidy will then look at the benefits of music listening on health parameters and experience during interactive game play, comparing physiological measures relating to health and wellbeing when gaming is accompanied by soundtrack music or self-selected music. Julie De Simone will present recent findings in collaboration with the music charity Polyphony on the effects of musical activity on communication and cognitive functioning of dementia sufferers. Douglas Lonie will then discuss his work on the relationship between music listening and emotional health in young adults, which encompasses both psychological and sociological theory and methodology and looks at preference for music seen as 'negative' such as heavy rock.

Eugenia Costa-Giomi will act as discussant for the symposium in bringing together the findings and themes.

The Influence of Cognitive Style on Pain Relief Using Preferred Music

Laura Mitchell, John McDowall, Raymond MacDonald; Glasgow Caledonian University, UK

1PM1-R01-01

A growing body of research has investigated music listening as a non-invasive technique capable of affecting pain, with consistent findings that the person's own choice of music is particularly effective (Mitchell and MacDonald, 2006). Further work is needed, however, to uncover potential individual differences which may aid clinicians in identifying who will benefit the most from this intervention. One significant recent research development is the empathising and systemising quotient (Wakabayashi et al, 2006), two brain types which relate to different cognitive styles; high empathisers can identify and respond well to emotions and thoughts in others, and high systemisers are able to deal easily with abstract, organisational and mechanical systems. This study used experimentally induced pain in 72 healthy volunteers to compare the effects of preferred music and mental arithmetic to control in individuals high in 'empathising' or 'systemising'. A significant interaction was

found between condition and cognitive style, with empathisers tolerating more pain during the music condition than during both other conditions, but no differences in systemisers. Systemisers were further found to rate pain lower in the arithmetic condition than the control, and empathisers to rate their perceived control as higher when listening to music. The findings here suggest that this may be an important individual difference in efficacy of the intervention that may also clarify previous gender differences in the research.

Music and Videogame Play: The Effects of Self-Selected and Experimenter-Selected Music on Performance and Experience

Gianna Cassidy, Raymond MacDonald; Glasgow Caledonian University, UK

`1PM1-R01-02`

The Wii platform presents not only a new form of interactive 'edutainment' for health and wellbeing, but a new platform for musical experience. There is a need to investigate both the nature of our music practices and preferences during gameplay, and the effects of exposure to music on gameplay performance and experience. The study aimed to investigate the effects of exposure to self-selected and experimenter-selected music on Wii game performance and experience. Employing a repeated-measures design, participants completed Wii Star Wars in the presence of experimenter-selected music, self-selected music or game soundtrack, in a counterbalanced order. Two physiological measures (heart-rate and calorific expenditure), three behavioural (pedometer rate, completion time, and performance), and three experience measures (enjoyment and mood state), were obtained. Preliminary results indicate that performance and experience measures were optimal when listening to self-selected music: players scored highest; burned most calories; and experienced greatest enjoyment and positive mood change. However, listening to music, whether self-selected or experiment-selected, resulted in more positive performance and experience measures in comparison to playing without music. The results are discussed in relation to theories of attention-distraction, arousal and affect modification, and our subjective relationship with the musical stimuli. Directions for further research and implications for serious-games design, practitioners, and educationalists are also discussed.

'It Just Makes Me Feel Better': Music and Emotional Health Over the Youth-Adult Transition

Douglas Lonie[1], Patrick West[1], Graeme Wilson[2]; [1]MRC Social and Public Health Sciences Unit, UK; [2]Newcastle University, UK

`1PM1-R01-03`

Much has been written about the salience of music in adolescence for identity formation and socialisation. The aims of the paper are to investigate the emotional health of fans of the three main 'taste groups' identified (Chart, Dance and Rock music) and explore the different uses of music for emotional regulation and wellbeing within these groups. To do this, logistic regressions were carried out on a large scale longitudinal dataset (The West of Scotland Twenty-07 Study). This was followed by semi-structured interviews with 18 participants, designed and analysed using Interpretative Phenomenological Analysis (IPA).

The quantitative analysis showed little variation between taste groups in measures of emotional health suggesting that this does not vary according to music preference. This was corroborated by the qualitative enquiry which highlighted how participants across all taste groups perceived multiple means of using music to aid emotional development and sustain emotional wellbeing throughout the youth-adult transition.

Participants used music for emotional regulation and 'feeling better'. This was not linked to any taste group in particular but instead was practised by participants who indicated a stronger taste for music generally. These results indicate that the process of using music for emotional wellbeing is closely linked to any music preference as opposed to particular music genres or styles.

A Mixed Methods Investigation into the Effects of Music on Individuals with Dementia

Julie C. De Simone, Raymond MacDonald; Glasgow Caledonian University, UK

`1PM1-R01-04`

This is a joint study between Glasgow Caledonian University and a music charity, *Polyphony*, who provide access to musical activities in a large psychiatric hospital in the west of Glasgow, Scotland. This paper investigates the use of music as an intervention in the treatment of individuals with dementia. An experimental design was utilised with 20 participants in an experimental group and 20 participants in a control groups. Cognitive function and communication skills were assessed. Semi structured interviews with the participants' carers which were also used and analysed using thematic analysis. Quantitative analysis utilising ANOVAs investigated the effects of music upon the dependant measures. The qualitative data was analysed using thematic analysis. This analysis reported a number of key themes such as enjoyment of sessions, improvement in social interaction and enhanced self esteem. This research highlights the benefits of music intervention which has the potential to improve quality of life. Future research should seek to uncover in more detail the process and outcomes of these types of intervention.

Researching the Relationship Between Music and Health: An Overview of Published Research and Key Themes

Raymond MacDonald, Laura Mitchell; Glasgow Caledonian University, UK

`1PM1-R01-05`

This paper will overview key issues for researchers interested in investigating the relationship between music and heath. It will provide an overview and critical evaluation of published research in the area highlighting the contrasting ways in which music and health can be studied. Different approaches will be presented with an emphasis on comparing and contrasting the ways in which quantitative and qualitative methodologies are utilised. For example, the paper will present studies that utilise focus group research (eg music education and health) and semi structured interview research (eg the effects of musical participation by patients with cancer). These will be compared with research that involves questionnaire designs (eg patterns of music listening and health) and with studies that have an experimental approach (e.g. the effects of listening to music while undergoing kidney dialysis treatment). Theories of musical identities and musical communication will be used to suggest psychological mechanisms by which music may have health benefits. The role of musical structure, cultural variables and the influence of personal musical preference will be discussed. The contrasting but related contributions of music therapy, community music and music education to our understanding of music and health will also be presented.

1PM2-R01 : Symposium 2 : Investigating Musical Performance: Aspects of Self in Advanced Musical Learning Across Different Musical Genres

Room 1, 15:15 – 17:15 Monday 25 August 2007, Oral session

Investigating Musical Performance: Aspects of Self in Advanced Musical Learning Across Different Musical Genres

Graham Frederick Welch [1], Andrea Creech [1], Ioulia Papageorgi [1], Margaret S. Barrett [2], Raymond MacDonald [3]; [1]IOE University of London, UK; [2]University of Queensland, Australia; [3]Glasgow Caledonian University, UK

`SUMMARY-2`

The purpose of this symposium is to present new evidence relating to teaching, learning and performance in diverse musical genres within higher education contexts that draws on data from a two-year research project funded by the UK's Economic and Social Research Council under their Teaching and Learning Research Programme (TLRP) and with Professor Graham Welch as the Principal Investigator. The presentation will also draw on an Australian Research Council Linkage grant 'Mapping the Novice-expert Continuum in Composing and Performing' with the Universities of Tasmania and Brisbane (led by Professor Margaret Barrett with Professor Graham Welch as the co-researcher).

The *Investigating Musical Performance [IMP]: Comparative Studies in Advanced Musical Learning* research project (http://www.tlrp.org/proj/Welch.html) is a two-year comparative study of advanced musical performance (2006–2008). The project has

been devised to investigate how classical, popular, jazz and Scottish traditional musicians deepen and develop their learning about performance in undergraduate, postgraduate and wider music community contexts. It is conceived as a multi-site, multi-methods research project that draws equally on the strengths and expertise of the four higher education partners (the Institute of Education, University of London; University of York; Leeds College of Music; and the Royal Scottish Academy of Music and Drama, Glasgow).

Included in the research methodology is a specially-devised web-based question-naire, linked electronically to a 623-field database, that provides a comprehensive, short-term, longitudinal comparison of participants (N= 244) concerning their backgrounds, attitudes and approaches to advanced performance learning over a twelve month period. This set of data is complimented by interviews, individual case studies, focus groups and digital video analyses of studio-based instrumental lessons.

Analyses of quantitative and qualitative data have produced new evidence relating to the processes that underpin teaching and learning within higher education music contexts. The motivation for hosting this two-hour symposium is that it provides a unique opportunity to bring together evidence relating to the concept of self in the teaching and learning of different musical genres - an aspect of higher education learning in music that remains relatively under-researched. It is anticipated the discussion will explore ways in which higher education music curricula should take account of how the aspects of self and genre interact and impact on learning, both in the UK and in Australia.

Specific research foci to be presented and discussed include: (a) the ways in which learning in music is mediated through gender and musical genre by self concept; (b) a longitudinal comparison of the attitudes and perceptions of advanced musical learners towards ideal and self-perceived musical skills; and (c) the relationship between musical self-efficacy and time, effort, perceived relevance and pleasure in musical activities amongst undergraduate music students. Professor Barrett will report on the perceptions of twenty eminent composers who teach composition in higher education settings concerning the learning and teaching strategies that they employ and the environmental conditions and factors that support these strategies.

Investigating Musical Performance: A Longitudinal Comparison of Advanced Musical Learners' Attitudes and Perceptions Towards Musical Skills

Ioulia Papageorgi, Andrea Creech, Graham Frederick Welch; IOE University of London, UK
`1PM2-R01-01`

This paper focuses on a twelve-month longitudinal comparison of 87 advanced musicians' attitudes regarding musical skills. Participants (undergraduate and portfolio career musicians) completed a specially-devised questionnaire investigating their backgrounds, attitudes and approaches to performance learning on two occasions, to capture potential changes in attitudes over time. Responses to questions focusing on (a) perceptions regarding the importance of particular musical skills in becoming a successful musician ('ideal' musical skills) and (b) self-assessment of musical skills ('perceived' musical skills) were analysed in SPSS. Findings suggest that, over the course of twelve months, musicians lowered their ratings of 'ideal' musical skills, whilst self-perceived skill ratings did not significantly change. A previously observed gap between musicians' 'ideal' and 'perceived' level of skill decreased, potentially due to gaining more experience and perhaps more realism about what is possible 'ideally'. Significant differences in attitudes were observed in relation to gender, but not musical performance genre or professional status. Female musicians appeared more likely to place unreasonable expectations upon themselves. As undergraduate musicians came towards the end of their studies, their attitudes seemed to converge with those of established professional musicians. Gender, musical genre and profes-sional status interacted to influence musicians' attitudes in a variety of ways.

Subjective Values and Musical Self-Efficacy: The Relationship Between Musical Self-Efficacy and Time, Effort, Perceived Relevance and Pleasure in Musical Activities Amongst Undergraduate Music Students

Andrea Creech, Ioulia Papageorgi, Graham Frederick Welch; IOE University of London, UK
`1PM2-R01-02`

Although musical self-efficacy has been found to play an important role in the development of higher education music students, an under-researched area is the relationship between musical self-efficacy and subjective values such as enjoyment of musical activities, perceived importance or usefulness of musical activities and the perceived time/effort cost of engaging in musical activities. This paper first addresses the question of whether the perceived relevance, time and effort expended and pleasure experienced in musical activities changed over time for music undergraduates. Secondly, this paper tests the hypothesis that these variables would account for variability in musical self-efficacy of the students. Fifty-nine music undergraduates in the UK (encompassing the four musical genres noted above) were surveyed at time 1 and again at time 2, 12 months later. Likert scales measured musical self-efficacy as well as perceived relevance, effort required and pleasure experienced in musical activities. A significant decrease in the perceived relevance and pleasure in practising alone was found, while an increase in pleasure experienced in mental practice was found. Multiple regressions revealed that pleasure in musical activities was the only predictor to account for significant variability in musical self-efficacy. The evidence presented here points to future research that probes the notion of pleasure in musical activities and how this may be capitalized on in order to maximize opportunities for enhancing musical development.

Musical Self, Genre, and Gender as Factors in Higher Education Learning in Music

Graham Frederick Welch, Ioulia Papageorgi, Andrea Creech; IOE University of London, UK

`1PM2-R01-03`

Educational and psychological research suggests that gender and musical genre can influence musical learning and the development of musical identities, particularly during adolescence. However, there are few studies concerning the possible impact of gender and musical genre on higher education (HE) musical learning. A two-year comparative study, funded under the ESRC's Teaching and Learning Research Programme (TLRP), investigated the effect of musicians' gender and chosen musical performance genre (Western classical, jazz, popular, or Scottish traditional music) on undergraduate and postgraduate (career-based) learning. Data were gathered through a web-based survey of participants (n=244) drawn from four HE institutions (HEIs) in Glasgow, York, Leeds and London and the wider workplace, supplemented by semi-structured case study interview data from a sub-set (n=27). Statistical and qualitative analyses indicate that gender and genre can impact individually on aspects of participants' psychological and socio-psychological make-up and attitudes to learning. However, there was no evidence any major interaction between genre and gender in the data. Also, irrespective of musical genre, skilled musicians had many aspects in common in terms of their core musical identities and behaviours, implying that the requirements for highly skilled musical performance can transcend particular group characteristics.

Eminence Lessons: Eminent Composers' Perceptions of Learning and Teaching Practices in Music Composition

Margaret S. Barrett; University of Queensland, Australia

`1PM2-R01-04`

The phenomenon of music composition learning and teaching has been the focus of considerable inquiry in educational and psychological research. Much of this inquiry has examined learning and teaching practices in school settings where music educators work with novice student composers. Less research has examined the learning and teaching practices of eminent composers working with experienced student composers. Eminence studies provide insights into the beliefs, values, processes and practices of eminent leaders in a domain of practice. This project employed life-history interview to examine the perceptions of 20 eminent composers who teach composition in higher education settings concerning the learning and teaching strategies they employ and the environmental conditions and factors that support these strategies. Findings suggest that composition teaching is individualistic, genre-specific, and shaped by composers' biographies and experience of learning and teaching as student and educator. Whilst all composers valued their learning and teaching experiences, their capacity to reflect on this, and develop individualised strategies for students was related to their experience in teacher education. These findings hold implications for the ways in which student composers in the higher education setting are prepared for their professional lives, and for the professional learning needs of higher education composition academics.

2AM1-R01 : Symposium 3 : Applying Music Psychology

Room 1, 8:30–10:30 Tuesday 26 August 2008, Oral session

Applying Music Psychology

David J. Hargreaves[1], Raymond MacDonald[2], Graeme Wilson[3], Hiromichi Mito[4], Adam Ockelford[1], Scott D. Lipscomb[5];
[1]Roehampton University, UK; [2]Glasgow Caledonian University, UK; [3]Newcastle University, UK; [4]Miyagi University of Education, Japan; [5]University of Minnesota, USA

SUMMARY-3

The digital revolution gave rise to the widespread availability of relatively cheap and portable music listening and recording equipment, which meant that a considerable proportion of the world's population now has access to virtually any music in many listening situations. More recent developments have seen music download services overtaking CD sales, and software packages which enable anyone to compose and transform music relatively easily. This has changed the ways we create and use music in everyday life, and to the study of its applications in areas including health care, education, consumer behaviour, leisure and the media. This newly-emerging field of study has recently been surveyed in The Social and Applied Psychology of Music, by Adrian North and David Hargreaves (Oxford UP, 2008).

The symposium aims to explain the historical context of applied music psychology within the discipline as a whole, and to outline its scope and main features.

The opening position paper by David Hargreaves outlines the historical context and scope of applied music psychology. It outlines the main areas of application, as well as some of the theoretical questions which arise. Each of the next three papers illustrates a different aspect of applied music psychology. Raymond MacDonald and Graham Wilson present some findings on musical identities in improvising musicians which emerge from their interviews with 10 improvising musicians from varied backgrounds, analysed using discursive psychological methods. Hiromichi Mito discusses some empirical studies which focus on the process of musical learning in informal settings, with an emphasis on how people can acquire various kinds of musical skill through everyday experiences. His research shows that young Japanese non-musicians can show very high levels of cognitive musical skill, and can outperform musicians with abundant experience in both formal musical training and daily musical activities on certain tasks. Finally, Adam Ockelford discusses the findings of research into the musical engagement of children with complex needs, and presents a model of musical development that synthesises (a) classroom observations, (b) the findings of psychological research into early music development in able-bodied children, and (c) a theory of music cognition.

Music not only fulfils many important roles in society, but has equally important cognitive, social and emotional functions for the individual. Applied music psychology is beginning to describe and explain these functions in a widening variety of real life contexts, such those illustrated in this symposium.

Learning Musical Skill Through Everyday Musical Activities

Hiromichi Mito; Miyagi University of Education, Japan

2AM1-R01-01

The purpose of the present study is to show the role of everyday musical activity in the acquisition of musical skills, and is based on the premise that people without formal musical training can acquire a high level of musical skills through exposure to everyday musical activities. The present study begins with the discussion of some studies from my own doctoral research which focus on the process of musical learning in informal settings. From a detailed analysis of research in music education, anthropology and ethnography, it became clear that people can acquire various kinds of musical skill through everyday experiences, and the discussion then goes on to examine some psychological studies which have been providing empirical evidence to show that various kinds of cognitive musical skills can be acquired without formal training. I describe some of my own experimental studies of the cognitive musical skills of young Japanese people, in which non-musician participants showed extremely high level of cognitive musical skill. It was especially surprising in these studies that even the musician participants who had abundant experience in both formal musical training and daily musical activities could not perform as well as

the non-musician participants. An important implication of this study is that young participants' daily musical leisure activities function, on a high level, as musical training, even though the participants may have no conscious awareness of this process.

Musical Identities in Improvising Musicians

Raymond MacDonald [1], Graeme Wilson [2]; [1]Glasgow Caledonian University, UK; [2]Newcastle University, UK

`2AM1-R01-02`

There is significant interest in improvisation and how this universal but under-researched musical activity is conceptualised and realised in contemporary practice. Our previous work has highlighted how professional jazz musicians talk about improvisation and how these discourses shape musical identities, definitions of jazz music and perceptions of lifestyle. In particular, a mastery repertoire prioritises instrumental virtuosity as a key feature of improvisatory practices while the mystery repertoire prioritises more inspirational, instinctual or 'soulful' understandings. However, while improvisation is often seen as the preserve of elite jazz musicians there is significant improvisational activity around the world by musicians who do not come from a jazz background and there is an urgent need to understand how these musicians utilise and talk about improvisational practices. This paper utilises discourse analysis to investigate how ten improvising musicians negotiate and maintain identities. Results highlight how participants used psychological constructs (eg flow) to describe successful improvisation across the very wide range of improvisational practices they describe. The findings are discussed in relation to discursive psychology, applied psychological research and research on the views of musicians and contemporary conceptualisations of improvisation. This paper highlights how applied psychological research in the form of discourse analysis can further our knowledge of musical identities and improvisational practices. The fundamental relationship between talking about music and performing music, and the importance of identity negotiations when improvising together, are highlighted.

Towards a Music Curriculum for Children with Complex Needs

Adam Ockelford; Roehampton University, UK

`2AM1-R01-03`

The aim of the research project that is reported here has been to provide an evidence-based model of musical development in children with complex needs, with the objective of providing teachers with an interactive software package for assessing and recording their pupils' achievements and progress, and to offer a curriculum framework and materials. Three sources of evidence have been used to build up the model of musical development: observations of children with complex needs, made by practitioners and members of the research team; the findings of the last three decades of psychological research into the early musical development of able-bodied children; and the 'zygonic' theory of music-structural cognition developed by Adam Ockelford in the last ten years. The model has been developed through an iterative process, as systematic observations have led to hypothesis-building - theories that have then been tested by practitioners in the classroom. The results indicate that the musical development of children with complex needs can usefully be modelled in six levels across three domains: 'reactive', 'proactive' and 'interactive'. Each sector is itself divided into four elements to provide the level of detail needed for teachers to make practical use of the material. The research is ongoing, and is currently in the phase of software development mentioned above.

Music Psychology: Developments and Applications

David J. Hargreaves; Roehampton University, UK

`2AM1-R01-04`

Music psychology has moved from a predominance of psychometrics in the 1960s, to an emphasis on cognitive psychology and the study of classical music in the 1980s, which accompanied the emergence of sub-disciplines including the developmental and social psychologies of music. We are now seeing a new emphasis on the applications of psychology in areas including health care, education, consumer behaviour, leisure and the media. This paper outlines the historical context of applied music psychology within the discipline as a whole, and outlines its scope and main features. The paper describes some of the main cognitive and learning functions that music can fulfil for the individual, which include the promotion of artistic and performance skills, of creativity and improvisation, memory, problem solving and reasoning, and

other potential scholastic gains. It also reviews some of music's main social and emotional functions, which include emotional communication, mood regulation, aesthetic appreciation, entertainment, teamwork and co-operation, and moral and spiritual development. It is argued that the understanding of these functions as they operate in everyday life contexts will become a primary task of music psychology, and that this will requite a much greater emphasis on practical implications, and an increasing use of naturalistic methodologies.

2PM1-R01 : Symposium 4 (Invited) : Absolute Pitch and its Implications for Music Perception and Cognition

Room 1, 13:30 – 15:30 Tuesday 26 August 2008, Oral session

Absolute Pitch and Its Implications for Music Perception and Cognition

Ken'ichi Miyazaki[1], Andrzej Rakowski[2], Piotr Rogowski[2], Sylwia Makomaska[3], Elizabeth W. Marvin[4], Elissa L. Newport[4], Sandra E. Trehub[5], David Huron[6], Carol L. Krumhansl[7]; [1]Niigata University, Japan; [2]Fryderyk Chopin University of Music, Poland; [3]Warsaw University, Poland; [4]University of Rochester, USA; [5]University of Toronto at Mississauga, Canada; [6]Ohio State University, USA; [7]Cornell University, USA

SUMMARY-4

Absolute pitch (AP), a faculty to identify musical pitch categories of individual tones without any context, is one of remarkable auditory skills associated with music and has drawn a great deal of interest of researchers. Research on AP has a long history from the early period of scientific psychology, but previous research on AP had rather limited perspectives, mainly focusing on aspects of AP as a musical talent and marvelous performance of its possessors, partially because AP possessors were believed to be extremely rare in the general population. During the recent few decades, however, AP has been studied in a wider range of perspectives, and a growing body of research has revealed perceptual and cognitive aspects of AP more in detail, and not only AP per se but several related phenomena have drawn wider interest of researchers in cognitive science, neuroscience, music education, and behavioral genetics. Recent studies have extended the scope of AP and raised several controversial issues including the possible association between AP and language — particularly an assumed relationship between AP and tone languages, the existence of the sensitive period for AP, learnability of AP, various types of implicit AP, and genetic basis of AP. These lines of research on AP from multidisciplinary perspectives are expected to converge on a consistent model for understanding human mind. In this symposium, four distinguished presenters from different perspectives talk about their insightful ideas about the nature of AP and related phenomena as well as findings of their experiments.

Absolute Pitch as a Measuring Device in Psychoacoustic Experiments

Andrzej Rakowski[1], Piotr Rogowski[1], Sylwia Makomaska[2]; [1]Fryderyk Chopin University of Music, Poland; [2]Warsaw University, Poland

2PM1-R01-01

Absolute pitch (AP) is a unique feature of the musical pitch memory. The possessors of full AP (several percent of the population of musicians) preserve in their long-term auditory memory the pitch standards of 12 within-octave values of musical pitch (chromas).

Two experiments concerning absolute pitch have been presented. In the first one pitch strength of short pure-tone pulses containing a limited number of vibration periods, was estimated as a proportion of correct chroma identifications by expert AP possessors. It was found that the duration time of a tone pulse, more than the number of vibration periods contained in it, determine the tone pulse's pitch strength.

Second experiment concerned estimations with the method of chroma identification of pitch strength in residual tones with missing fundamental and spectrum composed of 11 harmonics located at various parts of the harmonic series. The higher number of lowest harmonic of this band-limited spectrum, the more difficult to perceive the

virtual pitch of the tone's missing fundamental. Experimental results were compared with those obtained with the method of musical interval identification (Houtsma & Smurzynski, 1990).

Additional experiment concerned finding the frequency range where AP is fully effective. This range appeared to spread from third through seventh octave.

Statistical Learning in Language and Music: Absolute Pitch Without Labeling

Elizabeth W. Marvin, Elissa L. Newport; University of Rochester, USA
2PM1-R01-02

Absolute pitch (AP) is typically defined as the ability to identify or produce a musical pitch without access to an external reference tone. By this definition, pitches must be named by some standard, and the incidence of AP in the general population is estimated to be quite low (e.g., 1 in 10,000). Recent research has shown that pitch memory is more wide-spread if the labeling requirement is removed. We have developed a test of AP, based on statistical-learning research in language acquisition, which tests pitch memory after a familiarization phase but does not require labeling. Our results demonstrate a robust ability of listeners to learn and remember three-note patterns across four participant groups (n=44): AP (professional) musicians, non-AP musicians, amateur musicians, and nonmusicians. When listeners are asked to distinguish between learned pitch patterns and their transpositions, performance in all four groups is above chance (in accord with other recent studies). Further, the test discriminates reliably between AP musicians and non-AP musicians, and correlates well with traditional pitch naming tests for those who can name pitches. This allows us to test those without musical training. We discuss results for each group in light of current theories of pitch memory. Of particular interest are three nonmusicians whose scores place them well within the range of AP musicians' performance.

Developmental Perspectives on Pitch Memory

Sandra E. Trehub; University of Toronto at Mississauga, Canada
2PM1-R01-03

We examined pitch memory in children of different ages, cultures, and language backgrounds. Instead of using isolated pitches, as in typical AP studies, we used familiar music. In Study 1, Canadian 5- to 10-year-olds and Japanese 5- to 6-year-olds were required to distinguish the original versions of familiar TV theme songs from foils that were pitch-shifted by one semitone. Older children performed better than younger children, and Japanese children performed better than same-age Canadian children. In Study 2, 9- to 12-year-old children of Asian (Chinese) or non-Asian (European) heritage performed a similar task. Some Asian children spoke a tone language in addition to English; others were monolingual English speakers. Age, heritage (Asian, European), and tone-language use had no effect on memory for pitch level. These findings disconfirm the view that AP processing is superior in younger than in older children. They also disconfirm the reported contributions of genetic factors to cross-cultural differences in pitch memory. The absence of pitch memory differences between tone-language users and non-users in Study 2 makes it unlikely that language factors contributed to Japanese children's enhanced performance in Study 1. Instead, early note-naming and key-naming opportunities are likely to be responsible for the observed differences.

On the Mental Representation of Pitch: Lessons from Absolute Pitch

David Huron; Ohio State University, USA
2PM1-R01-04

How does the auditory system represent music-related percepts such as pitch? The extant research suggests that multiple representations exist concurrently in the auditory system, and that these representations are shaped by the auditory environment during development. These observations are consistent with theories of competitive representations, such as Edelman's "neural Darwinist" approach. Following Huron (2006), it is suggested that the difference in predictive accuracy for different representations provides the feedback mechanism by which competing representations are selected. Representations that perform poorly in predicting future sounds atrophy. Repercussions for cognitive modeling of music are briefly discussed.

2PM2-R01 : Symposium 5 : Musical Dynamics as Adaptive, Flexible Behavior: The Emergence of Meaning and Social Life

Room 1, 15:45 – 17:45 Tuesday 26 August 2008, Oral session

Musical Dynamics as Adaptive, Flexible Behavior: The Emergence of Meaning and Social Life

Patricia M. Gray [1], Edward W. Large [2], Paul J. Thibault [3], William Southworth Greaves [4], James D. Benson [4], Laurel J. Trainor [5], Ian Cross [6]; [1]University of North Carolina at Greensboro, USA; [2]Florida Atlantic University, USA; [3]University of Agder, Norway; [4]York University, Canada; [5]McMaster University, Canada; [6]University of Cambridge, UK

SUMMARY-5

The contributors to this Panel will discuss the question of whether music-making with its underlying concomitant sound and time dynamics is uniquely human.

Rhythmic Analysis of Musical Interactions Between Bonobo and Human

Edward W. Large [1], Marc J. Velasco [1], Patricia M. Gray [2]; [1]Florida Atlantic University, USA; [2]University of North Carolina at Greensboro, USA

2PM2-R01-01

Synchronization of rhythmic communication signals has been observed in insects and amphibians. While such behavior is rare among higher animals, synchronous chorusing may exist among bonobos. To our knowledge however, non-human primates have never been reported to spontaneously entrain with rhythmic sounds, and we are aware of no successful attempts to train them to do so. Thus, our goal was to establish whether three language-capable bonobos were able to entrain to auditory stimuli during musical interactions with a human. We analyzed MIDI recordings of the musical interactions, which took place over a three day period. During these interactions, a bonobo played "chords" on a MIDI keyboard while interacting with the musician, whom s/he could see and hear playing on a separate MIDI keyboard. Thirty-seven episodes of rhythmic interaction were identified. Within each, descriptors of rhythmicity and entrainment were computed, including instantaneous tempo and phase of bonobo events relative to human events. In about half of the rhythmic interactions, attunement of tempo was observed, and in just under half of these episodes, statistical evidence of phase entrainment was found. Our analysis provides evidence of meaningful rhythmic interaction between a non-human primate and a human in a musical context.

Musicking and Culture Creation: Sound and Time as Agents of Social Cohesion

Patricia M. Gray, Ryan Daniels; University of North Carolina at Greensboro, USA

2PM2-R01-02

The ubiquity of music-making throughout past and present human cultures, combined with recent research revealing a suite of musical faculties present at birth in normal humans suggest a deep evolutionary role for the perception and manipulation of sound and time. Just as the primary focus for spoken language lies not in its concepts or precepts but in the manipulations of sound and time that convey meaning, so it is with music-making (musicking). Musicking is often spontaneous and part of a natural and organic outcome of a social process. Participation in the group's manipulation of sound and time through musicking is a central element of citizenship in the group and of the group's cohesiveness. From this perspective, musicking is transformed into a process of social cohesion. Because musicking rides on rhythmic synchrony, a communicative interaction where a coupling between brains can affect each other's internal states, and because this interactional synchrony is basic to musicking, spoken language, and to other collective dynamics, new research with a group of bonobo apes (*Pan paniscus*) who demonstrate similar capacities

suggests these capacities may have existed in a common ancestor thereby offering increased resources for social cohesion earlier in the evolutionary record.

Norms, Co-Constructed Body Dynamics, and Interaction in Bonobos and Humans

Paul J. Thibault; University of Agder, Norway

`2PM2-R01-03`

This presentation will examine the centrality of micro-temporal bodily dynamics in bonobo-human interactions in a joint Pan-human cultural environment (Savage-Rumbaugh et al 1998). How do the micro-temporal interactional dynamics of bodies effect coordination relations among agents (bonobo and/or human)? How are these dynamical processes of bodies-in-interaction connected to norms and higher-scalar cultural and historical constraints? Our brains and bodies tune into and exploit these dynamics in ways that connect experience to normative cultural patterns and values, which exercise their own constraints on these same dynamics. Body dynamics can transform cognition, selfhood, and social reality. This view challenges the traditional idea of language as a code, which treats the brain as a processor of symbolic inputs and outputs. Instead, co-constructed body dynamics themselves have causal and cognitive powers. Hominids are influenced by and respond to these dynamics in micro-time. Hominids (e.g. bonobos and humans) exploit pitch, rhythm, cadence, tempo, duration, loudness and other aspects of vocalizations as well as facial and gestural activities. The term 'micro-temporal body dynamics' refers to the very fast, small-scale bodily processes involved in vocalizing, eye movements, rhythm, tone, gesture, voice quality, and much more.

Musical Representation by a Bonobo Resulting from the Assimilation of Meaning Through Bonobo-Human Dialogic Interaction

James D. Benson, William Southworth Greaves, Ashley Watkins; York University, Canada

`2PM2-R01-04`

The data for this study consists of a 30 minute interaction between the bonobo Panbanisha, the musician Peter Gabriel, and the primatologist Sue Savage-Rumbaugh: a dialogue between the three participants, interspersed with interactive song improvisations on an electronic keyboard by Panbanisha. There are six iterations of a speech genre, with the structure *song-title negotiation ˆ acceptance ˆ song production ˆ evaluation*. Panbanisha improvises five different songs in the six conversations: the 'orange and banana song', the 'lookout point song', the 'car song', the 'banana song', and the 'grooming song'. 'Groom' was originally proposed by Panbanisha in the second conversation, but no song was produced. During the course of the conversations, Sue mediates Panbanisha's song production by re-contextualizing Panbanisha's song-titles as activities and events in the past and future, such that the 'lookout point song' becomes the 'yesterday song', the 'car song' the 'tomorrow song', and the 'banana song' the 'later song'. In the process, Sue re-contextualizes the 'grooming song' as a 'now' song. The 'grooming song' with its focus on the here and now is the culmination of the preceding discourse, and the result is an expansion of Panbanisha's musical assimilation in the most aesthetically pleasing of the five songs, as indicated by the extended positive *evaluation* by Panbanisha, Sue and Peter. A linguistic methodology for the analysis of casual conversation is used to show how the assimilation of meaning through flexible dialogic interaction with Sue is the scaffolding for Panbanisha's assimilation of musical meaning in her musical interaction with Peter.

3AM1-R01 : Symposium 6 : Aesthetic Evaluation and Cognitive Classification of Music in Experts and Laymen: Behavioral and Electrophysiological Data

Room 1, 8:30 – 10:30 Wednesday 27 August 2008, Oral session

Aesthetic Evaluation and Cognitive Classification of Music in Experts and Laymen — Behavioral and Electrophysiological Data

Elvira Brattico[1], Sirke Nieminen[1], Kjetil Falkenberg Hansen[2], Mira Müller[3], Tuomas Eerola[4], David J. Hargreaves[5]; [1]University of Helsinki, Finland; [2]KTH, Sweden; [3]University of Leipzig, Germany; [4]University of Jyväskylä, Finland; [5]Roehampton University, UK

SUMMARY-6

Subjective processes aimed at aesthetic or cognitive evaluation of music are an important, although relatively neglected, aspect of music listening. Those processes occur without any instruction since, for instance, listeners involuntarily classify music as belonging to a certain style or as mismatching stylistic expectations. Expertise with music and musical concepts refines those cognitive and aesthetic evaluative processes leading to the usage of fine-grained or even novel categories by music experts. In this symposium, the interaction between expertise and subjective processes related to music classification and evaluation is studied from an original perspective. In the first talk by S. Nieminen & E. Istok, behavioral data will explore how aesthetic and emotional concepts of music develop from childhood to adulthood. This talk provides conclusions on the similarity of musical concepts applicable to Western tonal music in individuals with varying degrees of expertise and at different ages. The second talk by K. Hansen & R. Bresin presents contrasting behavioral findings showing how expertise with a special musical genre, such as DJ scratching, resulted in conceptual musical structures different from the knowledge repertoire of individuals exposed to the Western tonal music genre. The third and fourth talks will then reports attempts at finding neural correlates of subjective judgments and classification of music. In particular, the third talk by E. Brattico deals with brain oscillatory responses of orchestral musicians possessing a highly refined musical knowledge, enabling them to correctly classify the style of even 750-ms musical excerpts of the classical genre. The final talk by Mueller, L. Hoefel, E. Brattico & T. Jacobsen will illustrate how evaluative and descriptive judgments of musical passages modulate the time-locked brain responses and the correspondent role of formal musical instructions.

Verbal Description of DJ Recordings

Kjetil Falkenberg Hansen, Roberto Bresin; KTH, Sweden

3AM1-R01-01

In a recent pilot study, DJs were asked to perform the same composition using different intended emotional expression (happiness, sadness etc). In a successive test, these intentions could not be matched by listeners' judgement. One possible explanation is that DJs have a different vocabulary when describing expressivity in their performances. We designed an experiment to understand how DJs and listeners describe the music. The experiment was aimed at identifying a set of descriptors used mainly with scratch music, but possibly also with other genres. In a web questionnaire, subjects were presented with sound stimuli from scratch music recordings. Each participant described the music with words, phrases and terms in a free labelling task. The resulting list of responses was analyzed in several steps and condensed to a set of about 10 labels. Important differences were found between describing scratch music and other Western genres such as pop, jazz or classical music. For instance, labels such as cocky, cool, amusement and skilled were common. These specific labels seem mediated from the characteristic hip-hop culture. The experiment offered some explanation to the problem of verbally describing expressive scratch music. The set of labels found can be used for further experiments, for example when instructing DJs in performances.

The Development of Aesthetic Responses to Music and Their Conceptual Basis

Sirke Nieminen, Eva Istók, Elvira Brattico, Mari Tervaniemi; University of Helsinki, Finland

`3AM1-R01-02`

Aesthetic experiences are multidimensional in their nature and include both cognitive and affective responses. In our study, the developmental aspects of aesthetic and emotional responses to music were investigated. While listening to musical pieces (major, minor, atonal), our participants (six-to nine-year-old children) were asked to rate the pieces according to the beautiful-ugly, the like-dislike and the happy-sad dimensions by using a special, child-adapted method. Results revealed the major piece to be mostly considered as beautiful, while none of the pieces was rated as ugly. The children generally liked the major piece best, the atonal piece second best, and the minor piece least. All age groups rated the major piece as happy, but only nine-year-olds rated the pieces clearly either happy or sad. In addition to the different kinds of evaluative ratings, the children were asked to describe the pieces by giving them appropriate titles. None of the titles contained the word ugly, while beautiful occurred in several titles. These results confirm the results of the study investigating the conceptual basis of the aesthetic value of music in adults. Our study suggests the presence of aesthetic responses to music to be associated with the concept of beauty already in school-aged children.

The Electrophysiology of Aesthetic Music Processing: Comparing Music Experts with Laymen

Mira Müller[1], Lea Höfel[1], Elvira Brattico[2], Thomas Jacobsen[1]; [1]University of Leipzig, Germany; [2]University of Helsinki, Finland

`3AM1-R01-03`

This study augments prior findings of influence of music expertise on music processing by investigating whether music experts and laymen differ with regard to evaluative aesthetic processing of musical sequences. 16 music experts and 16 music laymen judged the aesthetic value (evaluative task) as well as the harmonic correctness (descriptive task) of musical chord sequences consisting of five chords with the ending chord sounding either incorrect, ambiguous or correct in the harmonic context established by the preceding four chords. Electrophysiological recordings were analysed. ERP data indicates differences in processing of the evaluative vs. descriptive judgements, i.e., a late and widespread positivity was observed that was significantly larger for aesthetic compared to correctness judgements. This difference, however, was equally pronounced for experts and laymen. Additionally, established ERP effects reflecting the processing of harmonic rule violation were investigated. Here, group differences were observed in the processing of the mild violation. Furthermore, experts and laymen differed in their early brain responses to the beginning of the whole chord sequence. Given the present results, a distinct influence of expertise on aesthetic music processing could not be revealed even though experts and laymen differed in their early brain responses to musical stimuli.

Brain Oscillatory Responses of Musical Style Classification in Orchestral Musicians

Elvira Brattico; University of Helsinki, Finland

`3AM1-R01-04`

The classification of music according to a particular style relies on abstraction of the characteristic acoustic features, as well as on long-term memory of schemata. The aim of the study was to determine the brain oscillatory signatures of musical passages belonging to different musical styles. Orchestral musicians classified hundreds of brief musical excerpts as belonging to one out of four musical styles: Baroque, Classical, Romantic, and Modern. Brain oscillatory responses at 2–25 Hz were measured. Spectral centroid, spectral entropy, roughness and spectral flux were also computed for each musical excerpt. The acoustical analyses revealed higher spectral centroid for Baroque and Modern styles as compared with the others and the highest entropy and roughness for the Modern style contrasted with the others. The behavioural responses showed that Classical style was the most difficult to classify whereas Modern style was the easiest. Early theta brain oscillations were increased and late alpha oscillations decreased to the Modern style as compared with all the others. Findings converged to suggest a sequence of style processing from initial extraction of the characteristic acoustic parameters to the subsequent matching of sensory codes with pre-existing style representations.

3PM1-R01 : Symposium 7 : Music and Health: a Paradoxical Relationship

Room 1, 13:30–15:30 Wednesday 27 August 2008, Oral session

Music and Health: A Paradoxical Relationship

Gunter Kreutz [1], Stephan Bongard [2], Cynthia Quiroga-Murcia [2], Stephen Clift [3], Jane Ginsborg [4], Laura Mitchell [5]; [1]University of Oldenburg, Germany; [2]University of Frankfurt, Germany; [3]Canterbury Christ Church University, UK; [4]Royal Northern College of Music, UK; [5]Glasgow Caledonian University, UK

SUMMARY-7

Musical practices including listening, singing, playing instruments and dancing are subject of a growing body of research in the context of wellbeing and health. In general, most musical practices seem to promote wellbeing by providing opportunities of psychophysical training in one way or another. Playing musical instruments, singing or dancing, for example, implies a certain amount of mental and physical exercise, social interaction and emotional reward, all of which may have profound implications for wellbeing and health. Paradoxically, professional engagement in musical activities appears not to raise the beneficial effects of musical practices to an optimum, but rather seems to be associated with increasing levels of practice-related health problems. These problems are both apparently intrinsic to the activities as well extrinsic to them as they may relate to contextual and situational conditions of practice. The papers presented in this symposium tap into this paradox by demonstrating effects of musical practices in amateurs and professionals. Three papers are dedicated to amateur singing and dancing, drawing from wide-spread practices in many countries. Partnered dance is a common activity particularly in urban areas that is practiced by a growing community of individuals, who often have otherwise limited musical backgrounds. Choral singing, which has attracted a larger number of studies over the past years, by contrast, appears to imply greater musical demands from the participants, but is similarly popular among non-professionals as is dance. These studies highlight beneficial aspects of amateur singing and dancing, contrasting sharply to the health implications of professional musicianship. The forth paper in this symposium draws from findings about occupational stress, coping, performance anxiety and personality variables in a study of musicians who work in high-ranked German orchestras. Thus the contributions they provide some insight into the controversial facets and impacts of musical activities on health and wellbeing on the basis of empirical research.

Does Partnered Dance Promote Health?

Gunter Kreutz; University of Oldenburg, Germany

3PM1-R01-01

The arts, music, and dance have recently become prominent topics of debate in healthcare and health promotion. There is growing recognition of the benefits of artistic involvement to well-being and health. This research focuses on partnered dance as a common practice in all human cultures. Its purpose was to investigate the dancers of tango argentino, and to explore potential health benefits in this group. Participants (N=110) completed a self-developed inventory, which was, in part, based on interviews and observations as a participant observer. The inventory addresses educational, musical, and socio-economic background, motivation for and investment in dancing tango, and other leisure activities. Dancers are characterized by high-level education and socio-economic status. Motivation appears to be predominantly driven by both hedonistic and social factors, accounting altogether for nearly 60% of the variance. Physical investment in terms of time and money indicate tango dancing as a highly important activity that seems to involve substantial opportunity of moderate physical exercise, social interactions and emotional reward. Tango dancers are dedicated to the practice in many respects, including physical and emotional. They draw from similar motivations as compared to participants of other musical activities such as singing and listening to music. Notably, aspects of physical fitness are more prominent in this group. Implications of partnered dance for social, emotional, and physical well-being and health promotion demand further research.

Effects of Tango Dancing on Testosterone, Cortisol and Emotional State

Cynthia Quiroga-Murcia; University of Frankfurt, Germany

3PM1-R01-02

The present study examine the physiological and emotional effects of one form of partnered dance: tango argentino. In particular, the influences of the presence of music and partner on testosterone, cortisol and emotional state were considered. Twenty four healthy tango dancers were submitted to four conditions of dancing: "with partner with music", "with partner without music", "without partner with music" and "without partner without music". The conditions were temporally separated by at least one week. Before the experimental treatment and again 20 minutes thereafter, the participants provided saliva samples for analysis of cortisol and testosterone concentrations and filled out the *Positive and Negative Affect Schedule* (PANAS). The data suggest that motion with a partner to music has a more significant positive effect on emotional state than motion without music, or motion without physical contact have by their own. Moreover, significant decreases of cortisol concentrations were found with the presence of music, whereas significant increases of testosterone levels were found associated with the presence of a partner. To our knowledge, this is the first study showing affect and hormonal changes in response to partnered dance, in general, and the differential influences of music and partner in particular.

Stress in the Orchestra: Interrelationships of Personality, Performance Situation, Performance Anxiety and Coping Strategies

Stephan Bongard, Volker Hodapp, Franziska Langendoerfer; University of Frankfurt, Germany

3PM1-R01-03

Professional musicians often suffer from performance anxiety. Some studies attribute levels of anxiety to personality variables, while other studies have identified influences of situation and context. Objective of the present study was to examine the influences of personality and coping strategies on performance anxiety among professional orchestra musicians. The sample consisted of 122 members of six German symphony and opera orchestras. The musicians were asked to complete questionnaires measuring various personality traits. In addition, shortly before a normal rehearsal and a public performance, they also gave details about their coping and their performance anxiety. The latter was measured by four aspects: Lack of confidence, worry, emotionality, and physical symptoms. The various aspects of performance anxiety are highly correlated and yet are differentially associated with other personality traits. In the rehearsal, there is greater concern about social interactions, whereas in the performance situation, the music becomes the focus of concern. Furthermore, performance anxiety is associated with personality traits that are related to neuroticism and escapism. In addition, musicians suffering from performance anxiety use a range of strategies before a rehearsal or performance to cope with the situation, even if some of these strategies may be inefficient to reduce performance anxiety.

Health Problems, Health-Promoting Behaviours and Their Effects on Music Performance and Non-Music Performance Students in Higher Education Institutions

Jane Ginsborg [1], Gunter Kreutz [2], Mike Thomas [3], Aaron Williamon [4]; [1] Royal Northern College of Music, UK; [2] University of Oldenburg, Germany; [3] University of Chester, UK; [4] Royal College of Music, UK

3PM1-R01-04

The interrelationships between lifestyle, physical health and psychological wellbeing have been studied in a number of populations. The health-promoting behaviours of music performance students are of particular interest given the physical and emotional demands of expert music making. The present study aimed to compare the health behaviours of music and non-music students in higher education. It also sought to determine the extent to which self-rated health and self-reported symptoms were associated with health-promoting lifestyle. Music performance students from two conservatoires and students of nursing and biomedical science from two universities aged 19–25 years completed the Health-Promoting Lifestyle Inventory and an inventory of musculo- and non-musculoskeletal health problems. Music performance students scored lower than non-music performance students on health

responsibility, physical activity and spiritual growth. Music performance students rated their health, generally, as better than non-music performance students, but reported worse symptoms. Lifestyle, self-rated health and self-reported symptoms were associated positively and negatively. Nursing and biomedical science students may be atypical in that they are likely to gain a greater awareness of health issues from their studies. Nevertheless, music performance students need to adopt healthy lifestyles in order to reach their full potential as musicians, and the evidence suggests an urgent need for better health promotion as part of their training.

3PM1-R06 : Symposium 8 : ICMPC-Rencon: Toward New Research on Designing Expression in Musical Performance

Room 5, 13:30 – 15:30 Wednesday 27 August 2008, Oral session

Rencon: Performance Rendering Contest for Automated Music Systems

Mitsuyo Hashida [1], Teresa M. Nakra [2], Haruhiro Katayose [1], Tadahiro Murao [3], Keiji Hirata [4], Kenji Suzuki [5], Tetsuro Kitahara [1]; [1]Kwansei Gakuin University, Japan; [2]The College of New Jersey, USA; [3]Aichi University of Education, Japan; [4]NTT Communication Laboratories, Japan; [5]Tsukuba University, Japan

`SUMMARY-8`
Rencon (Performance Rendering Contest) is an annual international competition at which entrants present the computer systems they have developed for generating expressive musical performances and audience members and organizers judge the performances. Recent advances in performance rendering technology have brought with them the need for a means for researchers in this area to obtain feedback about the abilities of their systems in comparison so those of other researchers. At the ICMPC10, the competition will consist of an autonomous section (for evaluating the ability of the entered systems to generate performances autonomously) and a system-supported section (for evaluating human performances done using computer systems). The autonomous section aims to evaluate performances rendered by autonomous computer systems using e.g. a rule-based or case-based approach, and the system-supported section aims to build common ground for evaluating human performances done using computer systems.

Musical Analysis of Conducting Gestures Using Methods from Computer Vision

Teresa M. Nakra; The College of New Jersey, USA

`3PM1-R06-01`
In this paper we present musical analyses and interpretations of a noted conductor's gestures. The analyses were enabled by computer vision techniques that tracked the position of the conductor's right hand from a video sequence. The resulting output of the hand tracking system, when combined with beat and tempo data from the audio signal, provides numerous possibilities for analyzing the conductor's gestures and expressive techniques. We describe the stages of the video and audio processing, and present our analyses of the conductor's movements.

3PM2-R01 : Symposium 9 : Musical Emotions: Effect of Structural and Performance Cues

Room 1, 15:45 – 17:15 Wednesday 27 August 2008, Oral session

Musical Emotions: Effect of Structural and Performance Cues

Petri Toiviainen [1], Tuomas Eerola [1], Eva Istók [2], Roberto Bresin [3], Isabelle Peretz [4]; [1]University of Jyväskylä, Finland; [2]University of Helsinki, Finland; [3]KTH, Sweden; [4]Université de Montréal, Canada

`SUMMARY-9`
Most of the research on human music information processing has until now focused on cognitive aspects, such as perception of musical elements, learning, and produc-

tion. Yet, one major reason for listening to music is the emotional impact it has. For the domain of affective science, therefore, music is of central concern. While a number of aspects contribute to music-induced emotions, the content of music is one of the most important factors. The aim of this symposium is to discuss recent advances in music emotion research, with the focus being on the relation between musical content and emotions. In particular, the effect of structural and performance features on perceived emotions will be discussed. Specific questions addressed in the three presentations of the symposium include the effect of structural features of music on different levels of abstraction on perceived emotion; the effect of expressive timing variations on the facilitation of auditory grouping and on perceived pleasantness; and the effect of performance features on perceived emotional quality as well as their interaction with structural features. These questions are investigated using interdisciplinary approaches that combine methods of musicology, psychology, and computer modeling.

Influence of Acoustic Cues on the Expressive Performance of Music

Roberto Bresin, Anders Friberg; KTH, Sweden

`3PM2-R01-01`

The main aim of this study was to investigate the optimal combination of performance and structural parameters for obtaining a certain emotional expression. To explore the role of the performer with respect to musical expressivity, musicians tested a number of acoustic and structural cues.

In a factorial design, twenty subjects adjusted the values of seven performance parameters (tempo, sound level, articulation, phrasing, transposition, instrument, attack speed) for communicating five different emotional expressions (neutral, happy, scary, peaceful, sad) for each of four different scores. The scores were specifically composed for communicating four different emotions (happiness, sadness, anger, calmness).

Main results showed a general agreement with previous research in the field of expressive music performance. There was a tendency to use faster tempi and louder sound level for happy and angry performances, and slower tempi and softer sound level for sad performances. More staccato articulation and faster attack time were used for happy and angry performances. Phrasing was used with the typical accelerando-ritardando/crescendo-decrescendo in happy performances while it was used in the opposite way for peaceful and sad performances. Happy performances were transposed to a higher pitch, while sad and scary performances to a lower one.

Effects of Timing Cues in Music Performances on Auditory Grouping and Pleasantness Judgments

Eva Istók[1], Mari Tervaniemi[1], Anders Friberg[2], Uwe Seifert[3];
[1]University of Helsinki, Finland; [2]KTH, Sweden; [3]University of Cologne, Germany

`3PM2-R01-02`

By means of varying timing, dynamics, pitch, and timbre music performers put emphasis on important events of a musical piece and provide their listeners with acoustic cues that facilitate the perceptual and cognitive analysis of the musical structure. Evidence exists that the speed and the accuracy with which stimulus features are being processed contribute to how a stimulus itself is evaluated. In our study, we tested whether expressive timing facilitates auditory grouping and whether these timing variations influence pleasantness judgments. To this aim, participants listened to short atonal melodies containing one or two auditory groups and performed both a cognitive and an evaluative task. The expressive phrasing patterns of the excerpts were gradually modified ranging from inverted phrasing through deadpan versions to exaggerated timing patterns. Reaction times decreased and hit rates increased with a more pronounced grouping structure indicating that subtle timing variations alone do facilitate the formation of auditory groups in a musical context. Timing variations also modulated the direction of pleasantness ratings. However, the results suggest that the threshold of an expressive musical performance to become more pleasant than its deadpan counterpart presumably can be exceeded only by the simultaneous covariance of more than one acoustic cue.

Mapping Musical Features to Perceived Emotions Using Partial Least Squares Regression

Tuomas Eerola; University of Jyväskylä, Finland

3PM2-R01-03

The aim was to uncover such musical features from audio that are relevant for perception of emotions using a specific multivariate analysis method, Partial Least Squares (PLS) regression. An experiment was conducted where non-musicians (N=116) rated either basic emotions or emotional dimensions (3) of film music excerpts (n=110). The musical features were extracted from audio files using MIR Toolbox (Lartillot & Toiviainen, 2007). For each excerpt, the first three moments and two other measures were calculated across the frame-based analysis of them, resulting in 400 features for each. PLS regression was applied to reduce the dimensionality of the musical feature space in the analysis as this technique preserves the link between independent and dependent variables unlike other data reduction methods (e.g., PCA). An optimum set of predictors was discovered using PLS regression. This consisted of 4–6 latent vectors which each explained a high proportion of covariance between the features and ratings. In sum, a high degree of correspondence was obtained for categorical emotion concepts (R^2=.55 - .79) and dimensional ratings (R^2=.59 - .84). Descriptors and explanations for the latent vectors were obtained by correlating them with the features and by visualising them.

Research on music and emotions have used high-level musical features (mode, tension), expressive features (articulation, tempo) and low-level acoustic features (loudness, roughness) to explain emotional expression in music. Often such studies focus on single level of features and a wide variety of acoustically-derived features has not been exhaustively studied due to inherent limitations of mapping techniques (e.g. multicollinearity problems in regression), lack of computational models, or insufficient coverage of features due to pre-selection of musical material or design constraints in analysis-by-synthesis studies.

The aim was to uncover such musical features from audio that are relevant for perception of emotions using a specific multivariate analysis method, Partial Least Squares (PLS) regression.

An experiment was conducted where non-musicians (N=116) rated either basic emotions or emotional dimensions (3) of film music excerpts (n=110). The musical features were extracted from audio files using MIR Toolbox (Lartillot & Toiviainen, 2007). For each excerpt, the first three moments and two other measures were calculated across the frame-based analysis of them, resulting in 400 features for each. PLS regression was applied to reduce the dimensionality of the musical feature space in the analysis as this technique preserves the link between independent and dependent variables unlike other data reduction methods (e.g., PCA).

An optimum set of predictors was discovered using PLS regression. This consisted of 4–6 latent vectors which each explained a high proportion of covariance between the features and ratings. In sum, a high degree of correspondence was obtained for categorical emotion concepts (R^2=.55 - .79) and dimensional ratings (R^2=.59 - .84). Descriptors and explanations for the latent vectors were obtained by correlating them with the features and by visualising them.

The results extend the previous research (a) by providing a solution to the reduction of the musical feature space and (b) by uncovering novel feature combinations. The approach advocates using real music and sophisticated acoustic features in music and emotion research.

4AM1-R01 : Symposium 10 : Experiencing Musical Multimedia: Empirical Investigations of Cross-Modal Perception & Cognition

Room 1, 8:30–10:30 Thursday 28 August 2008, Oral session

Experiencing Musical Multimedia: Empirical Investigations of Cross-Modal Perception & Cognition

Scott D. Lipscomb[1], Roger A. Kendall[2], Zohar Eitan[3], Assi Schupak[3], Lawrence E. Marks[4], Annabel J. Cohen[5], Yee-May Siau[5], Shin-ichiro Iwamiya[6], John Hajda[7]; [1]University of Minnesota, USA; [2]University of California at Los Angeles, USA; [3]Tel Aviv University, Israel; [4]Yale University, USA; [5]University of Prince Edward Island, Canada; [6]Kyushu University, Japan; [7]University of California at Santa Barbara, USA

SUMMARY-10

The purpose of this symposium is to present international, empirically-based perspectives related to the cognition of the multimedia experience, with its high level of sociological significance. Presenters from several regions of the world (Canada, Israel, Japan, and the United States) will share results of their most recent research. The presentations demonstrate a number of approaches to the serious study of multimedia, informing our current understanding of related artforms and their affect on those who experience them.

Stratification of Musical and Visual Structures II: Visual and Pitch Contours

Roger A. Kendall; University of California at Los Angeles, USA

4AM1-R01-01

This series of studies acknowledges the important elements of congruence and association, but emphasizes an often overlooked domain that is in-between, or a composite, of these two elements. In Experiment 1, animations in two-dimensional space were created consisting of a simple filled-circle that moves in x-y space. Patterns of ascending and descending ramps, arches, and undulations, used in previous experiments, were superimposed. These were accompanied by two-part pitch patterns. For Experiment 2, the relation of visual and melodic contour was investigated using monophonic pitch and monovisual animations. Animations consisted of an arch pattern, a circle, a triangle, a square, a pentagon, a hexagon, and a stair structure. The single pitch pattern combined with these visual structures was a melodic arch with 8 equally-spaced contour inflection points. Finally, Experiment 3 was based on several patterns used in Experiment 1 that crossed at C5, creating a paradoxical composite that could be interpreted in several ways. Musical pitch patterns were created using the piano tones as in Experiment 1 and also with two timbres, piano and oboe; visual patterns included monochromatic vs. multiple colors. In all experiments subjects rated the degree of fit between the visual and musical composites. Repeated measures ANOVA using MGLH generally showed that hypothesized patterns of pitch and visual motion have the strongest perceptual fit, with some notable exceptions.

Louder is Higher: Cross-Modal Interaction of Loudness Change and Vertical Motion in Speeded Classification

Zohar Eitan[1], Assi Schupak[1], Lawrence E. Marks[2]; [1]Tel Aviv University, Israel; [2]Yale University, USA

4AM1-R01-02

Garner's speeded discrimination paradigm was used to determine whether loudness change and spatiovisual vertical motion interact perceptually. 32 participants (16 musically trained) served in 2 experiments, where auditory stimuli (1000 Hz sinusoids) increasing or decreasing in loudness accompanied visual stimuli (dots on a screen) that simultaneously moved up or down. Participants rapidly discriminated values in one, "relevant," stimulus (auditory in Expt1, visual in Expt2) while ignoring the other. Each experiment included 2 baseline conditions, 2 correlated conditions (congruent and incongruent), and an orthogonal condition. Two outcomes would

indicate interaction: *Garner interference*, (Orthogonal condition RT > baseline RT), implying failure to attend selectively to the relevant stimulus, and *congruence effects* (RTs, incongruent stimuli > RTs, congruent stimuli). Results in Exp1 (auditory discrimination) indicate significant congruence effects both within the orthogonal condition and between correlated conditions. Exp2 (visual discrimination) gave no significant congruence effects. No Garner interference emerged in either experiment. Congruence effects were larger for musically untrained participants. Results suggest that loudness change and visually perceived vertical motion interact perceptually. The combination of congruence effects and no Garner interference conforms to a model in which information deriving from auditory and visual stimuli combines into a single variable, continuously compared to bipolar response boundaries.

The Narrative Role of Music in Multimedia Presentations: The Congruence-Association Model (CAM) of Music and Multimedia

Annabel J. Cohen, Yee-May Siau; University of Prince Edward Island, Canada
4AM1-R01-03

The present paper presents recent empirical work conducted within the context of the Congruence-Association Model of music in multimedia. Participants watched a 20-minute "silent" film twice with either an appropriate, inappropriate, or no music background. They responded as quickly as possible when an extraneous target "X" appeared in the corner of the screen at intervals of approximately 1 min. After the first (warm-up) presentation, response time was significantly slower with the original music as compared to the no-music condition. This finding was consistent with the view that appropriate music increased the narrative coherence of the presentation and inhibited detection of information extraneous to the story. One-half the participants were instructed to attend to the story, so as to answer some questions later about it. Results were consistent with the notion that music may play a similar role to telling a viewer-listener to attend to the story. Of secondary interest, response time was significantly correlated with individual difference measures on both the Tellegen Absorption Scale and experience with video games.

Subjective Congruence Between Moving Picture and Sound

Shin-ichiro Iwamiya; Kyushu University, Japan
4AM1-R01-04

To make impressive visual media production, subjective congruence between motion picture and sound is important. It is indicated that subjective congruency between motion picture and sound has two aspects. One is formal congruency: the matching of auditory and visual structures. The other is semantic congruency: the similarity of the auditory and visual meanings. The synchronization of auditory and visual accents of audio-visual stimuli created formal congruency. The similarity between auditory and visual impressions evoked from audio-visual stimuli created semantic congruency. Rating experiments showed both types of audio-visual congruencies had effects to raise subjective congruence. Furthermore, the relationship between the transformation of visual images and the pitch or loudness pattern of sound also contributed to rising subjective congruence. For example, combination of an ascending pitch scale and an enlarging image pattern created subjective congruence. Combination of a descending pitch scale and a reducing image pattern created subjective congruence. Furthermore, a combination of an ascending pitch scale and a sliding movement from left to right and that of a descending pitch scale and a sliding movement from right to left. Vertical correspondence of direction between movement of image and pitch shift had strong effect on the subjective congruence.

4AM2-R01 : Symposium 11 (Invited) : Animal Calls, Music, and Language: Search for Common Themes in Evolution

Room 1, 10:40 – 12:40 Thursday 28 August 2008, Oral session

Animal Calls, Music, and Language: Search for Common Themes in Evolution

Kazuo Okanoya[1], Aniruddh D. Patel[2], Yoichi Inoue[3], Thomas Geissmann[4], Ryo Oda[5], Kazutoshi Sasahara[1]; [1]RIKEN Brain Science Institute, Japan; [2]The Neurosciences Institute, USA; [3]Nishimaizuru High School, Japan; [4]Zürich University, Switzerland; [5]Nagoya Institute of Technology, Japan

SUMMARY-11

Animal calls, music, and language are vocal behaviors that depend upon precise motor control and auditory feedback. By comparing these behaviors, we can find common themes in evolution that are constrained by environmental, psychological, and physiological factors.

Empirical Comparisons of Pitch Patterns in Music, Speech, and Birdsong

Aniruddh D. Patel[1], Adam T. Tierney[1], Frank A. Russo[2]; [1]The Neurosciences Institute, USA; [2]Ryerson College, Canada

4AM2-R01-01

Musical melodies are characterized by certain statistical regularities. For example, large intervals ("skips") are often followed by reversals, and phrases often have an arch-like shape and final durational lengthening. These regularities could reflect motor constraints on pitch production or the melodic characteristics of speech. To distinguish between these possibilities we compared pitch patterns in instrumental musical themes, sentences, and birdsongs. Patterns due to production-related constraints should be present in all three domains, whereas patterns due to statistical learning from speech should be present in speech but not birdsong. Sequences were taken from classical music of 5 countries, sentences from 4 languages, and songs of 56 songbird families. For sentences and birdsongs each vowel/note was assigned one pitch. For each sequence we quantified patterns of post-skip reversals, the direction of the initial and final interval, the relative duration of the final vowel/note, and pitch contour shape. Final lengthening and post-skip reversals predominated in all domains, likely reflecting shared motor constraints; the latter may result from skips' tendency to take melodies toward the edges of the pitch range, forcing subsequent reversals. Arch-like contours were found in music and speech but not birdsong, possibly reflecting an influence of speech patterns on musical structure.

Vocal-Auditory Segmentation of Sound Sequence in Songbirds and Human Babies

Kazuo Okanoya, Miki Takahasi, Noriko Kudo; RIKEN Brain Science Institute, Japan

4AM2-R01-02

Segmentation and chunking are characteristics that are shared by human speech, music, and bird song. Male Bengalese finches sing complex songs with deterministic and probabilistic note-to-note transitions. When chicks were reared in a multi-tutor environment, they eventually learned to sing complex songs that contain 1–3 tutor songs segmented and arranged in personalized fashion. In humans, we recorded brain activity when hearing sound stream that were organized to have high- and low-transition points. At the scalp electrode placed at FCz, we found a negative potential corresponded with segmentation. The strength of the potential was correlated with the degree of learning to segment the statistical sequence, suggesting that this potential could be a marker for sound segmentation. The same procedure was applied to examine whether new-born infants can also segment ongoing statistical sequence. We found a positive potential corresponded with segmentation at the same electrode. Thus, right after the birth, infants can also demonstrate ability of segmentation. Results suggest that both in birds and humans segmentation of ongoing sound is enabled by the higher auditory-vocal integration area and by the

basal ganglia and this ability is probably innately prepared in humans and birds and help them to acquire songs, music, and language.

Gibbon Song Syntax Decodes Behavioral Contexts

Yoichi Inoue [1], Shigeto Yosida [2], Kazuo Okanoya [2]; [1]Nishimaizuru High School, Japan; [2]RIKEN Brain Science Institute, Japan
4AM2-R01-03

Gibbons are small, arboreal apes distributed throughout the tropical rainforests of Southeast Asia. Gibbons are known to produce songs. But, there has been little study about the syntax of gibbon song. So, I have conducted field observation in northern Borneo (Danum Valley Conservation Area). I followed one gibbon group for one week in succession in August and December every year since 2001. The data collection method is to record the voice, while collecting the activity data. From 2001 to 2007, I followed one group for a total of 82 days and collected 63 male songs. The Muller's gibbon (*Hylobates Muelleri*) lives in northern Borneo. Concerning the organization of this gibbon's song, the details were reported by Haimoff (1985). According to him, male songs consist of wa and oo notes. I examined the male songs recorded in my research acoustically and confirmed it. I studied whether one male gibbon named Sigyu changed the combination of wa and oo notes in various situations. As a result, the orders of 3 successive notes in his songs were observed to be different according to the situations. These observations suggest that gibbon song syntax may decode behavioral contexts.

Song-Diversity in a Gibbon Species: The Silvery Gibbon (Hylobates Moloch) from Java (Indonesia)

Thomas Geissmann; Zürich University, Switzerland
4AM2-R01-04

Because male silvery gibbon songs generally exhibit a higher degree of structural variability than female songs, the syntactical rules and the degree of variability in male singing have rarely been examined. The unusual rarity of male singing in the silvery gibbon makes such a study particularly challenging. The results can be summarized as follows: (1) Males appear to exhibit individual preferences in the order of different note types used in their phrases. (2) Male phrase variability both within and between individuals appears to be higher in silvery gibbons than in most, perhaps all, other gibbon species. This high variability appears to be a derived characteristic among the Hylobatidae. I will discuss the implications of this finding for the interpretation of song function. It appears that song function cannot be identified for "the gibbon". Gibbon songs appear to be multi-functional, and the relevance of these functions appears to exhibit strong differences among gibbon species.

1PM1-R02 : Pitch

Room 2, 13:00 – 15:00 Monday 25 August 2007, Oral session

The Correlation Between Absolute Pitch and Adaptation to Transposed Keyboards

Keun-Ah Jeon [1], Suk Won Yi [1], Kyungil Kim [2]; [1] Seoul National University, Korea; [2] Ajou University, Korea

1PM1-R02-1

The purpose of this study is to see whether there is a correlation between absolute pitch(AP) and sight-reading ability when playing on a transposed keyboard. A pilot survey showed that people assume AP possessors to have more difficulty using transposed keyboards than non-AP possessors do. The majority of the 25 college students with musical experience reported that the possession of AP may negatively affects sight-reading on transposed keyboards, resulting in perceptional confusion, psychological strain and mistakes in performance.

In order to investigate the correlation between AP index and sight-reading ability on transposed keyboard, two experiments were conducted:

1. The measuring of each subject's AP index. Subjects were instructed to identify the pitch class of presented tones.

2. The measuring of the adaptability to transposed keyboards. Subjects were asked to sight-read given scores on a keyboard in both the original and transposed key. When played in the transposed key, the subjects hear different pitch classes from those notated on score.

The result of the correlation analysis showed that AP index has no significant effect on the adaptability to transposed keyboards in contrast to the pilot survey. In addition, it appeared that the correlation between AP index and ability to sight-read was not significant.

Simultaneous Pitch Perception in Absolute and Non-Absolute Pitch Possessors

David J.T. Marco, Neil McLachlan, Sarah Wilson; University of Melbourne, Australia

1PM1-R02-2

This study explored the perception of simultaneous pitches between musicians with and without absolute pitch (AP). Listeners performed estimations of pitch number and pitch height for musical chords of increasing inharmonicity and spectral density. Sounds consisted of one, two or three simultaneous pitches. Results showed that AP performance accuracy decreased significantly for all multi-pitch sounds in a similar manner to non-AP (NAP) musician performance. In contrast, performance effects due to increasing inharmonicity and spectral density were only witnessed in NAP musicians. Comparison of pitch height judgment accuracy and pitch number estimation results provided evidence that pitch number estimation is not based on prior pitch extraction mechanisms as proposed in multiplicity models. The reduced ability to identify pitches in multiple pitch stimuli is likely to be due to reductions in the salience of individual pitches caused by increased masking of higher-order harmonics and co-modulation of harmonics occurring within the same critical band.

Perceived 'Closeness' in Pitch Depends in Part on Perceived 'Closeness' in Time: Further Support for an Auditory Motion Hypothesis

Molly J. Henry, J. Devin McAuley; Bowling Green State University, USA

1PM1-R02-3

Support for an auditory motion hypothesis was previously provided by a demonstration that increasing the pitch velocity of three-tone melodies increases the magnitude of the auditory kappa effect, which is characterized by dependence of time judgments on to-be-ignored variations in pitch (Henry & McAuley, in press). The aim of the current study was to test the auditory motion hypothesis with respect to the auditory tau effect, which is characterized by the dependence of pitch judgments on to-be-ignored variations in timing. Participants judged the relative pitch of a target tone embedded in three-tone ascending sequences, while ignoring changes to the target's timing; pitch velocity was varied between subjects. In accord with an

auditory motion hypothesis, increasing the pitch velocity of the sequences increased the magnitude of the auditory tau effect. Findings were supported by quantitative fits to an imputed pitch velocity model. Musical training was not correlated with magnitude of the auditory tau effect. Generally, the results of the current study provide support for the inherent interdependence of the dimensions of pitch and time in music perception.

Exposure to Ambiguous Tone Sequences Induces Short-Term Plasticity in Pitch Perception

A. Seither-Preisler[1], L. Johnson[2], S. Seither[2], B. Luetkenhoener[2];
[1]University of Graz, Austria; [2]Muenster University Hospital, Germany

`1PM1-R02-4`

Eleven non-musicians were tested with the Auditory Ambiguity Test (AAT), which assesses a subject's tendency to categorize ambiguous two-tone sequences either according to their concrete physical sound attributes (present upper harmonics) or to their implicit tonal meaning (virtual pitches at the respective missing fundamental frequencies). The exposure group (N=5) was repeatedly tested with the AAT over a period of 8 weeks (1 session per week; 3 consecutive AAT presentations). The training group (N=6) underwent the same procedure, but received training between the 3 presentations. There was one block of spectral training with the 'Noise Shift Test' and one block of virtual pitch training with the 'Present Fundamental Frequency Test'. The AAT scores increased steadily over the eight weeks period, both in the exposure group (p=0.0012) and the training group (p=0.011), regardless of the type of training (p=0.59), thus indicating a general increase in the salience of virtual pitch sensations. The same effect, although weaker, was observed over the 3 subsequent AAT presentations of a single session (exposure group: p=0.062; training group: p=0.01). These results suggest that short-term exposure to harmonic sounds enforces virtual pitch perception regardless of explicit training.

1PM1-R03 : Rhythm, Meter and Timing I

Room 3, 13:00 – 15:00 Monday 25 August 2007, Oral session

Investigating the Human-Specificity of Synchronization to Music

Aniruddh D. Patel[1], John R. Iversen[1], Micah R. Bregman[1], Irena Schulz[2], Charles Schulz[2]; [1]The Neurosciences Institute, USA; [2]Birdlovers Only Rescue Service Inc., USA

`1PM1-R03-1`

One universal of human music perception is the tendency to move in synchrony with a periodic beat (e.g., in dance). This response is not commonly observed in nonhuman animals, raising the possibility that this behavior relies on brain circuits shaped by natural selection for music. Consequently, if a nonhuman animal can acquire this ability, this would inform debates over the evolutionary status of music. Specifically, such evidence would suggest that this ability did not originate as an evolutionary adaptation for music. We present data from an experimental study of synchronization to music in a Sulphur-crested cockatoo (*Cacatua galerita eleanora*), "Snowball", who spontaneously dances in response to certain music (see YouTube: "dancing cockatoo"). Snowball's preferred song was presented at different tempi (original, +/- 2.5%, 5%, 10%, 15%, and 20%), and his rhythmic movements while dancing were quantified from video. The results reveal occasional bouts of synchronization at a subset of these tempi on ~20% of the trials. This demonstrates that a nonhuman animal can synchronize to a musical beat, though with limited reliability and tempo flexibility. These findings are consistent with the "vocal learning and rhythmic synchronization" hypothesis, which suggests that vocal learning provides the auditory-motor foundation for synchronization to a musical beat.

Identifying Timing by Sound: Timbral Qualities of Micro-Rhythm

Anne Danielsen[1], Carl-Haakon Waadeland[2], Henrik G. Sundt[3];
[1]University of Oslo, Norway; [2]Norwegian University of Science and Technology, Norway; [3]Norwegian Network for Technology Acoustics and Music, Norway

`1PM1-R03-2`

Temporal "deviations" from a given reference grid, such as in standard musical

notation, are well known and an identified characteristic of music performance. Yet, when a musician performs temporal patterns, strategies of movement and interaction with the instrument also affect the sound produced. Hence, sound and micro-timing are invariably closely related. In this paper we provide a report from an experiment aimed at investigating how variations in micro-timing are reflected through variations in sound. Five experienced drummers performed a rock groove in three different tempi, whereby the performances were subjected to three different playing conditions: a) playing as "natural" as possible, b) playing "laid-back", and, c) playing "pushed". Our focus was on how these different playing conditions influenced the timbral content of the snare drum sound. In this experiment the recorded sounds of the snare drum strokes were isolated and analysed for spectral content by using FFT, where the results showed that in a majority of the performances the sound of the snare drum is characteristically altered when the drummer attempts to play laid-back or pushed. This demonstrates that timbral content might contain information regarding micro-temporal positioning, and, moreover, that timbre needs to be taken into account in studies that deal with micro-timing.

Stealing Time: How Grace Notes Can Be Added

Peter Desain, Renee Timmers; Radboud University Nijmegen, The Netherlands

1PM1-R03-3

Previously collected data was re-analysed for data-driven appearance of distinct types of grace notes. Grace notes are one-note ornaments that are special in at least two ways: their duration is relatively inflexible over performances in different tempi, and they are timed by "stealing" time from surrounding notes rather than by inserting time. Two types of graces are usually distinguished that are either performed in time of the previous note, or in time of the main note.

Using time-shifts of note onsets between without and with grace note performances in seven tempi, the proportion of the grace note duration stolen from the previous note, the main note, and inserted was calculated. Additionally, the duration of the grace note at tempo 60 was measured and the slope of tempo scaling of the grace duration. These five parameters were used as input to a clustering analysis. The time-shifts profiles showed an amazing consistency in time-shifts over repeated performances. They also revealed different behaviour across participants. Their musical interpretations fall within two groups, as reflected in a clear clustering of parameter values for time stealing and grace note duration. The slope of scaling with tempo seems to allow for freedom on a continuous range.

Exploration and Imitation of the Timing of Grace Notes

Renee Timmers, Peter Desain; Radboud University Nijmegen, The Netherlands

1PM1-R03-4

The effectiveness of visual feedback to assist in the exploration and imitation of the timing of grace notes, which are short ornamental notes, was investigated in an experimental study. The ability of piano students to imitate target performances with different grace note timing was tested before and after a training session. During training, the piano students explored ways of grace note performance with the instruction to explore grace note timing in order to improve the imitation task in the posttest. Half of the group of participants received visual feedback during training. The results showed no significant improvement of the imitation of the target performances between pretest and posttest and no significant effect of visual feedback, suggesting that training using exploration was not helpful. However, the visual feedback did influence the timing of ornaments in the exploration training. Although overall participants in the no-feedback condition explored the timing of the grace note and surrounding notes more freely than the participants in the visual feedback condition, participants who received visual feedback explored different types of grace note timing more systematically.

1PM1-R04 : Education I

Room 4, 13:00 – 15:00 Monday 25 August 2007, Oral session

Learning Rhythm: The Impact of Visual Presentation

Frank Heuser [1], Scott D. Lipscomb [2], Glenn Pohland [2]; [1]University of California at Los Angeles, USA; [2]University of Minnesota, USA

1PM1-R04-1

This investigation aims to determine whether the visual organization of rhythmic information impacts learning by comparing two approaches. The *repetitive approach* presents a specific rhythm in the first measure of a four measure, visually discrete exercise with the same rhythm repeated in each measure. In the *varied approach*, different rhythm patterns are presented in each measure of a continuous exercise in which no pattern is repeated and with no visual separation of presented patterns. The study seeks to determine whether the repetitive or varied approach results in greater efficacy in learning.

Sixth grade beginning instrument students participated. Treatment commenced at the beginning of the second semester of instruction, after tone production was established. Regular classroom teachers provided rhythmic instruction to students and were asked to supplement their teaching with researcher-provided instructional materials for five minutes every class period. These materials used either the repetitive or varied approach and incorporated rhythms studied during the second semester. After two months of instruction, students were tested on their ability to perform the rhythms on their instruments. Results of the present study will provide empirical evidence to either confirm or disconfirm this hypothesis, providing useful cognition-based information for use in the creation of the next generation of beginning instrumental methods texts.

Teaching Expressivity to Advanced Instrumentalists

Katie Zhukov; Sydney Conservatorium of Music, Australia

1PM1-R04-2

Research into teaching of expressivity typically uses questionnaires and interviews to ascertain the teaching methods employed by instrumental instructors and the practising strategies of students. Little is known regarding the importance of expressivity in instrumental teaching in higher education or the role gender differences may play in its teaching. This study takes an encompassing view of expressivity by including tempo, articulation, dynamics and emotion in its definition as suggested by recent research. It re-examines observational data on lesson content from 24 instrumental music lessons in higher education by amalgamating the scores in four categories of tempo, articulation, dynamics and emotion as expressivity and comparing this to the scores in technique. The individual aspects of expressivity are re-calculated as percentages of expressivity to ascertain their relative importance with regard to gender. Results show greater emphasis on teaching of expressivity than technique, with subtle gender differences emerging between the two teacher groups, the two students groups and the four same-gender/ different-gender pairings. Findings support the new concept of expressivity and challenge traditional views on the importance of teaching technique to advanced instrumentalists. Gender differences in emphasis on particular aspects of expressivity add to our understanding of instrumental teaching in higher education.

The Significance of Qualitative Approach in the Research of Musical Cognition: A Study Methodology Using the Concept of Inter-Subjectivity

Yasuko Murakami; Kyoritsu Women's University, Japan

1PM1-R04-3

The aim of this study is to explore the significance of a qualitative approach to musical cognition research using the concept of inter-subjectivity in order to understand the internal sense of the player.

This paper will first give a brief overview of past research on the principle and methodology of qualitative approaches to educational psychology. It also looks at research that has used the concept of inter-subjectivity. Secondly, there will be a brief presentation of the author's research on piano lessons using such qualitative methods. Third is a comparison of the results of previous scientific research with

those of qualitative research and clarification of the distinction between them. Finally, the paper suggests the significance of using a qualitative approach in music cognition research.

Using the concept of inter-subjectivity allows us to glimpse the subjectivity of other people through our own subjectivity. This paper proposes the feasibility of implementing the methodology used here to clarify the internal sense of the player.

73 Forms of Actions (Diverse Exercises) Included in German Gehoerbildung-Books Published Between 1889 and 1983

Luis Estrada-Rodríguez; Universidad Nacional Autonoma de Mexico, Mexico

`1PM1-R04-4`

This paper presents a part of a larger research project in all the didactic components (exercises, fields of exercises, thematic contents and sequences) found in the most used Gehoerbildung-books between 1889 and 1985 in Germany. The author focuses on the analysis of 1209 exercises included in these books. Some cognitive functions have been used in these books together with musical actions as consecutive or simultaneous components of this kind of exercises. The basic forms of action (listening, singing, playing, reading, writing, analysis, recognition, memorization and others) as well as their combination constitute a total of 73 forms of actions used by the authors of the analyzed books. Some of these forms of action are little known outside Germany; they are thought to help the student develop the internal audition and are alternatives to take a dictation, one traditional exercise used with skepticism today. An important part of the didactic strategies of the authors rely on the applied exercises. These have also a strong influence on the future behavior of the students. However, there are various problems that make the evaluation difficult of the contribution of these exercises to the overall development of the student in an objective way.

1PM2-R02 : Memory

Room 2, 15:15 – 17:15 Monday 25 August 2007, Oral session

Musical Change Deafness: The Inability to Detect Change in a Non-Speech Auditory Domain

Kat R. Agres, Carol L. Krumhansl; Cornell University, USA

`1PM2-R02-1`

This article presents two experiments investigating the degree to which listeners can detect changes in melodies. In both studies, pairs of melodies were presented to a group of professional musicians and a group of non-musicians. In Experiment 1, musical structure and musical expertise were explored with stylistic, non-stylistic, and random melodies. Experiment 2 utilized a full-factorial design to examine tonality, musical interval, metrical position, note duration, and musical expertise. Significant effects were found for several variables, but tonality had a particularly large effect on performance. Under some conditions, large changes between the melodies went undetected even by professional musicians. These results suggest that listeners form a memory representation for schematically consistent tones, which we refer to as the "musical gist". These results also suggest a comparison with change blindness, in which viewers can fail to notice salient changes in a visual scene, raising the question of whether similar processing operates in both modalities.

The Effect of Timbre and Pitch Level on the Suzuki Violin Student's Processing of Familiar Melodies

Crystal Peebles; Florida State University, USA

`1PM2-R02-2`

The Suzuki method teaches students to play the violin by ear, focusing on daily listening and review of older repertoire. This study builds on work by Saah and Marvin (2004) to determine whether students who learn violin using this pedagogical method encode Suzuki repertoire with absolute pitch and timbre information. If so, then changing timbre and key might influence the student's ability to perform an error-detection task on a melody from the Suzuki repertoire. Thirty-eight Suzuki-trained students (ages 6–16) heard two-measure excerpts and evaluated whether they were correctly performed. Both familiar key and familiar timbre were shown to improve

performance: participants detected errors significantly faster and more accurately when melodies were played in their original key (p < .001) or on the violin (p < .001) and older children performed the task slightly faster and more accurately and than younger children, although this difference in performance was not significant. These results demonstrate that timbre and pitch level affect processing in Suzuki students, suggesting that these parameters may be encoded along with musical intervals and contour.

Modelling Memory Responses in a Melody Recognition Task

Andrea R. Halpern [1], Daniel Müllensiefen [2], Geraint Wiggins [2];
[1] Bucknell University, USA; [2] Goldsmiths University of London, UK
1PM2-R02-3

Most empirical studies investigating memory for melodies relate memory performance to a number of influencing and experimentally controlled factors. Memory performance is usually defined as a function of the correctly recognised items. In contrast to this conventional approach, we seek a more comprehensive model of melodic memory that predicts all types of memory response in a melodic recognition task, i.e. that also explains memory failures. The predictions are based on a set of algorithmically extracted analytical features of the melodic stimuli. In a presentation phase, 21 untrained participants rated the familiarity of 40 short melodic phrases. In the test phase, the participants were presented with 80 melodic phrases, half of which they had listened to in presentation. The participants' explicit and implicit memory was assessed by two rating judgements for each melody item. Employing several different statistical modelling techniques we show how the different analytical features and their combinations act upon the subjective memorability of a melody. From the prominence of the analytical features within the statistical model, we discuss how the presence of certain melodic structures can lead to specific subjective memory responses. The relationship between the traditional approach to musical memory analysis and this new one is discussed.

An Exploration of How Music Can Modify Long Term Memory

Sherilene M. Carr, N.S. Rickard; Monash University, Australia
1PM2-R02-4

Physiological arousal induced by emotion has been identified as an important modulator of long term memory consolidation. Animal and human research has shown elicitation of emotion can improve memory for an event compared to control non-emotion conditions, and this enhancement is believed to be mediated by the beta-adrenergic system. The clinical potential of emotional arousal to be used as a mnemonic strategy is exciting but limited by at least two methodological barriers. First, this research has tended to focus upon *intrinsic* sources of emotional arousal in that the emotion is an integral part of the material to be remembered. Such methodology typically involves participants viewing disturbing images combined with a negative narrative. Second, the majority of experimental evidence has relied on the use of negatively valent content to induce emotion; clearly this method would be undesirable in applied settings. Emotionally powerful music is a source of arousal induction not yet exploited in physiological models of memory-emotion research. Music is unique in that it has the potential to increase physiological arousal while at the same time infusing affect into otherwise neutral material. This research will investigate the utility of using emotion inducing music as an *extraneous* and externally valid source of emotional arousal that may then be used to enhance memory for otherwise neutral material.

1PM2-R03 : Performance I

Room 3, 15:15 – 17:15 Monday 25 August 2007, Oral session

Priming Preferred Tempo in Multi-Sectional Music

Peter Martens; Texas Tech University, USA
1PM2-R03-1

In most experiments studying preferred tempo (tactus), participants are kept metrically naïve, and the preferred tempo of each piece is defined from their unbiased responses. Much music that we experience in our daily lives, however, is multi-sectional. Logically, preferred tempo in subsequent sections of music might be "primed" by the preceding music. A pilot and follow-up experiment were conducted

to investigate how preferred tempo in a piece's second section (generically, the B section) was influenced by a preexisting preferred tempo from the piece's A section. Participants tapped their preferred tempo in response to 15 excerpts of diverse genres and styles, hearing either a "primed" (A-B) or "unprimed" (B only) version of each excerpt. The junctures between A and B sections in these excerpts were of two types. In seven excerpts, the metric structure of A and B sections were similar, with at most two layers added or subtracted across the sectional boundary. Participants' preferred tempo in the B section of these excerpts was significantly different under primed and unprimed conditions for all seven excerpts. In the remaining eight excerpts, the A and B sections shared at most two metrical layers. Only two of these eight excerpts showed significant differences between conditions, showing the ease with which participants experienced these musical boundaries as a kind of reset button for preferred tempo. This study demonstrates the malleability of preferred tempo given a preceding metrical context, and explores the types of musical boundary that will most affect the preferred tempo of subsequent musical sections.

MuSA.RT and the Pedal: The Role of the Sustain Pedal in Clarifying Tonal Structure

Elaine Chew, Alexandre R. J. François; University of Southern California, USA

`1PM2-R03-2`

Pianists use the sustain pedal to clarify and project tonal structure in performance. The effect of sustain-pedal use on the projected tonal structure, while potentially useful to piano pedagogy and automated transcription, remains a little-studied phenomenon. Our goal is to discover ways to model and measure, quantitatively, the effect of the sustain pedal on tonal coherence. We use the MuSA.RT system for tonal analysis and visualization to capture the tonal patterns analyzed from a pianist's performance of Bach's Prelude No. 1 from *The Well-Tempered Clavier*, paced by a metronome, with and without the use of the sustain pedal. The analysis is based on the Spiral Array Model, as implemented in MuSA.RT. Tonal contexts are mapped to short-term and long-term centers of effect (CEs) that trace out spatial trajectories over time. The likelihood of a triad/key is given by the distance between the short-term/long-term CE and that triad/key. We present quantitative results that show that increased tonal coherence in a pedaled performance can be observed as stronger likelihood of the nearest keys (i.e. shorter distances between the long-term CE and closest key), and that use of the sustain pedal results in smoother transitions to and from the nearest triads.

On the Effect of Performance Evaluation in Acquiring Samba Rhythm

Masato Kawakami, Tsutomu Fujinami; JAIST, Japan

`1PM2-R03-3`

It is difficult for anyone to acquire a new rhythm if it is unfamiliar to him. It is difficult, for example, for Japanese to acquire a Samba rhythm as its rhythmic structure is so different from the ones they have been familiar with. To study how one learns to play a new rhythm, we investigated the process in which Japanese subjects are trained to play Samba rhythms. We employed 18 subjects to separate them into three groups. An instructor showed all of them how to play Samba rhythm with a shaker. Two groups were provided with additional information, which was calculated based on the data obtained from acceleration sensors put on their wrists. We calculated for each subject's acceleration data its auto correlation function to compare it with the instructor's by calculating the cross correlation function between them. The cross correlation function represents how his arm movement is close to the one of the instructor, which we regard as an index to evaluate his or her performance. Of the two groups given additional information, one group was only informed whether or not his performance was correct. The other group was furthermore shown his auto correlation along with the instructor's, expressed as wave form on computer display. We compared these three groups to investigate how the different instructions affected the learners. It turned out the group who were shown auto correlation as wave forms learnt better than the group who were not given any information of their wrist movement. The group who were only told whether his performance was correct did however not outperform the group without any feedback. The result suggests that the learner needs a direction, not just a judgment, to acquire a new rhythm when they imitate the instructor.

A Pianist's Expression in the Role of Co-Performer: Changes in Timing and Dynamics Through Communicative Interaction with a Violinist

Yuriko Kubota; Independent Researcher, Japan

`1PM2-R03-4`

This paper is based on Seashore's theory of 'aesthetic deviation from the regular' (1938, p. 9). Studies of expression have been carried out by many researchers. Although studies of performance and social interaction are currently mainstreams of psychology of music research, the study of expression in ensemble performance has been paid relatively little attention. This study aims to investigate how a pianist's expression changes in timing and dynamics when playing with a violinist, through four conditions: solo performance, performance before and after rehearsal, and performance nineteen days after the rehearsal. A further purpose of the study is an exploration of the effects of the performers' interactions in rehearsal and performance on expression. The experiment took place at the University of Sheffield; Mozart's Sonata for Violin and Piano K.454 was played by two student participants. Quantitative research with MIDI data and supplementary data, comprising audio and video recording data, and qualitative data from semi-structured interviews were used for analysis. Findings included changes in the style of expression, the occurrence of different metrical features, and a 'characteristic' expressive style in the piano accompaniment. In ensemble performance, the treatment of temporal structures may be critical for an effective expressive style.

1PM2-R04 : Development I

Room 4, 15:15 – 17:15 Monday 25 August 2007, Oral session

Categorization of Melody During the First Year of Life

Eugenia Costa-Giomi, Leslie Cohen, Danielle Solan, Ashley Borck; University of Texas at Austin, USA

`1PM2-R04-1`

The ability to recognize a melody despite variations in some of its musical characteristics is essential for the understanding of music. The cognitive process of recognizing equivalence among stimuli that are not the same is called categorization. In order to group similar stimuli under the same category, listeners must disregard perceived differences among the stimuli and focus on their common properties. In other words, categorization requires the perception of both differences and similarities between stimuli.

We completed a series of experiments with 7- and 11-month olds to study the development of melodic and timbre discrimination and categorization during the first year of life. A habituation-novelty preference procedure was used. We found that 7- and 11-month olds can discriminate between instruments playing the same melody and can also discriminate between melodies played by the same instrument. We then proceeded to study categorization by determining whether infants can recognize a melody played by different instruments and an instrument playing different melodies. The results indicated that 7- and 11-month olds could do the latter but not the former. In other words, they could categorize timbre but not melody after short-term habituation to the stimuli.

Development of Tonal Organization: A Case Study in Melodic Improvisation

Pirkko A. Paananen; University of Jyväskylä, Finland

`1PM2-R04-2`

In a previous cross-sectional study of melodic keyboard improvisation of children aged 6 to 11 years it was found that tonal stability developed as a function of age, in accordance with the some earlier perceptual studies of tonal hierarchy. To further investigate whether tonality develops from a more global representation of pitch to hierarchical organization in melodic improvisation, a 2-year longitudinal case study was conducted with one child, who in the beginning of the study was 6 years 4 months (January 2006) and in the end of the study 8 years 4 months of age (January 2008). The child improvised on an accompaniment identical to the previous cross-sectional study, using eight marked keys of the synthesizer (diatonic scale, C major) for instrumental improvisation, and a headset and microphone for vocal improvisation. The child used stable tones as reference in both keyboard and

vocal improvisations increasingly with age. The ambitus of the melody was larger and motor exploring was typical in keyboard melodies. Vocal melodies were more static and pitch accuracy changing. Instrumental and vocal improvisation revealed different aspects of the development of the tonal organization in childhood.

Origin of Singing; Infants' Vocalization in Solitude

Yohko Shimada, Shoji Itakura; Kyoto University, Japan

`1PM2-R04-3`

The present study reported here investigated the psychological meaning of infants' vocalization when they are alone without any responses. In the experiment, we compared frequency and duration of the sound in three conditions; 1) an adult (caregiver) respond naturally to infant's vocalization, 2) infants are kept alone and begin to vocalize spontaneously, 3) Infants are kept alone and begin to vocalize spontaneously, with amplified sound feedback by stereo speakers. In all conditions, infants did not express uncomfortable such as crying or fussing. As a result, the duration of the behavior was significantly higher in the amplified condition than the respond condition. Ratio of sound during the recording was marginally higher in the alone condition than the respond condition, and the alone with amplified feedback condition than alone condition. The results suggested that infants vocalize not only for response to others but also listening the sound of their own.

Music in Our Lives: An Investigation of Music Learning Between 9–19 Years of Age

Jane Davidson[1], Paul Evans[1], Robert Faulkner[1], Gary E. McPherson[2]; [1]University of Western Australia, Australia; [2]University of Illinois at Urbana-Champaign, USA

`1PM2-R04-4`

This paper to investigate the factors that influence the current role of music in the lives of young adults (19 years old) who had formal music learning opportunities in primary school and who either persisted or gave up performance in the interim. It draws together data from a research project started in 1997 in which McPherson and Davidson began tracing the learning experiences of beginning instrumentalists, and continued for five years, by which time only 45 of the original 158 were still playing their instruments. Results compare the early opportunities with current achievements and factors crucial to continuing or quitting the musical learning are shown to include incremental beliefs about abilities and learning, family support, flexible strategies to problem solving when practising. To date there have been few longitudinal research opportunities to explore music learning in such a manner, especially how this music learning experience affects their adult lives, whether they persist in their learning or not, thus this paper contributes significantly to the research in music learning.

1PM2-R05 : Neuroscience I

Room 5, 15:15 – 17:15 Monday 25 August 2007, Oral session

Time Courses of Cortical Beta and Gamma-Band Activity During Listening to Metronome Sounds in Different Tempi

Takako Fujioka[1], Edward W. Large[2], Laurel J. Trainor[3], Bernhard Ross[1]; [1]Rotman Research Institute, Canada; [2]Florida Atlantic University, USA; [3]McMaster University, Canada

`1PM2-R05-1`

Oscillatory cortical activities in beta-band (13–20 Hz) are related to somatomotor system and gamma-band (> 20Hz) are involved with feature binding in perception. Previously gamma-band activity in electroencephalography was found to modulate with musical pulse with a two-beat metric accent. The present study examined beta- and gamma-band activities in auditory cortices recorded via magnetoencephalography (MEG) when subjects listened to musical pulse in various tempi. Tones were presented with an interval of (1) 390, (2) 585 and (3) 780 ms, and (4) with irregular intervals between 390 to 780 ms, and (5) with 390 ms-interval with a two-beat accent while occasionally a tone was omitted at the accented one, and (6) at the unaccented one. Results showed that beta-band activity decreased immediately after the stimulus and returned to the previous level just before the next stimulus,

regardless of the interval (tempo) while this pattern disappeared in the irregular condition. The omission of a tone resulted in an extra beta rebound. In contrast, gamma-band activity exhibited a peak right after the pulse, or the omission. We propose that beta oscillations may support encoding of predictable regularity in the stimulus sequence, whereas gamma oscillations likely reflect processing of the current auditory events.

The Effect of Musical Training on the Subcortical Processing of Musical Intervals

Kyung Myun Lee, Erika Skoe, Nina Kraus, Richard D. Ashley; Northwestern University, USA

`1PM2-R05-2`

How does the early (subcortical) stage of the auditory pathway encode musical intervals? We sought to examine how the subcortical auditory system of the human brain, specifically the brainstem, represents the acoustic properties of consonant and dissonant intervals, and how musical training might alter this representation. The auditory brainstem response (ABR) represents the spectral and temporal properties of sound with considerable fidelity. In the ABR, the fundamental frequency (pitch) and its harmonics (up to about 1000 Hz) are represented by phaselocking. There is a growing body of evidence to suggest the subcortical representation can be modified by long-term auditory experience such as musical training. Using scalp-electrodes, we measured ABRs (10 musicians and 10 non-musicians) to two chords: major 6th (G2 and E3) and minor 7th (F#2 and E3). The ABR accurately reflects the frequency and time-varying components of the two chords, however, musicians show more robust representations of higher harmonics than non-musicians, especially for the dissonant chord. Interestingly, the two groups did not differ in their representation of the fundamental frequency, nor in their representations of the individual notes in each interval. These results suggest that musicians have specialized sensory systems for processing musical intervals that occur as a consequence of their extensive musical experience. [supported by NSF Grant 0544846]

Beat Initiation versus Continued Beat Perception: The Role of Motor Areas in the Brain

Jessica A. Grahn, James B. Rowe; MRC Cognition and Brain Sciences Unit, UK

`1PM2-R05-3`

Certain motor areas in the brain (e.g., basal ganglia) are involved during auditory perception of sequences with a beat even when no movement is made. It is unclear, however, if the activity is due to early processing, such as *searching* for the beat, or later processing, such as internal beat generation. We investigated neural activity for different stages of beat perception using fMRI. Participants listened to a series of beat and non-beat sequences. The beat sequences could be preceded by a non-beat sequence, (the beat therefore must be perceived anew ('beat-new' condition)), or could follow another beat sequence with the same beat rate ('beat-continuation', or a different rate ('beat-interference'). If the basal ganglia are involved in 'finding' a beat, activity should be greater for 'beat-new' and 'beat-interference' sequences, whereas if the basal ganglia are involved in later beat processing, activity should be greater for 'beat-continuation' trials. We found greatest activity for beat-continuation trials, and less activity for beat-new and beat-interference trials. Other motor areas did not show this pattern of activation. Thus, the basal ganglia are more responsive to later stages of beat processing, suggesting a role in beat generation or prediction, as opposed to searching for the beat.

fMRI Investigation of an Enculturation Effect Among Western and Turkish Listeners

Steven M. Demorest [1], Steven J. Morrison [1], Laura A. Stambaugh [1], Munir N. Beken [2], Todd Richards [1], Clark Johnson [1]; [1]University of Washington, USA; [2]University of California at Los Angeles, USA

`1PM2-R05-4`

The purpose of this study was to test the hypothesis that listeners demonstrate patterns of activation associated with music structural processing, when encoding and retrieving both culturally familiar and unfamiliar stimuli. Participants (8 US, 8 Turkish) were right-handed adults and musical novices. Stimuli consisted of 9

30-second instrumental music examples: 3 Western classical, 3 Turkish classical, 3 Chinese traditional followed by a 12-item memory test completed in the scanner. Replicating the findings of previous research, all subjects were more successful remembering novel music from their home culture. There was increased activation in right frontal areas when subjects listened to culturally unfamiliar music suggesting greater cognitive demands for music constructed according to unfamiliar structural principles. We interpret the findings to mean that listeners interact with both culturally familiar and unfamiliar music in similar ways. That is, listeners employ common cognitive strategies to information identified as music, though easy access to deeper structural information appears restricted to individuals encultured to a given musical tradition. These results reflect the cultural specificity of music schemata that allow listeners to efficiently and effectively encode and recall musical information.

1PM3-R01 : Social Interaction
Room 1, 17:30 – 19:00 Monday 25 August 2007, Oral session

Exploring Enforced Occupational Change in Opera Singers: A Case Study Investigation into the Effects of Musical Identity in the Context of Career Change

Jane Oakland, Raymond MacDonald, Paul Flowers; Glasgow Caledonian University, UK

1PM3-R01-1

This paper is concerned with issues of construction and maintenance of identity within the context of occupational crisis. Interpretative Phenomenological Analysis (IPA) is used to investigate one opera singer who has been forced to abandon an operatic career as a result of physical disabilities, which despite extensive investigation have no medical diagnosis. The study examines how an identity concept, which has been constructed as a result of many years of professional opera work, has been challenged and questioned as a result of this illness. Under discussion will be the multifaceted, sometimes contradictory relationship the participant has experienced between singing, performance and control of musical expression and in particular the way his physical disabilities have impacted his sense of self as he re-negotiates an identity perception outside the operatic community. The study also evaluates the use of IPA as a methodology to investigate areas of musical identity in a case study situation.

Non-Musician Adult Perspectives on the Role of Music in the Formation and Maintenance of Musical Identities: An Interpretative Phenomenological Analysis (IPA)

G.N. Caldwell, Raymond MacDonald, B. Duncan; Glasgow Caledonian University, UK

1PM3-R01-2

Identity research is growing rapidly. Many current studies on musical identity focus upon childhood- and/or adolescent-centred investigation through quantitative measurement. Also, participants, often musicians, are usually defined by genre and/or duration of music lessons/levels of technical achievement attained. However, there is a need for research that investigates the role of music as a constituent part of identity from the perspective of adults who define themselves non-musicians. The current paper seeks to highlight the utility of Interpretative Phenomenological Analysis (IPA) for psychological research into musical identity. This paper, based on 10 open-question semi-structured interviews, examines the relationship between identity and music. Results suggest that musical identity is a subjective and socially constructed phenomenon. Emergent, recurring and superordinate thematic observations are discussed and analysed from a 'participant as expert' standpoint. Data from this study support the utility of IPA and provide avenues of further research employing both quantitative and qualitative methods. Music is a key factor in the formation and maintenance of personal and musical identities and plays a central role in mediating underlying psychological constructs across the lifespan. This research provides further evidence to support the assertion that all individuals, regardless of musical experience, have musical identities.

1PM3-R02 : Computational Models and Analyses I

Room 2, 17:30 – 19:00 Monday 25 August 2007, Oral session

Realizing Feature Exaggeration in Scale-Performance on the Piano

Shinya Morita [1], Norio Emura [1], Masanobu Miura [1], Seiko Akinaga [2], Masuzo Yanagida [3]; [1]Ryukoku University, Japan; [2]Shukugawa Gakuin College, Japan; [3]Doshisha University, Japan
1PM3-R02-1

This paper aims at realizing a feature exaggeration system for automatic scale performance on the piano with performance parameters modified from the originals extracted from the input human performance. The proposed system generates simulated performances by manipulating the extracted performance parameters. This paper proposes a set of parameters for describing performance features of scale-playing on the piano. The set consists of 15 parameters, or three sets of five parameters p_{i0} through p_{i4} where $i \in \{t, v, d\}$ distinguishes three basic features; onset time, velocity, and duration. Each of these basic features is modeled as the sum of a global curve and deviations from it, where the spline interpolation is employed using locally averaged points, or representative points, as the points to be passed. The suffix j in p_{ij} distinguishes the standard deviations (j=0), the rms deviation from the spline curve (j=1), the range of the spline curve (j=2), the rms difference between successive notes (j=3), and the rms of the spline curve from the metronomic line (j=4). All parameters are made controllable on the screen with slider bars from 0% up to 200% for synthesizing from "suppressed" to "exaggerated" performance, where 100% represents the original performance.

Development of an Automatic Basso Continuo Playing System for Baroque Music Performers

Masahiro Niizuma, Masaki Matsubara, Hiroaki Saito; Keio University, Japan
1PM3-R02-2

The purpose of this study is to develop an automatic basso continuo playing system. In order to find musically appropriate sequence of chords, we define "harmony cost" as the sum of two different costs; One is the "local cost" which indicates the likelihood of a certain chord allocation and the other is the "transition cost", which indicates the likelihood of a certain connection between two chords. Automatic basso continuo playing is realized by searching the most optimal chord sequence, which minimize the accumulated harmony cost. Our system is evaluated by three experiments. Each result showed the effectiveness of our approach.

Gaussian Process Regression for Rendering Music Performance

Keiko Teramura [1], Hideharu Okuma [1], Yuusaku Taniguchi [1], Shimpei Makimoto [1], Shin-ichi Maeda [2]; [1]NAIST, Japan; [2]Kyoto University, Japan
1PM3-R02-3

So far, many of the computational models for rendering music performance have been proposed, but they often consist of many heuristic rules and tend to be complex. It makes difficult to generate and select the useful rules, or perform the optimization of parameters in the rules. In this study, we present a new approach that automatically learns a computational model for rendering music performance with score information as an input and the corresponding real performance data as an output. We use a Gaussian Process (GP) incorporated with a Bayesian Committee Machine to reduce naive GP's heavy computation cost, to learn those input-output relationships. We compared three normalized errors: dynamics, attack time and release time between the real and predicted performance by the trained GP to evaluate our proposed scheme. We evaluated the learning ability and the generalization ability. The results show that the trained GP has an acceptable learning ability for 'known' pieces, but show insufficient generalization ability for 'unknown' pieces, suggesting that the GP can learn the expressive music performance without setting many parameters manually, but the size of the current training dataset is not sufficiently large so as to generalize the training pieces to 'unknown' test pieces.

1PM3-R03 : Psychoacoustics I

Room 3, 17:30 – 19:00 Monday 25 August 2007, Oral session

Sensitivity to Temporal Deviations on the Starting Point or the Ending Point of "Frequency" Glides

Satomi Tanaka [1], Minoru Tsuzaki [1], Eriko Aiba [1], Hiroaki Kato [2];
[1] Kyoto City University of Arts, Japan; [2] ATR-CIS, Japan

1PM3-R03-1

The occurrences of sound events in a sound stream can be perceived without critical difficulty even when it is difficult to define the corresponding acoustic boundary. This study is designed to investigate which acoustical feature functions as an effective cue to "mark" the occurrence of a new event. In the case where a sound glides quickly in frequency, at which point do we perceive the occurrence of the second sound, the starting point of the frequency glide or the ending point? To answer this question, experimental stimuli are designed so that an isochronous structure is conveyed exclusively by the starting or by the ending points of the glides. The frequency glide modulates the carrier frequency of a sinusoid in the first experiment so that the stimulus has the change in pitch, and the resonant frequency of a complex tone in the second experiment so that the stimulus has the change in timbre with no pitch change. In both experiments, the deviation from the isochronous structure is detected more easily under the starting-point condition than under the ending-point condition. The results suggest that the starting point function as a more effective cue to mark a new event than does the ending point [Work supported by the Grant-in-Aid for Scientific Research (B) No. 20300069, JSPS].

Factors Influencing Spatial Pattern Recognition in a Musical Context

Blas Payri, José-Luis Miralles-Bono; Universidad Politécnica de Valencia, Spain

1PM3-R03-2

Our experiment studies the recognition of spatial patterns and their usability as a musical language element. We used 4 rhythm patterns played at 2 different tempi. The sounds moved between left and right, either continuously or with abrupt changes. 7 timbres were used: 4 synthetic (sine and square wave, white noise) akin to psychoacoustics typical material, and 3 that represented real musical material (voice, orchestra). The stimuli were played in a silent room over two loudspeakers to 20 musicians that were asked to recognize the rhythm pattern out of a set of 4 patterns. A simplified version was played to 30 non-musicians that had to guess whether the movement accelerated.

The statistical analysis shows that mean differences in right/wrong pattern recognition were significant when at the .01 level depending on timbre harmonicity, listener position, jitter, movement shape, and rhythm pattern. Thus spatial patterns can be perceived better for harmonic sounds with neither temporal variations (jitter or tremolo) nor noise components. The literature is rich in studies of sound localization with simple sounds, but few studies deal with material actually used by electroacoustic composers (spatial trajectories, complex timbres) and we show that spatial trajectories recognition in a concert hall is fragile.

On the Factors of the Spatial Impressions of Reproduced Music in Surround Sound Comparing Recording Techniques

Toru Kamekawa, Atsushi Marui; Tokyo University of the Arts, Japan

1PM3-R03-3

Microphone technique for surround sound recording of an orchestra are discussed. Seven types of surround microphone sets recorded in a concert hall were compared in subjective listening test on the attributes such as powerfulness and spaciousness using a method inspired by MUSHRA (MUltiple Stimuli with Hidden Reference and Anchor). To minimize temporal change in music, Phase Randomized Signal (PRS) was proposed. From the average score of the listening test, the impression difference between original source and PRS was found in some microphone arrays at some pieces. It means that the impression of these arrays depend on temporal changes in music. The data from the listening test between original source and PRS showed that impression of powerfulness had slightly higher correlation. The relations of the

physical factors of each array were also compared, such as SC (Spectral Centroid) and LFC (Lateral Fraction Coefficient) of each array. The correlation of these physical factors and the attribute scores show that the contribution of these physical factors depends on music and its temporal change. 'Powerfulness' is related to timbral character and 'spaciousness' is related to temporal change. Furthermore signals synthesized from IR (impulse response) of each array were also compared. It was reaffirmed that sound of orchestra is consisted from more complicate signals.

1PM3-R04 : Perception of Musical Structures
Room 4, 17:30 – 19:00 Monday 25 August 2007, Oral session

Beginnings, Middles, and Endings: The Effect of Musical Parameters on the Perception of Intrinsic Formal Functionality

Michel Vallières [1], Daphne Tan [2], William E. Caplin [1], Joseph Shenker [1], Stephen McAdams [1]; [1]McGill University, Canada; [2]University of Rochester, USA

`1PM3-R04-1`

This study investigates the perception of intra-thematic formal functions — the temporal role of beginning, middle, or ending played by a musical passage within the boundaries of a theme — as expressed through musical materials. We examined the role of various musical parameters in the perception formal functionality in short, out-of-context musical excerpts. Participants (separate groups of 20 musicians and 20 non-musicians) heard two types of stimuli: original excerpts of Mozart's piano sonatas and modifications thereof. Their primary task was to identify the excerpts as a beginning, middle, or end of a theme. The original excerpts were modified by altering individual musical parameters. All modifications had to remain stylistically coherent. The results obtained in the first two experiments of this project showed, notably, an effect of (1) the excerpt's opening tonic and dominant harmonies on musicians' perception of beginnings and middles; (2) the unaccompanied anacrusis on musicians' and non-musicians' perception of beginnings and middles. The current study presents the results from the third experiment. They provide, notably, greater insight into the form-functional impact of (1) non-tonic harmonies other than the dominant on musician's perception of beginnings and middles; and (2) several aspects of the unaccompanied anacrusis — such as the opening scale degrees, texture contrasts, and duration — on musicians' and non-musicians' perception of beginnings and middles.

Effects of Leading and Following Contexts on the Music Sound Restoration

Takayuki Sasaki; Miyagi Gakuin Women's University, Japan

`1PM3-R04-2`

When a sound in a melody is deleted and replaced by a noise, the absent sound can be restored perceptually. This phenomenon, Music Sound Restoration, has been studied by indirect methods, that is, noise localization method (Sasaki, 1980) and discrimination method (DeWitt & Samuel, 1990). In the present study, Music Sound Restoration was studied by means of a report method. It was examined whether a leading or a following context has an influence on the perceptually restored sound (pitch). Ten musically trained listeners, without any knowledge about Music Sound Restoration, were asked to write down what they heard in a music notation. Two sounds in each of simple short tunes were removed and replaced by pink noises. As context information, a major or a minor chord was added previous to or following after the tunes. When the leading chord was major, the listeners reported the melodies in a major key. And when the leading chord was minor, they reported minor melodies. This context effect was observed also when the context chord was added after the tunes. It was revealed that the restored pitch is strongly dependent upon the context cue.

Children's Impression and Expression of Major, Minor, Whole-Tone, and Korean Traditional Scales

Eunsil Park; Seoul National University, Korea

`1PM3-R04-3`

The present study examined perception of major, minor, whole-tone, Korean traditional scales on condition of different tempo, and expression of those scales through

their own compositions. To examine impression of musical scales, I had the 5th grade students listen to 9 short musical phrases. While students listened to music, they checked on a meaning discrimination test. To examine children's expression of musical scales, 32 children of the 5th grade divided into 6 groups composed music. Their composing procedure involved listening to music related with a scale, searching common features, deciding title suitable for the scale, making music and performing, revising and recording.

The results of discrimination test displayed music in specific scale evoked specific mood, major showed positive but minor, Korean, and whole-tone negative. And children's composition showed different scale produced different composing characteristics, that is, title, measure, rhythm, sequence, closure, central tone were changed according to scales.

Children tend to be affected more by tempo than scale, when they listen to music. Generally different scales evoke different moods. Fast music makes more positive emotional responses than slow music. The titles of compositions are similar to the emotional responses of each scale. And children tend to concentrate more on the melody progress than rhythm and any other components. The products of composition reflect well many characteristics of each scale.

1PM3-R05 : Music Listening I

Room 5, 17:30–19:00 Monday 25 August 2007, Oral session

Metaphors of Motion in Listeners' Verbal Reports

Riitta Rautio; University of Jyväskylä, Finland
1PM3-R05-1

It is generally acknowledged that music elicits a sense of motion in listeners. There are, however, differing views (physiological, ecological, psychological, metaphorical) concerning the origins of the experience of motion. This study explored how listeners express their experience of musical motion in free verbal reports. Based on the assumptions of cognitive semantics and cognitive linguistics it is held that by exploring linguistic expressions one can conclude how the speaker understands the phenomenon under discussion. The data consisted of verbal reports (in Finnish), submitted to content analysis. Five musical excerpts were chosen from the repertoire of 20th century orchestral music, each excerpt possessing a clear pattern of ascent and/or descent. Preliminary results showed that the respondents tended to use motion verbs quite frequently when conceptualizing the semantic content of the excerpts. Descending pitch contours were connected either to subsiding dynamic processes or descending physical motion. In the latter case, descending motion was systematically conceptualized with verbs, which refer to locomotion caused by an external force, more specifically by gravity. The ascending pitch contour was conceptualized with verbs referring to motion caused by the mover him/herself. It seems that listeners use their bodily experience of gravity to conceptualize their experience of music.

Factors Influencing Music Preference Among Japanese Listeners Over 50 Years Old: Why do They Like Certain Songs?

Eri Hirokawa; Nagoya College of Music, Japan
1PM3-R05-2

The purpose of this study was to investigate why Japanese people miss certain songs when they grow older. The 233 Japanese people who participated in this study were 50 years old or older, and were either interview or they completed a survey. When answering the survey, they indicated which songs they miss and want to sing or listen to and why. Results showed that a third of the comments indicated that they missed particular musical selections because those songs are associated with specific memories, personal experiences or life events. Approximately 100 comments indicated that they miss certain music because those songs made them feel nostalgic. Results also showed that people miss songs that they used to sing or listened to. Many comments also indicated that people miss particular songs because they like musical elements of those songs, the mood or styles of those songs, or the composer or singers of those songs. People also enjoy listening or singing songs that provide positive effects on their mood or health. Such information is important for music therapists to enhance the quality of music applications and the quality of the lives of older adults. When music therapists pay attention to the music preferences of clients, the quality of music applications will become more therapeutic.

The Enjoyment in Opera — An Empirical Study of Visitors' Experience in Music Theatre

Johanna Jobst, Sabine Boerner; University of Konstanz, Germany

1PM3-R05-3

Our paper investigates the perceived artistic quality of the performance, visitors' affective responses, and context factors as predictors for the statement on their overall enjoyment in opera. After attending a performance of "The Magic Flute" by Mozart in the opera house of Dessau, members of the audience (n = 114) were asked to answer a questionnaire. Regression analysis yields visitors' affective responses to the performance as a better predictor of their overall enjoyment than the perceived artistic quality of the performance. However, satisfaction with the auditorium and service quality is shown to make virtually no contribution to the audience's overall enjoyment. Investigating intersubjective agreement on the overall enjoyment in opera, only minor individual differences (e.g., experts versus non-experts) are found.

2AM1-R02 : Melody

Room 2, 8:30 – 10:30 Tuesday 26 August 2008, Oral session

Polynomial Contour as a Core Feature for Representing Melodies

Daniel Müllensiefen, Geraint Wiggins; Goldsmiths University of London, UK

`2AM1-R02-1`

Melodic contour is often regarded as one of the most important features in the context of modelling music perception and melodic memory. Numerous psychological studies in the past have found contour to be an important mental representation of melodies or short melodic phrases. From an analytical point of view there have been several attempts to abstract a melodic contour representation from any given melody. These approaches differ in the degree of abstraction and the type of information used. In this paper we propose a novel method for representing melodic contour. This method is based on fitting a polynomial curve to the onset and pitch data of a melody using multiple regression. The melodic contour is then represented by the resulting set of polynomial coefficients. This representation of melodies allows for several interesting and useful applications. 1. To determine the commonness of any given melody with respect to a corpus of melodies by computing a probability space over the multi-dimensional distribution of the polynomial coefficients of melodic phrases. 2. This probability space also allows for the clustering of melodies into groups of similar contour. 3. The polynomial representation of melodies makes it also possible to construct several elegant and intuitively convincing similarity measures.

Perceptual Segmentation of Melodies: Ambiguity, Rules and Statistical Learning

Marcus T. Pearce[1], Daniel Müllensiefen[1], Geraint Wiggins[1], Klaus Frieler[2]; [1]Goldsmiths University of London, UK; [2]University of Hamburg, Germany

`2AM1-R02-2`

Models of perceptual segmentation in melody tend to rely either on local Gestalt-like rules that indicate boundary strength or statistical learning and the information dynamics of melody perception. In an experimental study, 25 musically trained participants were asked to indicate phrase boundaries during four repeated listenings of 15 unfamiliar, popular melodies. Several computational models of melodic segmentation are compared in predicting the participants' majority-voted boundaries. These include rule-based models (Cambouropoulos, 2001; Frankland & Cohen, 2004; Temperley, 2001), as well as simple (Saffran et al., 1999) and complex (Pearce & Wiggins, 2006) models based on statistical learning. The results indicate that the complex statistical model achieves comparable performance to the best of the rule-based models. Combining models selected on the basis of prediction accuracy and simplicity yields a hybrid model (containing both rule-based and statistical components) that outperforms its component models. To address low inter-rater agreement for many melodies, a further analysis is conducted in which participants sharing a similar segmentation strategy are clustered together for each melody separately. Nearly all melodies yield several perceptually valid and stable segmentations. This allows a more detailed comparative analysis of the various models' performance.

Pitch Space Processing and Melodic Expectancies in Tonal and Atonal Contexts

Juan Fernando Anta; National University of La Plata, Argentina

`2AM1-R02-3`

The extent to which tonal (TPS) or atonal (APS) pitch space, proximity and range, affect each other on melodic expectation was assessed. In Experiment 1, fourteen non-musicians rated how well test tones continued tonal melodies; in Experiment 2 fourteen non-musicians performed the same task with atonal versions of previously used fragments. Experiment 1 suggested that TPS did not affect expectation beyond a TPS-activated (TPS-a) area hypothesized for each fragment, and that events towards the TPS-a bulk were preferred. Experiment 2 showed that events placed towards the range bulk were preferred. Comparisons between data from both experiments

indicated that expectancies for events in the range bulk were greater in tonal than in atonal condition, suggesting that TPS-a should be considered a separate factor reinforcing expectations.

Recognition of Microtonal Musical Intervals by Performers and Composers

Terumi Narushima [1], Greg Schiemer [1], Emery Schubert [2], Richard Parncutt [3]; [1] University of Wollongong, Australia; [2] University of New South Wales, Australia; [3] University of Graz, Austria

`2AM1-R02-4`

Little is known about the ability of performers to perceive and reproduce microtonal intervals (intervals smaller than a semitone) relying purely on intervallic perception. The aim of this study is to explore the ability of trained musicians and composers to recognize microtonal intervals. Our experiments have demonstrated that within two weeks of learning, some participants are able to recognise with reasonable accuracy two tone sequential intervals that are varied by amounts smaller than 15 cents (15 hundredths of an equal tempered semitone). The results shed light on the ability to recognize microtonal intervals and the process by which such knowledge is acquired. Our data suggest that more complex forms of microtonality, such as 19-tone equal temperament or just tuning based on unfamiliar frequency ratios, can be performed successfully given sufficient practice over an extended period.

2AM1-R03 : Performance II

Room 3, 8:30–10:30 Tuesday 26 August 2008, Oral session

Experimentally Investigating the Use of Score Features for Computational Models of Expressive Timing

Sebastian Flossmann, Maarten Grachten, Gerhard Widmer; JKU Linz, Austria

`2AM1-R03-1`

In the expressive performance of music variation of tempo plays a major role in shaping and structuring the piece. We distinguish two aspects of tempo, the current tempo and the timing of individual notes with respect to the current tempo. Those two notions are influenced differently by the characteristics of the performed score. The relation between score and timing/tempo has many facets, one of which we examine more closely in the following. More precisely we provide experimental evidence for the hypothesis that timing is more aptly modeled with score characteristics from a small temporal score context, while tempo modeling profits from a bigger temporal score context.

Chopin's Rubato: A Solution

Manfred Clynes; Georgetown University, USA

`2AM1-R03-2`

We report on the Chopin rubato, not encountered with other composers, that lend to his music a unique power of communication, intimacy and often a touching charm not otherwise evident. No-one in is lifetime could equal Chopin's seemingly magical, and personal use of this.

Here we report on the discovery, using Superconductor II of a surprising but simple feature that appears to accomplish aspects of this elusive magic. The ritard curve is simply inverted. It is a faithful temporal inversion of a ritard function , with similar exponents: starting as a suddenly slowed tempo gradually returning to the normal tempo, with a dynamic curve similar to the ritard, but inverted in time. The gradual acceleration is carried beyond the normal tempo towards the end of the rubato phase, so that the total time taken may be only slightly different as if no rubato had taken place. Rubato often occurs initiated through a harmonic suspension with the resolution appropriately postponed. Several Chopin music examples of rubato realization are included in mp3 format. The complete first movement of the E minor piano concerto is being realized, including orchestra (well ahead of the 2050 Rencon deadline).

Intuitive Visualization of Gestures in Expressive Timing: A Case Study on the Final Ritard

Maarten Grachten[1], Werner Goebl[2], Sebastian Flossmann[1], Gerhard Widmer[1]; [1]JKU Linz, Austria; [2]McGill University, Canada

2AM1-R03-3

Expressive timing is vital for the aesthetic quality that makes us appreciate performed music. It is a largely tacit skill that musicians acquire by practice. A long-standing intuition is that expressive timing is closely related to the concept of motion. This view leads naturally to the adoption of a dynamical systems approach to the study of expressive timing. A well-known visualization technique from dynamical systems theory is the phase-plane representation. The application of this technique, that highlights the dynamic aspects of the data, is demonstrated in a case study on the final ritard in performances of Schumann's Träumerei. We argue that expressive gestures are visible in a clear and intuitive manner in the phase-plane representations. Another striking aspect of the phase-plane trajectories is their suggestion of human gestural motion.

Timing in Piano Music — Testing a Model of Melody Lead

Johan Bjurling, Roberto Bresin; KTH, Sweden

2AM1-R03-4

The main aim of this study was to investigate if a model of note synchronization, based on measurements of the mechanics of a real piano, would provide as side effects the so-called "melody lead effect" and more naturalness in automatic music performance of piano music. A real-time model was validated with a listening test.

Seven experienced pianists participated as subjects. For each of five pieces of music, they were instructed to adjust two sliders corresponding to parameters tempo and synchronization for making the piece sounding "as realistic as possible". Subjects could exaggerate the effect of both melody lead and inverted melody lead by up to 200 percent. In the second part of the test subjects were asked to adjust tempo to a preferred value with a slider, and to choose the most realistic synchronization with the mouse from three anonymous alternatives, in a forced choice fashion. The three alternatives corresponded to (1) perfect synchronization, (2) 100 percent melody lead, and (3) 100 percent inverted melody lead.

Main results show that on average subjects preferred positive synchronization values, corresponding to normal melody lead. Subjects preferred positive synchronization (normal melody lead) correlated with tempo, and this result assimilates reality. For negative synchronization values (inverted melody lead) the relationship to tempo seems more arbitrary.

2AM1-R04 : Emotion in Music I

Room 4, 8:30 – 10:30 Tuesday 26 August 2008, Oral session

Why do Listeners Enjoy Music That Makes Them Weep?

David Huron; Ohio State University, USA

2AM1-R04-1

Tearing of the eyes, nasal congestion, a constriction in your throat, and erratic breathing: your doctor would conclude that you are suffering from a severe allergic reaction. But in special circumstances, music can evoke precisely such symptoms. How does music evoke feelings akin to sadness or grief? And why do people willingly listen to music that may make them cry? In this presentation, some physiological, evolutionary, and behavioral aspects of adult crying are briefly surveyed. It is suggested that the pleasure of musically-induced weeping arises from cortical inhibition of the amygdala, and is linked to the release of the hormone prolactin.

Construction of a Quantitative Scale for Cheerfulness of Short Melodies

Kenta Shoji, Masashi Yamada; Kanazawa Institute of Technology, Japan

2AM1-R04-2

It has been shown that the cheerfulness of music depends on many factors such as tonality, tempo, performing register, and so on. However, it has not been

quantitatively defined how these factors determine cheerfulness. In the present study, three listening experiments were conducted to determine how the tonality, speed, and performed register vary the cheerfulness of music. In each experiment, listeners listened to each pair of stimuli and compared the cheerfulness of them with seven-step categories. Using Scheffé's method, each stimulus is plotted on cheerfulness scales. The performing register of a stimulus is evaluated as the centroid for the overall-term spectrum, and is shown in ERB (Equivalent Rectangular Bandwidth)-rate scale, in the present study. The results show that the degree of cheerfulness increases proportionally as the register shown in ERB-rate increases. Using this relationship, a quantitative scale of the cheerfulness can be constructed. On this scale, it is estimated that the effect of tonality (major or minor) corresponds to the centroid shift of 4 ERB-rate, and doubling the speed corresponds to an increase of the controid in 3.5 ERB-rate.

The Influence of Social Feedback on the Emotional Effects of Music

Hauke Egermann, Oliver Grewe, Reinhard Kopiez, Eckart Altenmüller; Hannover University of Music and Drama, Germany

`2AM1-R04-3`

Numerous studies have shown that music affects the so-called "subjective feeling" component of emotion. Our study investigates whether the emotional effects of music can be manipulated by social feedback. We used a web-based experiment because web experiments offer many advantages over lab experiments (like bigger external validity). The study was implemented into an online music-personality-test, in order to motivate subjects to take part. In about 10 minutes, participants could join data-collection and get personalised test results at the end, which described their music preferences and personality. The 2576 participants (mean age: 32,5 years (SD=12,6); 1443 male and 1133 female) were randomly assigned to 2 groups. All participants listened to 5 from 23 music excerpts (30 sec each) in random order. After each excerpt, participants rated the induced emotions using arousal and valence dimensions. Additionally, group 2 received faked feedback based on the emotional ratings of preceding participants. This was presented while the participants listened to the stimuli. Results show, that participants of group 2 (with social feedback) rate their own emotions significantly different compared to group 1 (without feedback) for 21 of the 23 pieces on at least one dimension. Looking at those group differences the feedback is proven to influence the participants' ratings. Thus, a social factor influencing emotional effects of music could be confirmed.

Construction and Validation of a Music-Directed Attention Scale (MDAS): A Preliminary Study

Joanna Kantor-Martynuska; Warsaw School of Social Psychology, Poland

`2AM1-R04-4`

Music-directed attention (MDA) is a tendency to automatically shift attention towards extant musical stimuli. MDA is defined with reference to theories of attentional resources and attentional filtering. A questionnaire measure of MDA, *Music-Directed Attention Scale* (MDAS), was constructed and validated. This paper presents the structure and psychometric characteristics of the MDAS. 422 musicians and non-musicians filled out a pilot version of MDAS which consisted of 44 items. Principal components factor analysis was performed on the results and suggested two independent factors named Distractability and Involvement. Distractability is a tendency to have music divert one's attention from tasks of primary focus, with a resulting decline in performance. Involvement consists in experiencing frequent and strong emotional responses evoked by music, which disturbs performance of the tasks of immediate importance. Three expert judges later freely categorized the items considering their content validity and consistency. Items with a strong response bias and those of insufficient validity were excluded from the present version of MDAS that consists of 13 items. Musical expertise was found to significantly affect the total MDAS scores and Involvement but not Distractability. MDAS is supposed to measure individual differences in a tendency to have one's attention involuntarily driven by music in a range of every-day contexts. The analysis of MDA's relationship with general attentional control and auditory style is in progress.

2AM1-R05 : Therapy

Room 5, 8:30 – 10:30 Tuesday 26 August 2008, Oral session

The Effects of Music Therapy on Declarative Memory Processes in Moderately Impaired Dementia Populations

M. Lynch [1], S.R. Toukhsati [1], D. O'Connor [1], M. Thaut [2], P.C. Bennett [1], B. Barber [3]; [1]Monash University, Australia; [2]Colorado State University, USA; [3]National Aging Research Institute, Australia

`2AM1-R05-2`

The aim of this study was to examine the effects of music therapy (MT) on declarative memory processes in persons diagnosed with probable Alzheimer's dementia. Participants were 57 individuals (MMSE = 15.57 ± 6.00; mean age = 83.09 years, SD = 7.46) from ten Residential Aged Care Facilities (RACFs). The effects of MT were compared with those following animal assisted therapy (AAT), diversional therapy (DT) and a no treatment control. Treatments were randomly assigned to RACFs and conducted in small groups, twice weekly for one hour over four weeks. A nested, mixed-model design compared pre- and post-intervention general semantic memory, personal semantic and episodic memory between groups. The findings revealed a significant improvement in autobiographical recall of events during childhood following AAT in comparison to MT (p < .05). In contrast, MT yielded an improvement in autobiographical recall of events during early-adulthood in comparison to DT (p < .01), but not in comparison to the no treatment control (p > .05) or the AAT group (p > .05). There were no significant changes evident with regard to general semantic memory or personal semantic memory. Taken together, these findings suggest that declarative memory processes are not generally responsive to MT. Methodological limitations and implications for future research will be discussed.

The Effects of Music Therapy, Animal-Assisted Therapy and Diversional Therapy on Attention and Memory Processes of Individuals with Probable Alzheimer's Dementia

R. Kharsas [1], S.R. Toukhsati [1], D. O'Connor [1], M. Thaut [2], P.C. Bennett [1], B. Barber [3]; [1]Monash University, Australia; [2]Colorado State University, USA; [3]National Aging Research Institute, Australia

`2AM1-R05-3`

The aim of this study was to evaluate the effects of exposure to music therapy (MT), animal assisted therapy (AAT), diversional therapy (DT) and a no treatment control (NT), on the attention and memory processes of cognitively impaired, elderly participants. The sample comprised 60 participants (mean age = 83.96 years, SD = 7.39) with mild to severe dementia (MMSE = 14.48 ± 6.89). A nested, mixed-model design was employed whereby each condition (MT, AAT, DT and NT) was randomly assigned to at least two Residential Aged Care facilities. Hour long group therapeutic interventions were scheduled twice weekly over four weeks. Pre- and post-intervention data on measures of cognition (MMSE), recognition memory, visual selective attention and auditory selective attention was collected. Findings revealed a significant interaction for the MMSE Language subscale (p < .05), with performance improvements observed following MT and DT in contrast to decrements following AAT and NT. An improvement on the MMSE Registration subscale was also observed (p < .05); however, improvements following MT were not differentiated from other conditions. There were no significant changes observed on the memory and attention measures. The application of a randomised controlled methodology has yielded data that do not support the utility of alternative treatments to ameliorate attention and memory deficits in dementia populations.

An Empirical Study of Proactive Multimedia Therapy Contents for Public: Production Design and Cognitive Response Measurements

Irene Eunyoung Lee, Charles-François Latchoumane, Jaeseung Jeong; KAIST, Korea

`2AM1-R05-4`

Whether it is under conscious or unconscious circumstances, people in today's society experience a range of multi-sensory stimulations through diverse confronted media that bring changes in feelings or moods. Multimedia contents including

arts and therapies are being developed increasingly nowadays, but their cognitive mechanisms and effects are still ambiguously ascertained. Can we really induce target emotions from audiences with short multimedia contents (60 sec. long) that employed abstractive visuals and non-lyrical musical expressions? If yes, would there be any common thread in audience responses to these purpose-driven new creations? In this study, under a hypothesis that it is possible to create certain emotion/mood inducing multi-modal contents, we first researched various psychology (and/or therapy) fields (e.g., music, colors, images, and motiongraphics) for guidelines to design three specific types of positive emotion elicitations (i.e., Relaxation, Happy, and Vigorous), and produced audio-visual contents based on the learned *expressive attributes*. Then we investigated the response of 12 subjects (6 males and 6 females, mean age 22 year old) on their EEG power differences between rest and watching movie sections, alpha asymmetry, cognitive performances during visual congruent continuous performance tasks (cCPT, attentional task), and self-evaluation question-naires. We concluded that emotional/mood induction using multi-modal contents could bring out changes in attention, visible from a behavioral study, however milder in the electrophysiological response.

2AM2-R07 : Musical Scales and Melody / Harmony and Tonality / Timbre / Psychophysics and Music Acoustics
Rooms 7, 10:40 – 12:30 Tuesday 26 August 2008, Poster session

The Relative Prevalence of Medieval Modes and the Origin of the Leading Tone

Richard Parncutt, Daniela Prem; University of Graz, Austria
2AM2-R07-01

The rank order of finals in the *Index of Gregorian Chant* by Bryden and Hughes (1969) is G (Myxolydian), D (Dorian), F, C, A, E, B. Why? Melodically, major-second intervals are universally preferred (cf. Vos & Troost, 1989), presumably for reasons of stream fusion and critical bandwidth. Adding M2s above/below a final creates a three-tone core, relative to which the tritone is avoided — presumably due to its low pitch commonality (Stoll & Parncutt, 1987). Harmonically, medieval musicians may have preferred the perceptual coherence created by optimizing pitch commonality between the spectral pitches of the finalis and the virtual pitches of the other tones. Both melodic and harmonic models are consistent with statistical prevalence data. In 13th-century polyphony, the leading tone lies a semitone below a following tone in a (consonant) harmonic dyad (Barsky, 1996). Why? Since B (and E) seldom function as finals, they are unstable, so the progression from B to C (or E to F) is more prevalent than the reverse. The tonality of major-minor music involves chroma stability profiles, which depend on chroma prevalence (Krumhansl, 1990). That in turn depends on two effects with distinct historical origins: the leading tone (c. 13th century) and chroma salience in the tonic triad (c. 16th). The success of key-tracking models may depend on how they separate these.

The Impact of Uniqueness in Musical Scales on Mistuning Detection

Marco Lehmann, Reinhard Kopiez; Hannover University of Music and Drama, Germany
2AM2-R07-03

In musical scales, the structural feature "uniqueness" refers to the idea that each scale tone can be unequivocally identified by its set of distances to the other scale tones (Balzano, 1982). The concept has been confused with the concept of scales with unequal step sizes (e.g., Trehub, Schellenberg, & Kamenetsky, 1999), and it is necessary to assert which one of the two is perceptually more prominent in musical scales. This study empirically compared two unique scale structures with one non-unique scale structure of unequal steps. We predicted that the two unique scales would allow for a better detection of mistuned single tones in repeated presentations. In contrast, on average, N=17 participants were more sensitive to mistunings in the non-unique scale condition. Moreover, exploratory analysis of the sensitivity for mistunings at different scale positions revealed that the vicinity of the target tones is possibly more important for the detection of mistuning than is the global scale structure. In fact, for each of the three scale structures, sensitivity diminished for targets following a comparably small scale step. In this study, uniqueness could not be promoted as

perceptually important for the detection of mistuning in musical scales. Conversely, the local structure of the scales appeared to be crucial in completing the task.

Assessing the Role of Sensory Consonance in Trained Musicians' Tuning Preferences

Johanna Devaney, Ichiro Fujinaga; McGill University, Canada

2AM2-R07-05

This study tests whether trained musicians' tuning preferences align with the interval sizes that can be calculated from the overtone series and whether there are any differences in the subjects' preferences when the intervals are produced with sine waves versus complex tones. This comparison is useful in assessing the impact of the partials in the tuning preferences. In the experiment, subjects were asked to tune one or two tones in relation to a sounding bass note; these tones were either a perfect octave, a perfect fifth, a major third, or a minor seventh above the bass.

This work builds on Terhardt's theory sensory consonance, which is rooted in Helmholtz's theory of consonance and dissonance. Helmholtz postulated that the coincidence of a significant number of partials between two pitches produces a consonance whereas the absence of such coincidence produces a dissonance. Terhardt found an inverse relationship between the degree of consonance and the amount of beating present in the sound. His theory suggests that the intervals that occur between lower partials and the fundamental sound more consonant when they are tuned to the integer ratio between that partial and the fundamental.

Estimating the Perception of Complexity in Musical Harmony

Jose Fornari, Tuomas Eerola; University of Jyväskylä, Finland

2AM2-R07-07

The perception of complexity in musical harmony is here seeing as being directly related to the psychoacoustic entropy carried by the musical harmony. As such, it depends on a variety of factors mainly related to musical chords structure and progression. The literature shows few examples of the computational estimation, directly from audio, of the complexity in musical. So far, the perception of this feature is normally rated by means of human expert listening. An efficient computational model able to automatic estimate the perception of complexity in musical harmony can be useful in a broad range of applications, such as in the fields of: psychology, music therapy and music retrieval (e.g. in the large-scale search of music databases, according to this feature). In this work we present an approach for the computational prediction of harmonic complexity in musical audio files and compare it with its human rating, based on a behavioral study conducted with thirty-three listeners that rated the harmonic complexity of one hundred music excerpts. The correlation between the results of the computational model and the listeners mean-ratings are here presented and discussed.

A Hybrid Model for Timbre Perception — Part 2: The Texture of Sound

Hiroko Terasawa, Patty Huang, Jonathan Abel, Jonathan Berger; Stanford University, USA

2AM2-R07-09

We propose a hybrid model of timbre integrating two complementary component models, one of "color" and the other of "texture". Previous studies on timbre perception describe a multidimensional space, in which spectral centroid, spectral fluctuation, and temporal attack and decay characteristics constitute the principal components. We propose that these factors can be effectively described in terms of a waveform's instantaneous spectral envelope (the color), and instantaneous temporal irregularity (its texture). The texture model employs normalized echo density (NED), developed by Huang and Abel ("Aspects of Reverberation Echo Density," AES 123rd Convention, New York, October 2007), as a metric to characterize the texture of noise with diverse granularity. Originally developed to describe perceived reverberation echo density, NED also appears to be useful for describing the temporal irregularities (texture) found in any sound object. In this experiment, we investigated the correlation between NED and perception of noise-like sounds with various static textures. The predictability of NED is consistent across the bandwidths tested, and at average NED explains 93% of the subjective judgments of texture dissimilarity. We therefore propose NED as a useful perceptual descriptor of a sound's time variant texture density.

Effects of Temporal Synchrony Between Two Sounds on Perceptual Impression Space and Its Relation to the Cochlear Delays

Eriko Aiba [1], *Minoru Tsuzaki* [1], *Satomi Tanaka* [1], *Masashi Unoki* [2];
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`2AM2-R07-11`

Onset synchrony is widely assumed to be an important cue for perceptual unification as a single tone. However, even if all the components physically begin simultaneously, their temporal relation might not be preserved at the cochlear level. This is called the cochlear delay. Our previous experiments about accuracy of judgment on perceptual synchrony between two sounds suggested the accuracy such as enhance the cochlear delays was higher than that such as cancel out the cochlear delays. Therefore, there is a possibility that the easiness of the perceptual unification differs according to the sound, because the range of the gap in time that assumed to be simultaneous is different depending on the sound. The perceptual impression space induced by the variation in the temporal gap between two sounds was estimated by the multi-dimensional scaling method. Three types of complex tones were used as stimuli to investigate whether the cochlear delay imposes a systematic bias in judging the perceptual unification of two sounds. As a result, the perceptual unification appears to occur more easily on the sounds such as cancel out the cochlear delays than that such as enhanced the cochlear delays. This result suggests the auditory system appeared more "tolerant" of the delay following the intrinsic, natural direction, i.e., the cochlear delay.

The Chromelodeon Scale: A Psychoacoustical Model of Roughness versus Harry Partch's One Footed Bridge

Alexandre Torres Porres; University of São Paulo, Brazil
`2AM2-R07-13`

Under a Psychoacoustical point of view, and because of the partials' alignment, it is the spectrum of sounds that determines the consonance of given musical intervals. For example, harmonic spectrums do align their components in harmonic musical intervals. On this paper, I adopt a computer software to analyze the spectrum of the Harmonium built by Harry Partch (the Chromelodeon). Its results show which are the most consonant steps in the span of an octave. I use this data to compare to a similar graph designed by Harry Partch, his *One Footed Bridge*. A major concern behind this research is to question at what extent musical intervals related to higher harmonics do provide a perceptual significant consonance perception. Another consequence is to promote a revision of Harry Partch's theoretical work.

2AM2-R08 : Rhythm and Timing / Body Movement / Memory

Rooms 8, 10:40 – 12:30 Tuesday 26 August 2008, Poster session

Effects of Musical Training and Tapping the Beat on Perceived Complexity of a Rhythm

Louis N. Vinke, J. Devin McAuley; Bowling Green State University, USA
`2AM2-R08-01`

Musical rhythms vary in complexity. However, many questions remain concerning the best way to measure rhythmic complexity in a manner that corresponds to listeners' perceptions. The present study (1) examined the potential mediating roles of musical training and tapping a beat on listeners' subjective ratings of rhythmic complexity and (2) evaluated previously proposed measures of rhythmic complexity. Of particular interest was the PS-measure proposed by Shmulevich & Povel (2000). Musicians and non-musicians rated the complexity of sixty-five auditory rhythms on a six-point scale (1 — very simple, 6 — very complex) in listen-and-tap and listen-only conditions. In the listen-and-tap condition, participants tapped along with rhythms at a steady rate that they felt coincided with the 'beat' before making a complexity judgment. In the listen-only condition, participants did not tap before making a complexity judgment. Results reveal that tapping the beat increased complexity ratings, but there were no clear differences attributable to musical training. Overall, mixed support was found for the PS measure of rhythmic complexity. Although the PS measure was positively correlated with judged complexity, tapping the beat while

listening to each rhythm, which was expected to <u>strengthen</u> the induction of a 'beat', increased rather than decreased complexity ratings.

Examining the Relationship Between Phonological Skills and Temporal Processing in Very Young Children

Charles Wigley, Janet Fletcher, Jane Davidson; University of Western Australia, Australia

2AM2-R08-03

It is widely acknowledged that phonological processing plays a critical part in literacy acquisition. Recently however, questions have been raised about the nature of these processes and currently there is evidence that basic temporal processing abilities may also significantly contribute to literacy development. This study investigates the links between a purely motor-rhythmic measure of temporal processing ability (synchronous beat tapping) and two pre-literacy indicator measures: Rapid Automized Naming [RAN] and Phonological Awareness [PA], at the early stages of literacy acquisition. Fifty kindergarten children were tested on PA, RAN, synchronized beat tapping, IQ and musical perception. Success for synchronised beat tapping was calculated as the maximum cross-correlation (*Max r*) between the transformed stimulus and response waveforms and the top and bottom performing quartiles were examined for differences on the pre-literacy skill measures using ANCOVA. Controlling for age, IQ and musical perception skills, a significant difference was found for RAN ($F(1, 23) = 7.17$, $p < .05$, $\eta_p^2 = .27$) but not PA ($F(1,23) = 1.45$, $p > .05$). These results suggest that at the earliest stages of literacy development, basic temporal processing skills (such as those used to perceive beats and generate rhythmic movements) may contribute to at least one behavioural measure strongly associated with literacy acquisition (RAN).

Moving to Music: The Influence of Familiarity, Enjoyment, and Groove on Spontaneous Dance

Bradley W. Vines [1], Petr Janata [2]; [1] University of British Columbia, Canada; [2] University of California at Davis, USA

2AM2-R08-05

Moving spontaneously while listening may be the most common act of musical engagement. The experience of familiarity, enjoyment, and groove may affect one's propensity to move. This research aims to determine how these three factors affect spontaneous dance. Participants completed online questionnaires pertaining to their general background in music and dance, and suggested music that makes them feel like dancing. They listened to segments of their own suggestions, as well as the other participants', and rated them on familiarity, enjoyment, groove, and the "urge to move." In the laboratory, a movement-tracking system measured participants' body movements while they listened to the music presented online. A preliminary analysis, using linear regression and correlation statistics, revealed that the perception of groove accounted for the most variability in the urge to move, and that judgments of the urge to move best modelled the amount of head movement. Further analyses will explore patterns of spontaneous motion associated with the experience of being in the groove with music, as well as the effects of interactions among familiarity, enjoyment, and groove on body movement. These data provide evidence for the connection between perceived groove and motor activity in the brain.

'Notes Inégales' in Contemporary Performance Practice

Dirk Moelants; Ghent University, Belgium

2AM2-R08-07

Playing the first of two equally notated notes notably longer than the second, the so-called 'notes inégales', is a common practice in the performance of French baroque music. It is a means of expression and enhances the metric structure of the (dance) music. Although there is a general agreement between performers about the application of 'inequality', its exact performance is an ongoing source of debate. In an experiment 8 harpsichordists and 8 baroque violinists performed 6 melodies of French baroque gavottes in three tempo conditions 40-60-80 bpm, along with a metronome. The mean ratio of inequality was about 1.63:1. Yet, a lot of variability was found with mean ratio's of individual performers varying between 1.89 and 1.33. Another main source of variance is the metric structure, with larger inequality found at metrically important points. The base tempo also has an important influence on the performance of the 'inégalité', but it is treated in very different ways by different

performers. Pitch factors have only a minor impact. Even in simple pieces individuals convey a personal expressivity through their use of 'notes inégales'. The results can be related to historical evidence (e.g. from mechanical instruments) and to the prosody of the French language.

Long-Term Memory for Simple and Complex Music: Quantity and Quality of Practice

Jane Ginsborg, Jenny Pitkin; Royal Northern College of Music, UK

`2AM2-R08-09`

Research into the recall of musicians for the music they perform from memory has focused on the effects of musical expertise, mental representations and the development of performance cues, practice and memorizing strategies and the characteristics of the music itself. The process whereby the memory trace of a performer for a specific piece of music fades over the course of time has also been described. The present study aimed to explore the effects of the expertise of performers and their practice quantity and quality on accuracy of recall for one of two newly composed pieces of music, simple and complex, in a series of performances from memory. Conservatoire students, all wind instrumentalists, kept practice diaries as they memorized either a simple or complex piece, which they then performed from memory over a four-week period. Errors and hesitations were analyzed in order to calculate accuracy and fluency of recall in each performance. There was a significant effect of expertise but no effects of quantity of practice or level of complexity. Content analysis of the diaries suggested that quality of practice — like quantity — varied widely. Strategies used by the more successful memorizers included mental practice, auditory and visual approaches, and attention to details. These findings have obvious applications for the teaching of effective practicing strategies at all levels.

Nameability: Can Unique Verbal Labels Improve Recollection of Music and Faces?

Jack D. Birchfield [1], James C. Bartlett [1], Andrea R. Halpern [2]; [1]University of Texas at Dallas, USA; [2]Bucknell University, USA

`2AM2-R08-11`

The present research examines whether nameability, defined here as the association of a proper name or some other uniquely identifying description with a given stimulus item, enhances the role of recollection in recognition of melodies. An additional goal was to extend our findings with melodies to another class of non-verbal stimuli: photographs of faces. To dissociate familiarity and nameability, we assembled familiarity-matched sets of highly nameable and low nameable items, as well as sets of unfamiliar items. Stimulus items were presented in a study/test procedure, using the remember-know paradigm to measure recognition performance. Our main hypothesis, that remember responses (indicating a recollective experience) would be more frequent for high-nameable items than for low-nameable items, was confirmed for both melodies and faces. A secondary hypothesis, that know responses (suggesting judgments based on familiarity) might be more frequent for low-nameable items than for high-nameable items, was also confirmed for both stimulus types. However, overall hit rates (remember + know responses) for high- and low-nameable items were significantly different for faces but not for melodies. We suggest that recognition memory for melodies may be more dependent on a sense of global familiarity than on a specific verbal label.

Memory for Tempo in Oral Music Traditions: Evidence for Absolute Tempo in Aboriginal Ceremonial Song?

Freya Bailes [1], Linda Barwick [2]; [1]University of Western Sydney, Australia; [2]University of Sydney, Australia

`2AM2-R08-13`

While long-term memory for the tempo of highly familiar music can be precise, it has been suggested that there is greater variability in the recalled tempi of performances of music for which no fixed version is known, as in oral music traditions. This study examines the tempi of multiple performances of one particular Aboriginal dance-song, to determine tempo stability within a specific oral music tradition. *Djanba* are ceremonial dance-songs from the Murriny Patha speaking people in the Wadeye area of the Northern Territory of Australia. The songs are characterized by a distinctive clap stick beat. We analysed the tempo of 49 extant recordings of

djanba 14, spanning a period of 34 years. The mean tempo of the recordings is 141 bpm (range 127–148), and a standard deviation of 3 bpm indicates that performance tempi deviated positively or negatively, on the average, by only 2%. There was no overall tendency for the tempo to decrease or increase either during a performance, or across the 34-year span. The lack of variation in the tempo of *djanba 14* is remarkable in the face of the numerous factors that are likely to modulate both choice of tempo and its stability through time, and these factors are discussed.

2AM2-R09 : Music Listening and Preferences / Development / Performance / Audio-Visual Interactions / Psychoacoustics

Rooms 9, 10:40–12:30 Tuesday 26 August 2008, Poster session

Effects of Orchestration on Musicians' and Nonmusicians' Perceptions of Musical Tension

Brian A. Silvey; University of Texas at Austin, USA

`2AM2-R09-01`

The purpose of this study was to examine the effects of orchestration on musicians' and nonmusicians' (N = 40) perception of musical tension. Participants were asked to register their perceptions of tension using the Continuous Response Digital Interface (CRDI) dial while listening to three orchestrations of the movement *Bydlo* from Mussorgsky's Pictures at an Exhibition. The full orchestra and brass quintet stimuli were digitally altered to have the same amplitude, frequency, and duration as the third orchestration for solo piano. Graphic analysis revealed similarities in how musicians and nonmusicians perceived tension across time for each of the three stimuli. Pearson product-moment correlations between the participant groups were all statistically significant at the $p < .001$ level and highest for brass quintet ($r = .96$), followed by full orchestra ($r = .91$), and piano ($r = .78$). Notably, musicians perceived the piano orchestration as being the least tense of the stimuli while nonmusicians felt this was the most tense, perhaps suggesting a difference in perceived tension response based on timbre. Overall, musicians' tension responses displayed less variability among the stimuli than nonmusicians who tended to use more of the dial when registering their responses.

Musicians' Transformations of the Listening Process: An Exploratory Study

Caroline Davis; Northwestern University, USA

`2AM2-R09-03`

Since the advent of recording technology, listeners have been accustomed to hearing music they know at the push of a button. Professional musicians often use recordings to hone their craft, repeatedly listening to find inspiration and influence. Previous studies have found evidence for increased emotional response, structural and thematic awareness, and preference over repeated listening, but these findings depend on a number of musically related features. This study addresses alternatives for cognitive changes during repeated exposure, drawing upon sociocultural variables such as shared mental representations and schemata. Semi-structured interviews were conducted with eleven professional musicians. In individual sessions, musicians were asked to describe both ingrained and barely familiar recordings. Many described similar processes of listening, spanning from the induction of enjoyment to analysis, and in many cases, to transcription. Musicians also speak of the importance of discovery in the listening process, suggesting that they seek out changes in schemata. In addition, musicians related by multiple performance collaborations experience similar cognitive transformations. Interview statements show that musicians' cognitions change not only according to structure, emotion, and preference, but also according to cultural schemata.

Who Listens to What Music, and Why? Correlations Between Personality, Music Preferences, and Motives for Listening in a Sample of Older Adults

Petri Laukka; Uppsala University, Sweden

`2AM2-R09-05`

A questionnaire was sent to a random sample of 500 Swedish elderly (65–75 years). It included (a) a brief Big-5 personality measure, and questions about (b) how often

various music listening strategies were used in everyday listening and (c) preference for different musical styles. Several positive correlations were found between personality and music preferences: e.g., extraversion/(jazz & classical), (agreeableness & conscientiousness)/easy listening, and (emotional stability & openness)/jazz. Positive correlations were also found between personality and motives for listening: e.g., extraversion/motives related to identity and agency, agreeableness/mood regulation, and (conscientiousness & emotional stability)/enjoyment. Emotional stability and openness were further negatively correlated with relaxation. Finally, correlations were found between music preferences and motives for listening: e.g., easy listening/(enjoyment & relaxation), folk music/(enjoyment & mood regulation), jazz/enjoyment, and classical/(enjoyment & mood regulation). All effect sizes were small to moderate. The results suggest that some associations between personality and music preferences generalize across age-groups, though the particular styles of music differ across generations. Like in previous research, openness was associated with liking of both complex (classical, jazz) and intense (rock) styles, whereas agreeableness was associated with preference for more conventional styles (easy listening). Results also suggest that motives for listening are mediated by the listener's personality characteristics. Finally, certain styles of music may be preferred depending on the particular motives for listening.

Does Music Taste Last? A Mixed Methods Study of Music Taste Over the Youth-Adult Transition

Douglas Lonie [1], Patrick West [1], Graeme Wilson [2]; [1]MRC Social and Public Health Sciences Unit, UK; [2]Newcastle University, UK

`2AM2-R09-07`

Although much work has been conducted to identify and map different music tastes there is a lack of longitudinal data in the literature. The aims of this paper are to investigate the nature of music taste over the period 1987–2006 and to understand perceptions of the factors contributing to music tastes and how this changes over time. To do this, data regarding music taste were collected from a cohort every three to five years, since participants were aged 15. This was followed by qualitative interviews with a subsample of 18 participants, designed and analysed using Interpretative Phenomenological Analysis (IPA).

The statistical analysis indicated 5 taste trajectories, labelled: Consistent, Prodigal, Early Shift, Late Shift, and Transient. Around half the sample displayed consistent taste across the youth-adult transition. The IPA analysis revealed a range of exposures and differing life events over the youth-adult transition as cited by participants to account for their changing music tastes.

The social factors influencing music taste emerged as primary within individuals' accounts of their taste trajectories. The influence of social structure (e.g. marriage, child rearing and employment) was recognised by participants as the strongest explanation for their changing taste and changing musical participation. These findings indicate that music taste should be considered as dynamic and related to other social and personal circumstances over the lifecourse.

The Effects of Kindermusik Training on Infants' Abilities to Encode Musical Rhythm

David W. Gerry, Ashley Faux, Laurel J. Trainor; McMaster University, Canada

`2AM2-R09-09`

Previous work showed that when infants were bounced on every second beat of an ambiguous (unaccented) rhythmic pattern, they later preferred to listen to an auditory alone version of the pattern with accents every second beat (march), whereas infants bounced on every third beat of the same unaccented rhythmic pattern preferred to listen to an accented version of the pattern with accents every third beat. We tested infants in Kindermusik classes in the identical procedure to see whether enriched experience with rhythm affects the development of metrical perception. As with infants not in Kindermusik classes, movement influenced metrical interpretation in those enrolled in Kindermusik. Overall, those enrolled in Kindermusik listened longer during the test, indicating heightened interest in music. However, unlike the infants in the previous study, those taking Kindermusik showed a general bias to interpret patterns in groups of two rather than in groups of three. This bias is consistent with the musical materials of their classes, which are predominantly in march as opposed to waltz rhythms. We conclude that musical classes for infants can affect the development of metrical perception.

A Perceptual Study on Asynchrony Between Auditory and Visual Stimuli: The Effect of Anticipation by Motion or Periodicity

Minori Saikawa, Kohei Washikita, Masashi Yamada; Kanazawa Institute of Technology, Japan

`2AM2-R09-11`

It has been shown that the delay of an auditory stimulus has a greater range of accept-ability than the case of an auditory stimulus prior to a visual one for the perception of synchrony in audio-visual stimuli. In these studies, the following audio-visual stimuli were typically used: For visual stimulus, anticipation of timing is available by motion of an object. In the present study, another type of anticipation by periodicity was also prepared. These two types of anticipation took place in auditory and visual stimuli respectively. The detection threshold of asynchrony was determined for each type of stimulus described above, and compared with the threshold of the audio-visual stimulus where no anticipation is available. The results showed that the threshold for the sound-prior condition was consistent in 80–100 ms for the stimuli where anticipation was available, but for the "no anticipation" stimulus, it showed a quite large value of 150 ms. For the sound-later condition, the threshold commonly showed a large value at 160–220 ms, not only for the "no anticipation" stimulus, but also for the "anticipation" stimuli, except for "visual periodicity" stimulus for which the threshold was 98 ms. The results imply that anticipation affects the detection of asynchrony, and suggest that there is an interaction between the type of anticipation and modality.

Computational Model of Congruency Between Music and Video

Tetsuro Kitahara[1], Masahiro Nishiyama[2], Hiroshi G. Okuno[2]; [1]Kwansei Gakuin University, Japan; [2]Kyoto University, Japan

`2AM2-R09-13`

We propose a method for calculating congruency between music and video based on similarity of accent structure and mood. There are two types of congruency between music and video: temporal congruency related to synchronization of accents and semantic congruency related to similarity of mood. Previous works, however, have dealt only with either congruency. We model the temporal congruency based on the correlation between accent feature sequences extracted from audio and visual content, and the semantic congruency based on mutual mapping between two feature spaces representing music and video respectively. Then, we integrate the two types of congruency as a weighted linear sum. Our experiments with real-world content show the effects of our method.

2AM2-R10 : Emotional Aspects / Rhythm and Timing

Rooms 10, 10:40–12:30 Tuesday 26 August 2008, Poster session

Music and Emotion: An Experimental Study on Emotional Responses from Musicians and Nonmusicians to Modal Musical Excerpts with Tempo Variation

Danilo Ramos[1], José Lino Oliveira Bueno[1], Emmanuel Bigand[2]; [1]University of São Paulo, Brazil; [2]University of Bourgogne, France

`2AM2-R10-01`

The purpose of this study was to verify emotional responses from Musicians and Nonmusicians on modal musical excerpts with tempo variation. Participants were 30 Musicians and 30 Nonmusicians. Three musical excerpts on moderato tempo, constructed on the Ionian mode, and transposed to the Dorian, Phrygian, Lydian, Mixolydian, Aeolian and Locrian modes and to the largo and presto tempi were employees. The tasks of the participants were listening to each musical excerpt and associating them to Joy, Sadness, Serenity or Fear/Anger. The results show a greater uniformity in the emotional responses from Musicians than Nonmusicians. The results suggest a greater influence of the tempo on the mode in the triggering of specific emotions in listeners, except the Locrian mode, where there was a greater influence of the musical mode, regardless in which tempo the musical excerpts were heard.

Cognitive Styles Influence Perceived Musical Coherence

Gunter Kreutz [1], Laura Mitchell [2], John McDowall [2], Emery Schubert [3];
[1] University of Oldenburg, Germany; [2] Glasgow Caledonian University,
UK; [3] University of New South Wales, Australia
2AM2-R10-03

Baron-Cohen and co-workers propose a theory of individual differences that is based on two characteristic cognitive styles (Baron-Cohen, Knickmeyer and Belmonte, 2005), called empathizing and systemizing. The present study explores the influences of general and music cognitive styles on perceived musical coherence. A total of 64 participants (33 female) were selected who were scoring high in either (general or music) empathizing or systemizing. Participants listened to pairs of pre-selected music excerpts, four representing classical and four representing popular music. Within each genre, two excerpts expressed a 'happy' tone and two excerpts conveyed a 'sad' tone. Pairs of excerpts were matched in genre and mismatched in emotion, or vice versa. Participants rated how well excerpts within each pair went together on a 10-point Likert-type scale. Results show that coherence ratings were significantly higher for emotion-matched than for genre-matched pairs. Significant interactions were found between both general and musical cognitive styles on the one hand and type of matching on the other. In particular, general systemizing shows a tendency to be associated with higher values of genre-matching (p = .051) whereas music empathizing leads to significantly higher values of emotion-matching (p < .05). These results suggest that cognitive styles may influence high-level cognitive processes in music listening. [Acknowledgement: We would like to thank the Carnegie Trust for the Universities of Scotland for funding this study.]

Comparison Between Perceived Emotion and Felt Emotion in Music Listening: Analysis of Individual Difference and Musical Expertise by Use of Factor Score

Etsuko Hoshino; Ueno Gakuen University, Japan
2AM2-R10-05

Two experiments were conducted to investigate the differences in perceived emotion and felt emotion using classical music excerpts. In Exp.1, 54 students who did not major in music were asked to listen to each phrase from four orchestral pieces twice. Half of them (Perceived-Emotion group) were instructed to rate the emotional characters of the phrases on 30 seven-point adjective scales each time, while the other half (Felt-Emotion group) rated the emotion aroused by them. Factor analysis was conducted then separately for each group. In addition, the data of two groups was also analyzed together by other factor analysis once more to compare the factor scores of all of the subjects directly. In Exp.2, the same procedure was carried out with 17 other students majoring in music, except that only one factor analysis was conducted together for the two music groups. Standard factor scores of the subjects in these two experiments were calculated, and compared between both listening conditions in each group of subjects. The results suggested that (1) Perceived emotion was not exactly identical to felt emotion in each semantic structure, and that (2) musical expertise and emotional responsiveness of music were related closely.

Therapeutic Forgetting? Relaxing Music Counters Hyperconsolidation of Emotionally Arousing Stimuli

Lauren Velik, N.S. Rickard; Monash University, Australia
2AM2-R10-07

Memory for emotionally powerful events can sometimes be unusually heightened and unwanted, for instance, in the case of post-traumatic stress disorder. Recent research has shown that the strength of memory for emotionally intense events can be reduced by blockade of beta-noradrenergic receptors. The current study explored whether enhanced memory for emotional events could be prevented by concurrent exposure to relaxing music. Participants (29 males, 60 females; mean age=22years, SD 5.83) viewed an emotional or non-emotional slideshow accompanied by either silence or Satie's Gymnopedie No. 1. Recall of the slideshow was tested one week later, using 76 four-alternative forced-choice (4AFC) questions. Groups were equivalent on mood and arousal levels prior to treatment, and the groups exposed to the music reported equivalent familiarity and likeability. The findings revealed that recall of the slides shown immediately after the emotionally arousing images was significantly greater than recall of the non-emotional images. However, this effect was entirely prevented in the presence of calming music. A group by phase

interaction effect was observed, $F(2,168)=3.45$, $p=.003$, with Tukey's post-hoc tests confirming that calming music resulted in similar levels of recall of the emotional story as observed with the non-emotional story. These findings provide promise for a non-pharmacological means of ameliorating excessively strong and intrusive memories associated with trauma.

Emotion-Related Autonomic Nerve Activity with Musical Performance and Perception

Hidehiro Nakahara[1], Shinichi Furuya[2], Tsutomu Masuko[3], Satoshi Obata[4], Hiroshi Kinoshita[4]; [1]Morinomiya University of Medical Sciences, Japan; [2]Kwansei Gakuin University, Japan; [3]Mukogawa Women's University, Japan; [4]Osaka University, Japan

`2AM2-R10-09`

Previous studies have demonstrated significant changes in cardiac and autonomic measures during musical perception. The changes are commonly evident when the listeners are emotionally aroused to a pleasurable music. However, there has been no attempt on a similar issue for musical performance. The present study therefore examined the effect of emotion on the heart rate (HR) and heart rate variability (HRV) associated with musical perception and performance. Eleven pianists underwent experiments under the expressive piano playing, non-expressive piano playing, expressive listening, and non-expressive listening conditions. The music selected was the well-tempered Clavier, Vol. I, No.1 prelude (J. S. Bach), which was played 60 bpm and needed 2.5 min for one tune. HR and HRV data (HFpower, LFpower, HF/total power, LF/total power, RMSSD) were evaluated using 5-min (two tunes) data, and 20 sec data at the self-reported highest pleasant period. It was found that expressive effort in perception as well as performance modulated HR and HRV, and that such modulations were much greater for the musical performance than perception. The results confirmed that musical performance was far more effective in modulating emotion-linked cardiac and autonomic nerve activity than musical perception in musicians.

Rhythm Play and Enhanced Emotional Sensitivity in Children

Yuriko Nakanishi[1], Takayuki Nakata[2]; [1]Nagasaki Prefectural Center for Children Women and Persons with Disabilities, Japan; [2]Future University-Hakodate, Japan

`2AM2-R10-11`

This study examined if three months of group rhythm activities enhance 3–4 year-olds' emotional expressivity. Twelve children from one child care center were assigned to the rhythm play condition and seven children from another child care center were assigned to the control condition. Children in rhythm play condition experienced rhythm play for three months that emphasized synchronizing rhythm with others. Children in rhythm play condition were individually presented with 10-minute long puppet shows before and after the rhythm play and video recorded. For the children in the control condition, two puppet shows with video recordings were separated by three months without experiencing group rhythm play in between. Between puppet shows, all children experienced usual musical activities at the child care centers, including singing or listening to music CDs between recordings. Analyses of adults' ratings of the videos revealed that when emotional events involved the target child, ratings were higher for children in rhythm condition than in control condition, but no difference was found between groups when emotional events involved puppets only. Also, when events were positive in valence, ratings were higher for children in the rhythm play condition than in the control condition, but no group effects were found for negative emotional events. These findings suggest that learning to synchronize rhythm with others may help 3–4 year-olds to express their positive emotions.

Steady Beat Production (SBP) with Various External Stimuli by 7 th Grade Students

Yo Jung Han, Sun-Hee Chang; Seoul National University, Korea

`2AM2-R10-13`

To investigate the characteristics of Steady Beat Production (SBP) 30 music-majored students (trained students) and 30 general students in 7th grade participated. There were 5 tasks consisted of SBP without external signals, with visual and auditory signals and with metric and rhythmic sequences. Means of tempo, steadiness of beats

and accuracy of synchronization were analyzed by recording the means of individual IOIs, the SD of individual IOIs and synchronization errors. The study found that participants tended to produce faster than the tempo was given with stimuli. SBP without external signals was the fastest and the difference of its individual results was the largest. SBP with auditory signals was steadier and more accurate than with visual signals. SBP with rhythmic sequences was steadier than with metric sequences. Trained students were more accurate and steadier in all tasks except SBP with auditory signals. In regard to tempo and steadiness, a relationship was found between SBP both with and without signals. With regard to steadiness, a similar relationship seemed to exist, except for with auditory signals. In conclusion, the sensory modality and structural feature of stimuli plays an important role in SBP. Musical training affects extracting the periodicity from external stimuli and responding to the stimuli more accurately.

2AM2-R11 : Education / Performance
Rooms 11, 10:40 – 12:30 Tuesday 26 August 2008, Poster session

Rhythm and Reading: Improvement of Reading Fluency Using a Rhythm-Based Pedagogical Technique

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[3] Music-in-Education National Consortium, USA; [4] New England Conservatory, USA
`2AM2-R11-01`

In the Fall of 2007, a music-integrated reading program was introduced to a north Minneapolis urban school to help third grade students improve reading fluency. The purpose of this investigation was to determine to what extent the use of musical rhythm could facilitate the acquisition of reading fluency and improve accuracy when reading high frequency sight words.

The "Rhythm & Reading Group" was established in each of three third grade classrooms. This pedagogical method involves establishment of a clear beat to which students read lists of 25 words. A variety of tempos and word orders were used to provide variety so that the activity continuously engaged the students. A carefully designed assessment schedule was established to measure reading ability at two- to three- week intervals throughout the testing period.

Results revealed impressive levels of improvement for both students below grade-level reading ability and for those at or above grade-level. Students improved dramatically in their reading fluency on the list of 25 words, as measured by the number of words read correctly (increased significantly) and the time required to read the list of words (decreased significantly). Results revealed significant transfer of reading fluency, as both the accuracy and reading time improved significantly for lists of words not seen since the initial pre-test.

Effects of Metacognitive Instruction on Thinking During Piano Practice in Experienced Pianists and Novices

Iwao Yoshino; Hokkaido University of Education, Japan
`2AM2-R11-03`

This study aims to investigate whether musical experts are more metacognitively aware during practice than novices, and whether any instruction can enhance metacognitive activity. Eight experienced pianists (music majors) and ten novices practiced a short piece for piano under "normal condition" or "metacognitive instruction condition". When they temporally stopped physical practice, they were asked to tell what they had thought during practice and what they were thinking at that time. Participants of metacognitive instruction condition were also asked to set their goal before practice, to evaluate their performance, and to reflect and plan their practice at the time stopping physical practice. Their video-recorded verbal reports were classified into metacognitive reports and cognitive reports. Metacognition scores were calculated according to quality and quantity of the metacognitive reports. Under the normal condition, experienced pianists demonstrated significantly higher metacognition scores than novices. Metacognitive instruction yielded significantly higher metacognition scores to only novices. Experienced pianists were not influenced by metacognitive instruction because they appeared to have high metacognitive skills. This study demonstrated that metacognition was relevant to

the acquisition of expertise also on a musical instrument, and that metacognitive instruction could enhance metacognitive activity particularly for beginners. Making instrument students image their goal, monitor their problems and think methods of solving them may develop their capacity of self-regulated learning.

Stirling Silver: Understanding the Psychology of Group Singing for Health and Wellbeing

Jane Davidson[1], Andrea Lange[1], Bev McNamara[1], Sue Jenkins[2], Gill Lewin[2], Lorna Rosenwax[2]; [1]University of Western Australia, Australia; [2]Curtin University of Technology, Australia

`2AM2-R11-05`

This poster aims reports on the degree to which various health benefits of singing can be claimed. Stress reduction, feelings of wellbeing and a general sense of being better exercised have been claimed (Bailey and Davidson, 2003, 2005, and 2008). But the question still remains whether it is the singing activity itself which promotes these espoused benefits or other factors. A choir of people who had never participated in group singing or singing in any formal context was formed, matched for age and social group. All were over 70 years of age, half were in receipt of home-help services and were regarded as being marginally socially isolated. The other half was not receiving any social assistance. Standardised measures of social wellbeing, health and emotional state as well as detailed interviews were made and pre and post a singing course that lasted 12 weeks. The choral leader's remit was to introduce basic techniques of singing (posture, breath control, voice placement) alongside facilitating social group process: jokes, coffee breaks, group tasks etc. All participants reported positive benefits of singing and feelings of having had exercise, but none found these as significant as the social aspects, including their interactions with the choral leader. These results have important implications revealing the important social psychological benefits of the group activity of singing.

Music Provision in Young Children's Education: Scottish Perspectives

Raymond MacDonald[1], Lana Carlton[1], Katie Reid[2], Tom Bancroft[3], Cerin Richardson[4]; [1]Glasgow Caledonian University, UK; [2]University of Glasgow, UK; [3]ABC Creative Music, UK; [4]Edinburgh City Council, UK

`2AM2-R11-07`

From an international perspective there is increasing interest in early years music interventions in terms of how best to implement such education programmes and the types of outcomes that can be expected from these activities. This study aimed to gain insight into the organisation and delivery of music provision in Scottish early education. It explores the experiences and perspectives of music service providers at various levels across nursery schools and primary schools (Children aged 3 to 12). The present study utilised four semi-structured focus groups and an individual interview. Participants (n=20). included primary and nursery teachers, project workers, educational officers, and music programme developers. Results highlight a number of key themes. For example: wider social and educational benefits for children in music education; a perceived lack of music education specialists; issues relating to teacher training. Appraisal of various music provision programmes was also discussed and issues of language and culture in music were highlighted as important. The heterogeneous mix of contributors in this research project has provided a unique opportunity to stimulate discussion between those who make music programmes available to teach and those who are expected to teach them. As a result, key issues relating to the success of early music provision have been identified. These include tackling teachers' confidence in their ability to 'teach' music and identifying 'core' components in the music programme utilised.

The Effect of Contextual Interference on Instrumental Practice: An Application of a Motor Learning Principle

Laura A. Stambaugh, Steven M. Demorest; University of Washington, USA

`2AM2-R11-09`

The purpose of this study was to examine the effects of low (blocked), moderate (hybrid), and high (serial) levels of contextual interference during one practice

session on the technical accuracy and musicality of seventh grade clarinet and saxophone students at acquisition and retention and their attitude towards the practice conditions. In motor learning, the contextual interference hypothesis predicts the blocked condition would exhibit higher performance at acquisition and the serial condition at retention. Students (N=19) practiced three eight-measure songs during one 18-minute practice session. They were randomly assigned to either the blocked group (switch songs after 6 minutes), the hybrid group (switch songs every 2 minutes), or the serial group (switch songs every 1 minute), until all songs were practiced a total of 6 minutes. Test recordings were made immediately after practice concluded (acquisition) and 24 hours later (retention). Students also completed an attitude questionnaire. Performances were scored on technical and musical achievement. There were no significant differences in technical accuracy, musicality, or attitude among the groups at acquisition and retention. There was a significant interaction between practice condition and trial for musicality [$F(2,15)$ = 4.84, $p<.05$]. Though students demonstrated considerable technical accuracy, averaging at the 95th percentile, they did not as often perform musically, with mean scores at the 49th percentile.

Timing and Dynamics in Infant-Directed Singing

Takayuki Nakata [1], Sandra E. Trehub [2]; [1]Future University-Hakodate, Japan; [2]University of Toronto at Mississauga, Canada

`2AM2-R11-13`

The temporal and dynamic features of mothers' performances (n=10) of *Twinkle, Twinkle, Little Star* for their infants (i.e., ID singing) were compared with performances of non-mothers (n=10) singing the same song while alone (solo singing). ID singing had a slower tempo and was more temporally more stable than solo singing. ID singing also showed smaller timing deviations at phrase endings than did solo singing. With respect to dynamics, ID singing was more expressive than solo singing, as indicated by more gradual changes in dynamics at phrase endings. Also, the correlation between pitch height and dynamics for the first two notes explained 5.22 times more of the variance in ID singing than in solo singing. In sum, the findings revealed systematic differences in the timing and dynamics of ID and non-ID versions of the same song. The greater predictability and smoother transitions of maternal performances may have important affective and attention-regulating consequences for infant listeners.

2AM2-R12 : Performance / Neuroscience

Rooms 12, 10:40 – 12:30 Tuesday 26 August 2008, Poster session

Effect of Harmonic Distance on Performance Expression

Christopher Bartlette; Baylor University, USA

`2AM2-R12-01`

In two experiments, I investigate the effect of harmonic distance — the extent to which a harmony is "closely" or "distantly" related to a context — on volume and timing levels for performances of 20 newly composed musical excerpts by 12 graduate piano students. Several earlier studies have suggested that performance expression may be affected by harmonic factors, but this issue has not been studied in a controlled experiment with multiple participants. For the first experiment, one chord changes within each pair of excerpts: One chord is either "close" or "distant" from its preceding chord, and all other chords are held the same. Distance between chords is measured using a simple, key-neutral, two-dimensional model. For the second experiment, each pair of excerpts begins with the same musical material; at a point of modulation, one excerpt continues in a "close" key, while the other excerpt continues with the same material transposed to a "distant" key. The two experiments agree in their results: "Distant" chords are performed louder and with delayed onsets. In addition, the results offer insights into the effect of meter, key, texture, and "sequential" (chord-to-chord) versus "contextual" (multiple-chord) measurements of harmonic distance on performance expression.

Pre-Symbolic Musical Expressiveness: A Case Study Related to the Performer's Expression in Singing

Jin Hyun Kim; University of Cologne, Germany

`2AM2-R12-03`

This study aims at giving evidence for musical expressive features as rule-based pre-symbolic "signs", focusing their symptomatic aspect related to the performer's emotional states.

Taking up the concept of micro-intonation, the author carries out FFT-based spectral analyses of acoustic features of singing voices consisting of mechanisms such as attack, vibrato, amplification of singing formant, sforzando. Different combinational possibilities of some of these mechanisms are associated with a variety of emotional expression guided by singing. The analyzed musical pieces include opera arias, contemporary art songs, and Korean traditional songs. The FFT-based analyses of single individual tones are used for observer training and verified by observer agreement.

The result of this study shows that acoustic features of singing voices related to different categories of emotional expression are rule-conducted. This supports the author's thesis that the capacity of singing voices to additionally form a temporary structure of individual sounds renders singing performance a means of mediating emotions in an intended way: The aspect of micro-intonation allows a singer to generate expressive musical features not only immediately expressing her/his emotional inner states, but rather intentionally controlled.

This study opens future research perspectives on expressive acoustic features in music performance, which — albeit their symptomatic characters — act as pre-symbolic "signs" that are based on rules applied within a cultural system.

An Investigation into the Relationship Between Student Typologies and the Experience of Performance Anxiety in Adolescent Musicians

Ioulia Papageorgi; IOE University of London, UK

`2AM2-R12-05`

Data presented in this paper form part of a study exploring the experience of performance anxiety by adolescent musicians. The aim is to investigate the presence of different music student typologies and explore relationships between student type, experiences of performance anxiety and examination achievement. Students aged 12–19 (N = 410) in two geographical locations (UK and Cyprus) responded to a new self-report questionnaire dealing with a range of learning and performance issues. Participants attended junior conservatoires and/or youth orchestras. K-Means cluster analysis was used, grouping students into clusters based on similarity of responses and allowing the establishment of student typologies. Further in-depth analysis of student responses was conducted through thematic analysis of qualitative data for representative cases from each of the student clusters. Results suggested three typologies: 'unmotivated students feeling ineffective but guarding self-esteem', 'students susceptible to maladaptive performance anxiety' and 'confident students that experience adaptive performance anxiety'. Chi-square tests revealed relationships between typology and gender, age group, nationality and examination achievement. The study suggests that different types of students are affected by anxiety in distinct ways and evidence different patterns of examination achievement. Students may be predisposed to experiencing maladaptive or adaptive performance anxiety. Findings have implications for education.

Kinematics and Muscular Activity of Upper Extremity Movements in Piano Keystroke by Professional Pianists

Shinichi Furuya [1], Tomoko Aoki [2], Hidehiro Nakahara [3], Hiroshi Kinoshita [4]; [1] Kwansei Gakuin University, Japan; [2] Prefectural University of Kumamoto, Japan; [3] Morinomiya University of Medical Sciences, Japan; [4] Osaka University, Japan

`2AM2-R12-07`

This study investigated the effects of sound volume and striking tempo on control of upper extremity movements in expert pianists (N=8) when they performed repetitive octave keystrokes. It was found that at all levels of sound volume and striking tempo, the upper limb angles at the moment of finger-key contact were invariant. The effects of sound volume and striking tempo on limb movements were revealed differently. The proximal segments contributed more to the movement of the limb for the production of larger sound, whereas they contributed less for increasing striking tempo. We propose that sound volume control is achieved by an "impulse strategy", whereas striking tempo control is made by a "moment of inertia strategy".

To control sound volume and striking tempo simultaneously, pianists selected an intermediate way of these two strategies where movements at the elbow joint played a major role in keystroke.

The Difference in Neural Correlates of Singing a Familiar Song and a Newly Learned Song: An fMRI Study

Shizuka Uetsuki[1], Tatsuya Kakigi[1], Hiroshi Kinoshita[2], Kazumasa Yokoyama[1]; [1]Hyogo Prefectural Rehabilitation Center Nishi-Harima, Japan; [2]Osaka University, Japan
`2AM2-R12-09`

The understanding of the neural network for singing familiar songs and its difference from singing newly learned songs are utmost importance for the conduct of effective music and/or speech therapy. The present study used the fMRI to investigate the brain correlates for singing a familiar song(FS), and those for singing a newly learned song(NS). Fifteen normal subjects performed the experimental singing task, sung the FS and NS songs covertly during fMRI scans. The FS was a well-known nursery song while the NS was composed by one of the authors. Both songs had the same musical components but had different melodies and lyrics. The subjects completely memorized two songs before the scan. Greater activation was found for the left hemisphere at the superior temporal gyrus, angular gyrus and uncus for the FS compared to the NS. The uncus is a part of the entorhinal cortex(EC) which interconnects to the hippocampus with an important role in memory retention and consolidation. It could be related to the retrieval process of the melodies and lyrics from semantic memory. The NS had greater activation in the left IPL including the precuneus, SMG, SFG, MFG, and the right IFG, posterior cingulate gyrus and precuneus. The wider activation in the prefrontal area and precuneus with the NS should reflect the difficulty of retrieving the song from episodic memory as well as attention to perform the task accurately.

Music Playing Enhances Auditory Memory Trace: Evidence from Event-Related Potentials

Keiko Kamiyama, Kentaro Katahira, Dilshat Abla, Kazuo Okanoya; RIKEN Brain Science Institute, Japan
`2AM2-R12-11`

In this study, we examined the relation between practice and memory of sound sequences, specifically the hypothesis that practice involving physical performance enhances auditory memory. Musicians learned two unfamiliar sound sequences with different type of trainings. In the key press condition, they learned a melody with key press while listening to the auditory input. In the no key press condition, they listened to another melody without any key press. These two melodies were presented alternatively, and the subjects were given each of these trainings. They were instructed to pay sufficient attention in both conditions. Following the training stage, they listened to these two melodies again without any key press and the ERPs were recorded. During the ERPs recordings, 10% tones of these melodies were deviated. The analysis showed that the amplitudes of mismatch negativity (MMN) for deviant stimuli were larger in the key press condition than in no key press condition. The result suggests that training with key press efficiently promoted auditory memory.

Comparison Between Expert and None-Expert Pianists' Cognitive Processes in Piano Playing: Quantitative and Qualitative Studies

Michiko Ono[1], Toshihiko Matsuka[1], Masakazu Iwasaka[1], Masaki Hara[2], You Nakayama[2]; [1]Chiba University, Japan; [2]Yamaha Music Foundation, Japan
`2AM2-R12-13`

Recent studies in music cognition have revealed that the way in which experts process musical information while playing musical instruments is qualitatively different from that of none-experts. Oura and Hatano (2001), for example, showed that experts tended to pay close attention to artistic expression while novices gave emphasis to the technical aspects in piano playing. A majority of these comparative studies on music cognition, however, has employed only qualitative methods (e.g. interview). In order to facilitate better understanding of the nature of differential music cognition by experts and none-experts, we replicated Oura and Hatano's (2001) experiment

using both qualitative and quantitative (i.e., neuroimaging) methods. In our study, participants were asked to practice a previously unseen score for seven minute, followed by a detailed interview. In addition, we also recorded neuro-physiological measures using multichannel near infrared spectroscopy (NIRS) while the participants were practicing the score. The marked differences were obtained in both qualitative and quantitative data. The results of detailed interview were similar to that of the precedent experiment (i.e., Oura & Hatano, 2001). The neuroimaging data (i.e., multichannel NIRS) revealed that the experts and the none-experts indeed processed music differently — the marked differences were observed in the left hemisphere, the right lateral temporal and the right dorsal frontal regions.

2AM2-R13 : Neuroscience

Rooms 13, 10:40–12:30 Tuesday 26 August 2008, Poster session

Neural Mechanism of Melody Perception Revealed by Functional Magnetic Resonance Imaging

Miho Yamauchi, Takuya Hayashi, Akihide Yamamoto, Hiroshi Sato, Hidehiro Iida; National Cardiovascular Center Research Institute, Japan

`2AM2-R13-01`

A neural process of melody perceptions has not been fully understood. A key process of melody perception is that we recognize "melodic shape" (temporal change of relative pitch) in a piece of music. To locate brain areas associated with melody perception, we used a discrimination task of temporal changes of relative pitch in functional magnetic resonance imaging (fMRI) study. Twelve non-musician subjects received fMRI scan while performing a discrimination task of sound sequences: they listened to a "target melody" followed by an "object melody", and were asked to answer whether the relative pitch of the object was same or not as the target. One half of object melodies differed in pitch of only 6th tone while a half of them altered in pitch of all the tone from the target. The rate of correct answer significantly decreased when all tones of the object melody changed in pitch. Analysis of fMRI revealed significant task-related activations in inferior frontal gyrus, medial prefrontal area, and right inferior parietal lobule. Particularly the inferior parietal lobule related to a correct answer rate. Our findings suggest that the right inferior parietal lobule, regarded as subserving visuo-spatial information, has a pivotal role in recognition of melodic shape.

Investigating the Perception of Harmonic Triads: An fMRI Study

Takashi X. Fujisawa[1], Norman D. Cook[2]; [1]Kansei Gakuin University, Japan; [2]Kansai University, Japan

`2AM2-R13-03`

We have undertaken an fMRI study of harmony perception in order to determine the relationship between the diatonic triads of Western harmony and brain activation. We have run an fMRI study on 12 right-handed, Japanese, male non-musicians in order to determine the sites of brain activation in response to the common triads of Western diatonic harmony. All stimuli consisted of 2 triads of 1.5 sec duration each and presented as grand piano sounds. None of the chords contained intervals of 1 or 2 semitones, but differed in terms of their inherently resolved/unresolved character (major, minor and tension [diminished and augmented] chords). Stimuli were presented in blocks of 5 chord pairs per 30 seconds. Subjects were not aware of the block design. Subtracting out the brain activation in response to a white noise condition, the strongest response was found in right frontal and temporal regions. The brain response to these three types of chords could be distinguished within the right orbitofrontal cortex and cuneus/posterior cingulated gyrus in occipital lobe.

Investigation of the Musician's Brain Activation During Different Music Listening Modes: A Near-Infrared Spectroscopy Study

Toshie Matsui[1], Koji Kazai[2], Minoru Tsuzaki[3], Haruhiro Katayose[2]; [1]JST, Japan; [2]Kwansei Gakuin University, Japan; [3]Kyoto City University of Arts, Japan

`2AM2-R13-07`

Some well-trained musicians empirically argue that they listen to the music in diverse

modes. They may change their listening "mode" in accordance with situations; trying to understand the musical structure, evaluating the level of performance and so on. This study investigated the prefrontal cortex activation during listening to music in different modes by Near-Infrared Spectroscopy (NIRS). Two tasks and two stimuli conditions were prepared. Two tasks were to detect a target (Detection task) and to simply listen to the stimuli (Listening task). Two types of stimuli were unknown piano pieces (Original condition) and scrambled fragments of Original stimuli (Scrambled condition). In Detection task of Original condition, participants were required to respond to their subjective phrase boundaries. In Detection task of Scrambled condition, participants were asked to detect a noise burst presented at the timing when the participants in the Detection task of Original condition had marked. As a result, superior frontal cortex activation was significantly decreased for Original condition stimuli in Detection task, while it was significantly increased in the other conditions. The result suggests that specific cognitive processes included in analyzing a musically structured stimulus affect activities in the superior frontal cortex.

Non-Right-Handedness as a Neurophysiological Selection Variable in Musicians: The Influence of Early Beginning and Practice on the Incidence of Handedness

Reinhard Kopiez[1], Niels Galley[2], Andreas C. Lehmann[3], Marco Lehmann[1], Hauke Egermann[1]; [1]Hannover University of Music and Drama, Germany; [2]University of Cologne, Germany; [3]Hochschule für Musik Würzburg, Germany
`2AM2-R13-09`

For musicians, practising plays an important role. However, the question remains whether particular occurrences of handedness are the result of intensive bimanual training or the neurophysiological and genetically determined prerequisite for year-long successful practising (Kopiez, Galley & Lee 2006). The theoretical basis is given by Annett's (2002) "right-shift theory" which classifies people as right-handers (RH) and non-right-handers (NRH). We assume that bimanual training could result in a higher proportion of NRH in bimanually performing musicians (pianists, violinists), compared with the normal population. 128 music students (76 pianists, 47 string players, and 5 various instrumentalists) participated in a performance test of handedness (speed tapping), resulting in a lateralisation coefficient (LC=100*[L-R/L+R]). Based on the subjects' self-declaration of handedness (11.7% NRH), the proportion of RH and NRH was identified by binary logistic regression. We found a proportion of 30.8% of NRH in the group of musicians, while in the control group of non-musicians (matched for age range), a proportion of 21.7% of NRH was observed. The correlation between LC and the age at which pianists and string players began playing was found to be r(128) = .06; (n.s.). We argue that this increased proportion is based on an early onset of a selection effect in the course of instrumental lessons. In other words, pianists do not become ambidextrous, but ambidextrous people can become pianists.

Comparing Cortical Networks Underpinning Singing with Lyrics and Propositional Language

Sarah Wilson[1], David Abbott[2], Anthony Waites[2], Regula Briellmann[2], Dean Lusher[1], Gaby Pell[2], Jenni Ogden[3], Michael Saling[1], Graeme Jackson[2]; [1]University of Melbourne, Australia; [2]Austin Health, Australia; [3]University of Auckland, New Zealand
`2AM2-R13-11`

Research has suggested that singing with words may facilitate propositional language in patients with aphasia, however mechanisms supporting this observation remain poorly understood. We compared cortical activation associated with covert propositional language and singing with familiar lyrics in the same group of 26 healthy individuals undergoing functional magnetic resonance imaging (fMRI). For each task, the BOLD response compared to rest was modeled assuming the SPM canonical haemodynamic response function and assessed with unpaired t-tests, using a cluster threshold of $p<0.05$ corrected for multiple comparisons. To control for variable singing ability, an out-of-scanner behavioural measure of pitch accuracy was included in the model as a covariate of no interest. The Sing-Rest contrast revealed significant bilateral activation in the middle frontal gyri, maximal on the right at 50, 2, 44 and 58, 4, 28 (BA6) and on the left extending more posteriorly into the pre-central gyrus at -46, -14, 32. The Speech-Rest contrast revealed that this left-sided activation

overlapped with a portion of the left middle frontal activation observed during generative language. Our findings confirm previous research indicating involvement of the right frontal lobe during singing. They extend this research by suggesting involvement of the propositional language network in singing with familiar lyrics.

2AM2-R16 : Demonstration I

Rooms 16, 10:40 – 12:30 Tuesday 26 August 2008,

Illusions Related to *Auditory Grammar*: Ten Demonstrations in Musical Contexts

Yoshitaka Nakajima; Kyushu University, Japan

`2AM2-R16-1`

Auditory illusions that can be interpreted in the theoretical framework of *auditory grammar* are demonstrated in contexts that are related to music. Auditory grammar is a conceptual tool to construct auditory streams out of *auditory subevents*, i.e., onsets, offsets, fillings, and silences. Cues of subevents are detected independently to be interpreted, or suppressed, by the auditory system. Interpreted subevents should be concatenated grammatically to form auditory streams. A few Gestalt principles work in this process. If subevents are reconstructed subjectively in such a way to show an inconsistency with the physical structures of stimulus patterns, or if some subevents are suppressed or restored perceptually, illusory phenomena should appear. My colleagues and I explained, and sometimes predicted the existence of, several auditory illusions in this framework. Ten auditory demonstrations made of synthesized instrumental and vocal sounds are presented to indicate how the human auditory system as described by auditory grammar can work in music. The illusions to be presented are the gap transfer illusion, the illusory auditory completion, the illusory split-off, subjective reconstruction of melody, and time-swelling. These illusions appear clearly in the musical contexts, and often more clearly than when simpler sounds are employed.

2AM2-R17 : Demonstration II

Rooms 17, 10:40 – 12:30 Tuesday 26 August 2008,

Collecting Continuous Data in Music and Listeners: PsySound3 and RTCRR, Two Free Resources

Densil Cabrera [1], Emery Schubert [2], Farhan Rizwi [2], Sam Ferguson [1]; [1] University of Sydney, Australia; [2] University of New South Wales, Australia

`2AM2-R17-1`

This demonstration describes two software resources for collecting data on musical features of sound recordings and continuous human responses: PsySound3 and RTCRR. PsySound3 is a soundfile analysis framework that enables analysis of various general and psychoacoustical parameters of sound recordings including time-series data. The general parameters relate to spectrum, autocorrelation, sound level, and the like, and psychoacoustical parameters include loudness, sharpness, pitch, roughness and binaural modelling. In several cases, more than one algorithm is implemented for a type of output parameter, and new analysis algorithms are easily introduced into the software framework. PsySound3 is Matlab-based. RTCRR (Real Time Continuous Response Recorder — pronounced 'Arty-car') is a Macintosh based tool that samples continuous responses of experimenter-selected response scales (up to 2 recordable simultaneously) to multimedia stimuli. The time-based responses are synchronised with the audio stimulus and can be exported for further analysis at a sampling rate of up to 30 Hz. Examples of the use of each will be provided. The resources are freely available from www.psysound.org and under software/facilities at empa.arts.unsw.edu.au/em/. PsySound3 received financial support from the Australian Research Council grant LE0668448 and the University of New South Wales via its Strategic Investment in Research Scheme. RTCRR received financial support from the Australian Research Council grant DP0452290.

2PM1-R02 : Rhythm, Meter and Timing II
Room 2, 13:30 – 15:30 Tuesday 26 August 2008, Oral session

An Empirically Validated Model of Complexity: Longuet-Higgins and Lee Reconsidered

Olivia Ladinig, Henkjan Honing; Universiteit van Amsterdam, The Netherlands

2PM1-R02-1

This paper aims to validate and elaborate the Longuet-Higgins and Lee's (1984) model of syncopation (L-model for short) using previously published empirical data (Ladinig & Honing, 2007) on complexity judgments. First, the L-model event salience is combined with a sequential component, so as to better reflect the empirical results. Second, formal musical training will be a parameter of the model accounting for the differences found in the responses of non-musicians and musicians. The empirical data suggest that not only do listeners use hierarchical templates to make sense of a rhythm (as suggested by the L-model), but their judgments are also influenced by the temporal extent and absolute position of the events. For all listeners, events at the beginning of a bar in general receive higher salience ratings, presumably because they help in establishing a mental framework (primacy effect). For non-musicians, an additional strong recency effect is observed. We show that when models of rhythm perception are extended with a sequential component based on heuristics, a better fit with the data is obtained. This shows particularly useful when considering on-line perception of ecologically plausible patterns.

Musical Rhythm Parsing Using Mixture Probabilistic Context-Free Grammar

Makoto Tanji, Daichi Ando, Hitoshi Iba; University of Tokyo, Japan

2PM1-R02-2

The metrical structure is important to analyze music pieces. And there has been cognitive interest in it. Listener perceives the metrical structure relatively easily. However machine like approach has been difficult. It implies that listener have a model containing prior knowledge for music and listen music applying to the model.

In this paper, we attempt to model the metrical structure by mixture model of Probabilistic Context-Free Grammar named *Metrical PCFG Model*. Because the Metrical PCFG Model is probabilistic model, it allows us to estimate maximum likelihood structure on the model based on Bayes's Theorem. And the mixture model distinguishes musical meters 4/4, 3/4 and 6/8.

The quantitative performance of metrical structure estimation and score quantization problem are investigated. We found that our model needs relatively small amount of training data compared to HMM. The best result of the metrical structure problem was about 90% in F-Score. For score quantization problem, 98.8% notes are correctly estimated from MIDI data. The result of simple threshold quantization method works about 88%. We infer that our model works a part of human perception.

Role of Partner's Feedback Information in Rhythm Production

Taiki Ogata, Takeshi Takenaka, Kanji Ueda; University of Tokyo, Japan

2PM1-R02-3

Although rhythm production between two people might be inaccurate, we can produce a rhythm more smoothly with a partner than with a metronome. This study was intended to investigate the role of a partner's feedback in rhythm production using a continuous and alternating tapping task. The alternate tapping task was to tap a pressure sensor using an index finger alternately with metronomes of two kinds (constant inter-stimulus intervals (ATm) or constant time difference from response to stimulus (ATf)) or with a partner (ATp) following the eight pacemaker stimuli. The continuous tapping task (CT) was to keep twice the tempo of the pacemaker. Tapping performance under the ATp condition was better than under the CT condition. Furthermore, tapping performance under ATp condition was better than under ATm and ATf conditions in means and standard deviations of time differences from stimulus to response (*ds*). The results of time series analyses suggest that under ATp condition, inter-tap intervals (ITIs) were corrected to adapt to the partner's ITIs and ds were corrected using long past *ds* of the participant's own and of the partner in mutually complementary manner.

Phase Correction in Sensorimotor Synchronization with Non-Isochronous Rhythms

Bruno H. Repp [1], Justin London [2], Peter E. Keller [3]; [1] Haskins Laboratories, USA; [2] Carleton College, USA; [3] MPI CBS, Germany

`2PM1-R02-4`

Phase correction is required to maintain synchronization of a movement with a rhythm. It has been studied primarily with isochronous sequences. We used a phase perturbation method to examine how phase correction operates in cyclically repeated non-isochronous rhythms containing two or three intervals whose long and short durations form a 2:3 ratio. Musically trained participants tapped in synchrony with computer-controlled sequences containing small local phase shifts. The immediate reaction to a phase shift (the phase correction response, PCR, of the next tap, expressed as a percentage of the phase shift in the rhythm) was the dependent variable. In isochronous control sequences, we confirmed previous findings that the PCR is larger when tone inter-onset intervals are long (600 ms) rather than short (400 ms). In non-isochronous two-interval rhythms containing alternating intervals of these same durations, we found a similar dependence of the PCR on the duration of the interval following a phase shift. In three-interval rhythms, however, where either the short or the long interval occurred twice, there was no clear dependence on interval duration. In general, phase correction in non-isochronous rhythms was as effective as in isochronous rhythms. The metrical interpretation of the rhythms (i.e., where the downbeat was located) had no effect on either rhythm production or phase correction.

2PM1-R03 : Music Listening II

Room 3, 13:30 – 15:30 Tuesday 26 August 2008, Oral session

How Music Touches: The Effects of Pitch, Loudness, Timbre and Vibrato on Listeners' Audiotactile Metaphorical Mappings

Inbar Rothschild, Zohar Eitan; Tel Aviv University, Israel

`2PM1-R03-1`

Relationships of touch and sound are central to music performance, and audiotactile metaphors are pertinent to musical discourse. Yet, few empirical studies have investigated systematically how musical parameters such as pitch, loudness, and timbre and their interactions affect auditory-tactile metaphorical mappings. In this study, 40 participants (20 musically trained) rated the appropriateness of six dichotomous tactile metaphors (sharp-blunt, smooth-rough, soft-hard, light-heavy, warm-cold and wet-dry) to 20 sounds, varying in pitch, loudness, instrumental timbre (violin vs. flute) and vibrato. Results (repeated measures ANOVAs) suggest that tactile metaphors are strongly associated with all musical variables examined. For instance, higher pitches were rated as significantly sharper, rougher, harder, colder, and lighter than lower pitches. We consider two complementary accounts for the findings: psychophysical analogies of tactile and auditory sensory processing, and experiential analogies, based on correlations between tactile and auditory qualities of sound sources in daily experience.

The Effect of Music Listening on Spatial Skills: The Role of Processing Time

Doris Grillitsch, Richard Parncutt; University of Graz, Austria

`2PM1-R03-2`

Previous research on the effect of music listening on spatial skills has not carefully considered the time taken by participants to complete spatial tasks. We randomly selected 4 groups of 10 participants. Each group listened to 3 minutes of music (or silence) then worked on a cube rotation task (A3DW). Group 1 listened to happy, fast music by Mozart, Group 2 to a favorite CD track, Group 3 to sad, slow music by Mozart and Group 4 sat in silence. The groups did not differ in spatial skills, but there was a large difference in working time: the mean time spent on each rotation task was 47s, 103s, 90s and 73s for Groups 1–4 respectively. We speculate on possible reasons why listening to a favorite piece of music might cause participants to spend more time on a subsequent spatial task. The results imply that music can *indirectly* promote the acquisition of non-musical skills, since children who spend more accumulated time on any task will become more skilful in that task.

Continuous Measurement of Musical Impression by the Color Image

Hiroshi Kawakami; Nihon University, Japan

`2PM1-R03-3`

Continuous change of the impression while listening to music was observed by choosing the color. The possibility of observing continuous impression change was verified using the color selection. Subjects were 17 volunteers and they clicked the start button for playing music and selected the color, which they felt, on RGB gradation. The value of each RGB parameters was recorded. Music was "Ah, vous dirai-je Maman" by Mozart. Although how to choose a color for every subject was different, the similarity of change in 12 variations was seen. Warm colors were selected in the dynamic parts, such as pink or orange, and contrast was deep. In the 8th variation that changes to minor, dark blue and purple were chosen. In the 7th variation that modal interchanges on the parallel minor key were used frequently, dark colors, such as purplish red, were also chosen. Moreover, in the 9th variation that changed from the 8th minor to major, the yellowish green or orange were chosen. Even if the color chosen by every subject was different, it was possible to record the impression change continuously by recording color and that the selected color was related to the impression of a musical piece.

Aesthetic Reactions to Music in Elementary School Children: Revisiting the Open-Earedness Hypothesis

Marco Lehmann, Reinhard Kopiez; Hannover University of Music and Drama, Germany

`2PM1-R03-4`

The open-earedness hypothesis (Hargreaves, 1982) states that younger children are more tolerant towards music that is regarded by adults as unconventional. To understand the transition from more to less open-earedness, we had to examine the precise interaction between the factors age and type of music. In line with Hargreaves, a decline in open-earedness should not only result in less preference for unconventional music in older children, but also in a stabilized level of preference for conventional music. Based on the statement that pop music is a "badge of identity" for adolescents (Hargreaves, Marshall, & North, 2003), we classified pop music as conventional and examples of classical, avant-garde and ethnic music as unconventional music. Elementary school children in the four grades (N=186) rated their preferences for eight short musical examples taken from these genres. We found a decline in open-earedness between grades one and two, in contrast to earlier results by Schellberg & Gembris (2003). However, the decline in open-earedness was due to a decreasing preference for classical music in older participants. Thus, while children prefer pop music and devalue classical music within their acquired stylistic sensitivity in western tonality (Hargreaves, North & Tarrant, 2006), with increasing age, they possibly maintain open-earedness in regard to music which does not belong to this idiom.

2PM1-R04 : Emotion in Music II

Room 4, 13:30 – 15:30 Tuesday 26 August 2008, Oral session

Cross-Cultural Investigation of Adolescents' Use of Music for Mood Regulation

Suvi Saarikallio; University of Jyväskylä, Finland

`2PM1-R04-1`

The current study was a cross-cultural exploration of differences and similarities in how adolescents regulate their mood through music in Finland and in Kenya. As a whole, the study was a qualitative exploration of cultural characteristics, but it included also quantitative analysis of a pilot survey. The results demonstrated the many-sidedness of music as a means of mood regulation, specified previous understanding of the mood-regulatory mechanisms, established similarity between the cultural groups in the basic nature of mood regulation, and revealed some cross-cultural differences in how the regulation was realized and what aspects were emphasized. The study increased knowledge of the role of cultural background in the emotional experience of music.

Strong Emotional Experiences in Choir Singing — A Cross-Cultural Approach

Jukka Louhivuori; University of Jyväskylä, Finland
2PM1-R04-2

The main reason for people to sing in a choir is according to previous studies music's social and emotional dimensions. In previous studies choir singers have reported strong emotional experiences (SEM). Although SEM has been widely studied, the role of cultural background in these experiences is not well understood. The study aims to compare the quality and quantity of strong experiences of music experienced by the singers with results reported in previous studies about SEM. It is argued that the basic emotions are very similar in different cultures because of the long evolutionary history of emotions. The cultural differences are believed to appear more in the realization of emotions in behavior (phenotype). The research material consists of quantitative (N=713) and qualitative data (40 interviews), which has been collected from choir singers in six countries (Finland, Estonia, Belgium, Rumania, South Africa, Kenya). The main cultural differences concerned the role of social situation and strength of emotions. Cultural background did not show a prominent role in the frequency or quality of emotional experiences. Cultural background had an influence on how emotions are expressed in musical performance and on speech about music. Understanding underlying cognitive, emotional, social and cultural process behind musical experiences asks for a global perspective. Deeper understanding of cultural differences in musical experiences increases multicultural societies' abilities to manage complex socio-cultural processes.

Orientation Effect in Continuous Emotional Response Tasks

Emery Schubert; University of New South Wales, Australia
2PM1-R04-3

This paper discusses identification of initial-orientation-time based on the second-order standard deviation (SD2) method, a simple time series technique that identifies significant activity in multiple response time-series data. For each emotion dimension of each piece investigated, the mean of the SD series, and the SD2 were calculated, ignoring the first 20 seconds. A one SD2 confidence range was produced. Initial orientation was then defined as the time taken for the SD series to first enter this range. For the 2 dimensions by four pieces, the median orientation time was 7.5 seconds. Initial orientation time varies according to several factors. The ambiguity of the emotional message and the tempo of the piece are two examples. Orientation time can also be hidden in a 'true' response which happens to be close to the initial response position. This raises the question of whether the start of a continuous response task should be made at a neutral position (such as middle or zero points of valence and arousal scales) or at random. The former falsely deflates the spread of scores. However, there are pragmatic concerns about starting a continuous response task in random positions. It therefore seems likely that there will be a typical lower limit of initial orientation time where SD is initially less than the mean second order SD, and then overshoots, and then settles into the 'reliable' confidence region.

Evaluating Structure and Performance: Relationships Between Judgments of Tension, Emotion, Expression, and Interest in Different Musical Performances

Richard D. Ashley; Northwestern University, USA
2PM1-R04-4

Numerous studies have explored the relationship between musical structure, expressive performance, and listener responses; often continuous ratings are obtained for emotionality (valence, intensity, or both), tension, expressiveness, and familiarity of thematic materials. The relationship between these different scales, and their connection to specifics in musical structure and expressive performance, has been little explored. This study aimed at more systematic exploration of the relationships between continuous judgments of musical tension, emotion, expressiveness, and interest; Two compositions were used: Mozart Piano Sonata K. 282, I (development and recapitulation) and Scriabin Prelude Op. 11/4, in both expressive and mechanical versions. Participants listened to these performances and gave continuous responses to musical tension, emotionality, expressiveness, and interest. In addition, they marked moments in the performances which were particularly expressive or interesting and gave summary post-listening evaluations of the emotionality, expressiveness, aesthetic quality, and interest of the performance. Results to date indicate that there are both significant correlations and significant differences between the categories

of continuous ratings, showing that these variables are tapping into different aspects of musical structure and performance. Individual musical moments marked as expressive or interesting contribute in different and complicated ways to these judgments and have a strong effect on not only momentary but overall responses.

2PM1-R05 : Education II

Room 5, 13:30 – 15:30 Tuesday 26 August 2008, Oral session

The Social Representations of Music, Musicality, Music Child and General Teachers

Anna Rita Addessi, Felice Caurgati; University of Bologna, Italy
2PM1-R05-1

This paper deals with a research project currently being undertaken at University of Bologna about the training of the university students studying to become music teachers. The general hypothesis of the project is that "musical knowledge" (Olsson 1997, 2002), can be investigated as a social and psychological construction as described by the theory of Social Representations (Moscovici 1981; Mugny-Carugati 1989), as well as social music values (Baroni 1993, Bourdieu 1983) affecting music education and teaching practice.

Mobile Music for Children — Experiences of MobiKid

Maija Fredrikson[1], Pirkko A. Paananen[2]; [1]University of Oulu, Finland; [2]University of Jyväskylä, Finland
2PM1-R05-2

In the present study, mobile software applications for young children were developed and tested. The pedagogical design is based on IP-/Neo-Piagetian theory of development. The research perspectives were focused on child-centered usability and software development. MobiKid software was developed to allow children to sing, record and listen to the songs, and forward the recorded songs to the server independently at home. The song repertoire in the software was learned in advance in music plays school; a group of nine girls worked on their personal mobile phones. The music play school teacher worked also as the mobile teacher in the hardware. Outside the music play school context, one boy used the device independently at home. (UI) and the software design were investigated by parent questionnaires and video-observations. Children were able to work independently on the device, and the structure of decision-making was suitable for the users. However, some UI-features were uncompleted. Children were highly motivated in singing, learning and decision-making. MobiKid provided a natural, motivating context for musical creativity and social sharing as well as a tool for research in the development of singing.

Differences in Conceptions of Musical Ability

Susan Hallam; IOE University of London, UK
2PM1-R05-3

Historically, musical ability was largely conceptualised in relation to basic aural skills. Recently, broader conceptions have identified a range of skills required for reaching high levels of musical expertise. This study aims to explore the different conceptualisations of musical ability held by musicians, educators, other adults, and children. An inventory with statements derived from previous qualitative research exploring conceptions of music ability was used to assess the conceptions of musical ability held by 650 individuals aged 14 to 90 including musicians, educators, adults who were actively engaged in music making in an amateur capacity, adults were not actively engaged in making music, children actively engaged in making music in addition to their engagement with the school curriculum and children with no engagement with music outside of the school curriculum. Factor analysis of the responses revealed 6 factors related to: the skills required for playing an instrument or singing; musical communication; listening and appreciating music; composition and improvisation; personal commitment and motivation; and aural and analytic skills. There were statistically significant differences between each of the respondent groups in relation to each of the factors. The findings suggest that the way that musical ability is conceptualized by any individual depends on the nature of his or her engagement with music.

The Impact of Formal and Informal Learning on Students' Compositional Processes

Sylvana Augustyniak; University of New South Wales, Australia
2PM1-R05-4

Many students spend hours a day listening to music; from the moment students wake up in the morning to the time they go to bed, students engage in listening to music. The accessibility of various music technologies such as iPod, iTunes, compositional software and the like have helped to increase the rate of memorized learning by students.

Few studies have acknowledged the impact that these out-side influences have in the classroom. One such influence is the impact of technology on students' absorption of conscious and unconscious knowledge regardless of whether students are trained or untrained musically.

The two different types of listening students engage in have been operationally defined in my PhD thesis as either conscious listening (purposeful listening/ explicit learning) or unconscious listening (background listening/ implicit learning).

2PM2-R02 : Rhythm, Meter and Timing III
Room 2, 15:45 – 17:45 Tuesday 26 August 2008, Oral session

Selective Rhythmic Impairments in Music

William F. Thompson[1], Linda Sigmundsdottir[1], John R. Iversen[2], Aniruddh D. Patel[2]; [1]Macquarie University, Australia; [2]The Neurosciences Institute, USA
2PM2-R02-1

Research has addressed tone deafness or "congenital amusia" (CA), but most of this research concerns pitch-related deficits. Rhythmic deficits sometimes co-occur in CA but may be secondary to pitch problems. The aim of this research was to determine if there are individuals with normal musical pitch perception but impaired musical rhythm perception. Another aim was to evaluate two novel tests of rhythm perception. Participants were administered the MBEA (which includes 3 subtests of pitch perception and 2 of rhythm perception) and two new rhythm tests: the Monotonic Rhythm Test (MRT) and the Beat Alignment Test (BAT). The MRT involves same/different discrimination of rhythmic patterns produced on a single pitch. The BAT involves listening to musical excerpts and judging whether a superimposed train of beeps is "on the beat" or not. Five participants performed in the normal range on pitch-related subtests of the MBEA but showed impairments on one or both rhythm subtests. Individuals with impaired rhythm also showed reduced performance on the BAT and MRT tests, suggesting a selective rhythmic impairment. However, variability on these latter two tests was large, pointing to the need for larger samples in order to determine if the tests can help diagnose rhythm impairments.

Does *Amusic* Mean *Unmusical*?

Jessica Phillips-Silver[1], Isabelle Peretz[1], Nathalie Gosselin[1], Petri Toiviainen[2], Olivier Piché[1]; [1]Université de Montréal, Canada; [2]University of Jyväskylä, Finland
2PM2-R02-2

The severe pitch deficit in congenital amusia can interfere with the ability to perceive and produce a rhythmic beat in music. However, the extent of rhythm abilities in the context of music without melodic pitch information is unknown. We tested the rhythm abilities of a classic amusic subject, in the context of real music devoid of melodic pitch : percussion music. Using perception and production of body move-ment as an index of rhythm processing, we demonstrate that an amusic subject can judge and synchronize movement to percussion music as well as to a metronome. We suggest that in congenital amusia, performance on melodic music is not equivalent to performance on percussion music. An amusic's rhythmic ability is not limited to the metronome : by removing the primary source of their musical deficit, pitch, and by using simple body movement, an amusic subject can be musical.

Effects of Marker Durations on the Perception of Inter-Onset Time Intervals

Emi Hasuo, Yoshitaka Nakajima; Kyushu University, Japan
2PM2-R02-3

When people perceive rhythm in music, they are listening to the intervals between the onsets of successive sounds. This study focuses on how the temporal length between the onsets of two sounds is perceived. We varied the duration of the sound markers systematically and conducted two experiments to examine how the durations of the markers affect the perception of time intervals. The results of the experiments can be summarized as follows: 1) lengthening both the first and the second marker caused the inter-onset time interval to be judged longer, 2) lengthening only the first marker in some cases caused the interval to be judged longer, although not clearly, and 3) lengthening only the second marker caused the interval to be judged longer in a stable manner. These tendencies appeared both when the amplitude of the markers of different duration was made constant, and when the total energy of the markers of different duration was made constant. It was shown that the perceived length of an inter-onset time interval increases as the duration of the markers lengthen, and that the effect of the second marker is more stable and more systematic.

A Multiresolution Model of Rhythmic Expectancy

Leigh M. Smith, Henkjan Honing; Universiteit van Amsterdam, The Netherlands
2PM2-R02-4

We describe a computational model of rhythmic cognition that predicts expected on-set times. A dynamic representation of musical rhythm, the multiresolution analysis using the continuous wavelet transform is used. This representation decomposes the temporal structure of a musical rhythm into time varying frequency components in the rhythmic frequency range (sample rate of 200Hz). Both expressive timing and temporal structure (score times) contribute in an integrated fashion to determine the temporal expectancies. Future expected times are computed using peaks in the accumulation of time-frequency ridges. This accumulation at the edge of the analysed time window forms a dynamic expectancy. We evaluate this model using data sets of expressively timed (or performed) and generated musical rhythms, by its ability to produce expectancy profiles which correspond to metrical profiles. The results show that rhythms of two different meters are able to be distinguished. Such a representation indicates that a bottom-up, data-oriented process (or a non-cognitive model) is able to reveal durations which match metrical structure from realistic musical examples. This then helps to clarify the role of schematic expectancy (top-down) and it's contribution to the formation of musical expectation.

2PM2-R03 : Performance III

Room 3, 15:45 – 17:45 Tuesday 26 August 2008, Oral session

Influences of Movement and Grip on Perceptual and Measured Tone Quality in Drumming

Sofia Dahl, Michael Grossbach, Eckart Altenmüller; Hannover University of Music and Drama, Germany
2PM2-R03-1

In drumming, the interaction between drumstick and drumhead is determining the quality of the tone. It is believed that a richer spectrum is developed when the stick freely strikes and bounces up from the drumhead, as compared to strokes when the rebound of the stick is hindered. However, on occasion the rebound is too strong for the next stroke and needs to be controlled, for instance by a muscular hypertension of the grip. In order to investigate the movement-to-sound interaction during drumming, audio, contact interaction between drumhead and drumstick, and muscle activity in grip (EMG) were recorded. Furthermore, the movement of drumstick and player were analyzed using a motion capture system.

Professional players were asked to play two types of mezzoforte strokes on a drum: "normal" and "controlled". "Normal" strokes were allowed to freely rebound from the drumhead. For "controlled" strokes the player was asked to control the ending position of the drumstick, stopping it as close as possible to the drumhead directly after the stroke.

Results show that the two playing instructions influenced the interaction between drumstick and drumhead. Compared to normal strokes, the controlled strokes yielded a shorter contact duration and higher peak force. Listeners rated the normal strokes as having a fuller timbre and harder attack.

Continuous Self-Report of Engagement to Live Solo Marimba Performance

Mary Broughton [1], Catherine Stevens [1], Emery Schubert [2]; [1]University of Western Sydney, Australia; [2]University of New South Wales, Australia

2PM2-R03-2

Laboratory-controlled experiments have demonstrated that expressive bodily movement (or lack thereof) can contribute positively (or negatively) to assessments of marimba performance. The experiment reported here investigates audience continuous self-report engagement responses gathered via the portable Audience Response Facility (pARF). The stimulus material was a solo marimba piece performed in a live concert. A female musician performed two musically similar sections within the piece in two different performance manners (deadpan and projected). The *second-order standard deviation threshold* method analysed signal reliability. As hypothesised, mean engagement responses were greater in the projected sample than the deadpan sample. Reliable signal was only observed in the projected sample. Difference between deadpan and projected sample mean engagement responses may be due to expressive bodily movement from the performance manner manipulation; alternatively, an order effect may be responsible. Experimentation in ecologically valid settings enables understanding of audience perception of music performance as it unfolds in time.

An Effective Singing for Musical Expressions

Kiyomi Toyoda [1], Tsutomu Fujinami [2]; [1]Tokyo Nikikai Opera Foundation, Japan; [2]JAIST, Japan

2PM2-R03-3

It is widely accepted among singers and voice trainers that singing in the same manner for opening throat like yawn may result in increasing the resonance and thus allow singers to express the content of music in detail. We carried out an experiment to investigate whether the practice is effective in improving vocal skills. We employed a female singer, whose repertoire is mostly consisted of classical music, and asked her to adopt the particular way of singing. We measured its effect in two aspects:1) Objectively, we measured the vibration of her body while she was singing using a laser interferometer, an innovative optical sensing technology, and 2) Inter-subjectively, we measured how listeners perceived the content of music composition with a questionnaire. As the result, we found the technique to be effective in increasing the resonance of the voice by opening the cavity of larynx and pharynx. The FFT analysis of the vibration revealed that the spectrum values around high tones(750–800Hz) were distinctively high when she opened the cavity of larynx and pharynx, compared to the ones when she did not adopt such a technique. We examined how thirty listeners perceived the content of a song by adopting the Music appreciation evaluation experiment (Mood Adjective Check List) to observe its effects as we expected. We conclude that the singing, in which the throat opens like yawn, resulted in increasing the resonance of voice. We believe that our finding will help singers to improve his or her vocal-skill in musically meaningful ways.

Hype vs. Natural Tempo: A Long-Term Study of Dance Music Tempi

Dirk Moelants; Ghent University, Belgium

2PM2-R03-4

Musical tempi found in dance music provide us with information on the relationship between music and movement. Large databases of (dance) music tempi are available as tools for DJs. In this paper, one specific database, the 'Scandinavian Dance Charts' is the main object of study. The database contains the tempi of the Top 40 in the dance charts which is updated weekly since 1998. Analysis of the tempo distributions thus provides us with details on the evolution in tempo over a period of 10 years. The long-term study of dance music tempi may allow us to distinguish between fashion trends in dance music (and dance movement) and the most preferred, natural tempo. It shows that he main peak stays very consistent at 128 bpm, with a small range

around it (125–130) representing about half of the total entries. Looking for variation in the data throughout time has allowed us to identify the styles behind different tempo zones and to follow their evolution throughout time. Dance music found outside the preferred range can be associated with different types of movement related to different resonance phenomena.

2PM2-R04 : Education III
Room 4, 15:45 – 17:45 Tuesday 26 August 2008, Oral session

Exploring Children's Understanding of Music Through the Use of Drawings and Interviews

Tiija Rinta, Susan Hallam; IOE University of London, UK

2PM2-R04-1

Research on children's understanding of music has generally considered children's improvisations, compositions, notations, or their understandings of the emotions portrayed in music. The aim of this study was to investigate children's overall understanding of music through drawings and their explanations of those drawings. 18 10-year-olds participated in the study listening to music from three different genres, classical/ film, jazz, and popular music. After listening to each piece the children drew a picture reflecting how they understood the music and were then interviewed and asked to explain the relationship between the picture and the music. The drawings were analysed using content analysis, and consideration of colour and size. The interviews were subject to thematic analysis. The themes emerging related to musical elements, dynamics, images associated with the music, affective responses, events associated with the music, adopting a holist listening style, musical structure, lyrics, familiarity with the musical style, and musical instruments. There were differences in response relating to the genre of the music. The combination of drawings and interviews was found to be a useful means for investigating children's musical understanding illustrating the range of different types of understandings which children may have in response to different types of music.

Defining Relationships Between Motivational Beliefs and Self-Regulated Practising Behaviours Using a Structural Equation Model

James M. Renwick [1], Gary E. McPherson [2], John McCormick [3]; [1] University of Sydney, Australia; [2] University of Illinois at Urbana-Champaign, USA; [3] University of Wollongong, Australia

2PM2-R04-2

The amount of time musicians spend practising and their use of adaptive learning strategies are crucial to skill development. Because practice is self-directed, motivational effects are especially salient. This study of young people preparing for a music examination investigated associations between practising behaviour and motivational constructs derived from self-determination theory, which interprets motivation as lying along a continuum of perceived autonomy. Relations between five regulatory styles on this intrinsic–extrinsic continuum and three types of practising behaviour were investigated through structural equation modelling. Factor analysis revealed five motivational dimensions with partial correspondence to research in academic and sport domains: internal, external, social, shame-related, and exam-related motives. Three behavioural factors consistent with self-regulated learning theory emerged: effort management, monitoring, and strategy use. Structural equation modelling showed a clearer picture than emerged from previous multiple regression analyses: internal motivation accounted best for variance in each type of practising behaviour, with only a small added effect from competence beliefs and exam-related motivation. Thus, for young musicians engaged in a demanding assessment task, intrinsic motivation was not statistically distinguishable from internalised extrinsic motivation, despite the distinction drawn in self-determination theory. Self-regulated practising behaviour was explained more powerfully by this unitary internal motivation construct than by perceived competence and other less internalised forms of extrinsic motivation.

Developing a Music Aptitude Test for Schoolchildren in Asia

Yoko Ogawa[1], Tadahiro Murao[2], Esther Ho Shun Mang[3]; [1]Tottori University, Japan; [2]Aichi University of Education, Japan; [3]Hong Kong Baptist University, China

`2PM2-R04-3`

This paper addressed a New Music Aptitude Test (NMAT) for Asian school children, and the relationship between NMAT scores and children's musical achievement as rated by their teachers. Participants in the study were 135 male and 149 female aged 8 to 13 years (3rd, 4th, 5th and 6th grades). In the first part of the study, the children were asked to respond to each item on paper while listening to audio stimuli of NMAT, which consists of 5 categories: timbre, time, pitch, loudness and tonal imagery-melody. In the second part of the study, music teachers also required to rate whole children's musical achievement using traditional musical tests. Children performed best in the timbre and loudness categories while, weaker in the pitch and tonal imagery-melody categories. Younger children were particularly weak in the tonal imagery-melody category. Teachers' assigned achievement scores did not have strong correlations with NMAT scores. However, Pearson correlations ($p<.001$) were insignificant among the younger children but significant among the older children. Therefore, the results of the NMAT were similar between those found in teachers' evaluation in older children. This finding implies that NMAT could be a reliable predictor of children's musical aptitude.

The Professional Relevance of Music Psychology: An Internet Survey

Richard Parncutt[1], Nicola Dibben[2], Margit Painsi[1], Manuela Marin[1]; [1]University of Graz, Austria; [2]University of Sheffield, UK

`2PM2-R04-4`

What careers are pursued by music psychology students? How professionally useful are music psychology courses? Some 150 ex-students were recruited through teacher/researchers and email lists. They completed an internet questionnaire "Careers After Music Psychology". Questions addressed the educational experience and current profession of participants, and the usefulness and professional relevance of music psychology courses. Most respondents were female and lived in industrialized English-speaking countries. Their ages covered a wide range. Most had successfully completed one or more unit/s or program/s in music psychology at bachelors or masters level, as part of several (typically 5) years of post-secondary study, mostly in the past 10–20 years. Respondents were mostly working full-time in music therapy, performance, education, technology or research. Most had played an instrument (often piano or voice) for many years (typically 25). Most rated music psychology studies as "somewhat" or "quite" useful for later work but would like to have seen more practical application (applied settings, experience/demonstrations, industry/practitioner contact), career-relevant content (music therapy, neuroscience, self-healing, performance, teaching), research methods/experience, new research, intercultural topics, interdisciplinary content/skills, or professional communication skills. Some wanted less (psycho-) acoustics and more historical/cultural context. Our findings can help instructors orient course content towards careers, motivate the study of music psychology, and promote music psychology among employers.

2PM2-R05 : Computational Models and Analyses II

Room 5, 15:45 – 17:45 Tuesday 26 August 2008, Oral session

Analysis and Automatic Detection of Breath Sounds in Unaccompanied Singing Voice

Tomoyasu Nakano[1], Jun Ogata[2], Masataka Goto[2], Yuzuru Hiraga[1]; [1]University of Tsukuba, Japan; [2]AIST, Japan

`2PM2-R05-1`

This paper presents a dual approach to the study of breath sounds in singing, consisting of an acoustic analysis of breath sounds, and development of an automatic breath detection system. Previous work on automatic breath detection were based on relatively simple features that were postulated to be relevant to the detection. In contrast, this study starts with a detailed acoustic analysis of breath sounds, with the aim to explore novel characteristics. The obtained results can be used to enhance

the capability of automatic breath detection.

The acoustic analysis used singing voice recordings of 18 singers with a total length of 128 mins (1488 breath events). The results of the analysis show that the spectral envelope of breath sounds remain similar within the same song, and their long-term average spectra have a notable spectral peak at about 1.6kHz for male singers and 1.7kHz for female singers. A prototype version of a breath detection system was implemented, using HMM based on MFCC, ΔMFCC, and Δpower as acoustic features. In an evaluation experiment with 27 unaccompanied song samples, the system achieved an overall recall/precision rate of 97.5%/77.7% for breath sound detection.

Composition Model of Modal Melody Based on the "Core Note" Concept

Yuriko Hoteida, Yuichi Aizawa, Takeshi Takenaka, Kanji Ueda; University of Tokyo, Japan

2PM2-R05-2

This study proposes a modal melody composition model based on the "Core Note" concept. We define the Core Note as a hypothetical note sounding with the melody. We then use it as a reference note to calculate sensory dissonance. Sensory dissonance is used to evaluate composed melodies. First, we specifically examined Japanese children's folk songs. The proposed model uses reinforcement learning for decision-making. The model includes an agent that perceives the preceding four notes, decides the next note's pitch and duration, and learns to compose better melodies based on sensory dissonance and proximity evaluation. We introduce simulations of melody composition and psychological experiments using the Semantic Differential method to check impressions of composed melodies. For the simulations, we set conditions using five different Core Notes and a condition without setting Core Notes. Results of the simulations reveal that Core Notes determine which notes are likely to be chosen in the composed melodies. Results of psychological experiments show that impressions of the composed melodies depend on the Core Notes: Core Notes such as E and G make melodies brighter, whereas D and A make them darker. Results further show that, given no Core Notes, the agent is forced to earn a reward from proximity evaluation; consequently, the generated melodies become more stable.

A Spectral Timing Mechanism pour L'ART

Michael Connolly Brady; Indiana University, USA

2PM2-R05-3

In the late 1980s and early 1990s, Robert Gjerdingen presented a model called L'ART pour l'art. It is an artificial neural network based on Adaptive Resonance Theory (ART) that forms proactive memories for early Mozart melodies. Gjerdingen's model provides an eloquent introduction to Adaptive Resonance Theory in terms of how the theory may be applied to complex serial patterns. The model also helps to illustrate a recognized limitation of ART concerning the problem of 'when next' as opposed to 'what next' in serial pattern processing. The artificial neural network I have been developing, called ART-PaC (Adaptive Resonance with Temporal Pattern Coordination), relates to Gjerdingen's model and incorporates a spectral timing mechanism, enabling the network to recognize the temporal relationships of an input pattern and thus to make 'when next' predictions. The ART-PaC architecture is employed as a control system for a saxophone-playing robot. The objective is for the robot to learn to improvise melodies based on a bank of melodies it is trained on.

A Theory of 'Four' in Igbo Culture and Its Application in the Harmonic Structures of Oral and Written Musical Compositions

Christian Onyeji; North-West University, South Africa

2PM2-R05-4

The centrality of the number 'four' in Igbo cultural milieu is quite significant. While figures designate statistical/numerical values in most cultures of the world, certain figures have deep spiritual and social meaning in Igbo culture, such that understanding the spiritual and physical worlds of the Igbo is, inextricably, tied to the knowledge of the significance of such figures. Central to the social, spiritual and general cultural systems of Igbo people, the number 'four' manifests in the creative arts in some ways. The dominance of the interval of 'fourths' in harmonic structures of many transcribed Igbo oral compositions (indigenous music) constrained field and literature research that revealed interconnection of the number 'four' in various aspects of Igbo culture. The inquiry covered the spiritual/belief system, social rites/rituals and the musical

arts enabling theoretical deductions presented in this discourse. Also discussed is exploitation of harmonic principles based on the intervallic structure of fourths found in Igbo indigenous music in art music compositions by selected Igbo composers in their search for a socio-cultural base for their compositions. This presentation spotlights the deep interconnection of musical practices of the Igbo with the social and spiritual aspects of the culture manifested in the special use and meaning of the number 'four', revealing the cultural root of harmonic structures that feature dominance of fourths in Igbo oral compositions.

3AM1-R02 : Timbre I

Room 2, 8:30–10:30 Wednesday 27 August 2008, Oral session

Auditory Roughness in East Asian Hybrid Compositions

Steve Everett; Emory University, USA

`3AM1-R02-2`

Timbre is a primary structuring element in music and one of the most important and relevant features of auditory events. The auditory sensation of roughness can be described as a timbral attribute based on the sensation of rapid fluctuations in the amplitude envelope. It is involved in several aspects of sound evaluation. This paper examines culturally-specific properties of timbral roughness in compositions of several East Asian composers and proposes a method of interpreting cross-cultural perceptions based upon findings in recent neuropsychological investigations of timbre space and language. Comparisons will be made of the spectral analyses of timbres in traditional Japanese and Korean musical forms with those found in select compositions by modern Japanese and Korean composers. Also a survey of several spectral analysis programs that use traditional FFT and STFT algorithms will be discussed. Special prominence is given to compositions involving the male voice in combination with an instrumental ensemble that mirrors, shadows, or anticipates the timbral structures of the voice without ever playing in strict unison with it. This paper concludes that the consequence of a culturally-specific process of timbral recognition is an important dimension to ascertaining musical meaning.

Can Pianists Recognize and Consistently Label Gesture-Controlled Timbre Nuances from Hearing Only the Sound?

Michel Bernays, Caroline Traube; Université de Montréal, Canada

`3AM1-R02-3`

When discussed amongst professionals, timbre is empirically described through subjective descriptions. This study aims to determine the consensus and coherence of such vocabulary among pianists, at first by testing their ability to aurally recognize timbre and then by examining their consistency in labelling gesture-controlled timbre nuances. A professional pianist was asked to perform three short pieces with eleven adjectives as successive timbre instructions (bright, round, etc.). The audio recordings were used as stimuli, first in an identification task by the pianist himself, then by 17 other pianists, who provided a verbal description of each timbre they could recognize (in free form, then by forced choice). The control procedure showed that the pianist himself could easily identify which timbre he had used. An analysis of the listening test revealed the semantic proximity between the descriptors chosen by the group of pianists and the actual verbal descriptors. The results of this study indicate that the expressive intentions of a virtuosic pianist can be perceived by his peers and can be verbally described in a way that concurs with a common ability among pianists to identify and label timbre.

A Hybrid Model for Timbre Perception — Part 1: The Color of Sound

Hiroko Terasawa, Jonathan Berger; Stanford University, USA

`3AM1-R02-4`

We propose a hybrid model of timbre integrating two complementary component models, one of "color" and the other of "texture". Previous studies on timbre perception describe a multidimensional space, in which spectral centroid, spectral fluctuation, and temporal attack and decay characteristics constitute the principal components. We propose that these factors can be effectively described in terms of a waveform's instantaneous spectral envelope (the color), and instantaneous temporal irregularity (its texture). The color model employs MFCC (Mel-Frequency Cepstral Coefficients) as the spectral envelope descriptor. Our previous study suggests that MFCC is well correlated with human perception. In this study, we further investigated the degree to which each of twelve MFCC coefficients has a good association to human perception of timbre, when a single coefficient from MFCC is manipulated in an isolated manner. Each of the Mel-cepstral coefficients predicts the timbre perception at the similar level for all the twelve coefficients. At average, MFCC explains 85% of the subjective judgments of the deviation in spectral envelope and thus suggests itself as a good representation for the perceptual model of a sound's color.

3AM1-R03 : Computational Models and Analyses III

Room 3, 8:30 – 10:30 Wednesday 27 August 2008, Oral session

Computational Model for Automatic Chord Voicing Based on Bayesian Network

Tetsuro Kitahara[1], Makiko Katsura[1], Haruhiro Katayose[1], Noriko Nagata[2]; [1]Kwansei Gakuin University, Japan; [2]JST, Japan

`3AM1-R03-1`

We developed a computational model for automatically voicing chords based on a Bayesian network. Automatic chord voicing is difficult because it is necessary to choose extended notes and inversions by taking into account musical simultaneity and sequentiality. We overcome this difficulty by inferring the most likely chord voicing using a Bayesian network model where musical simultaneity and sequentiality are modeled as probabilistic dependencies between nodes. The model represents musical simultaneity as probabilistic dependencies between voicing and melody nodes while it represents musical sequentiality as probabilistic dependencies between current-chord and previous- or following-chord voiding nodes. The model makes it possible to take into account both simultaneity and sequentiality at a single inference process. Experimental results of chord voicing for jazz musical pieces showed that our system generated chord voicings that had appropriate simultaneity and sequentiality.

An Experimental Comparison of Human and Automatic Music Segmentation

Justin de Nooijer[1], Frans Wiering[2], Anja Volk[2], Hermi J.M. Tabachneck-Schijf[2]; [1]Fortis ASR, The Netherlands; [2]Utrecht University, The Netherlands

`3AM1-R03-2`

Music Information Retrieval (MIR) examines, among others, how to search musical web content or databases. To make such content processable by retrieval methods, complete works need to be decomposed into segments and voices. One would expect that methods that model human performance of these tasks lead to better retrieval output.

We designed two novel experiments in order to determine (1) to what extent humans agree in their performance of these tasks and (2) which existing algorithms best model human performance. Twenty novices and twenty experts participated in these.

The melody segmentation experiment presented participants with both audio and visual versions of a monophonic melody. In real time, participants placed markers at segment borders. The markers could be moved for fine-tuning.

The voice separation experiment presented participants auditorily with a polyphonic piece. They then listened to pairs of monophonic melodies and chose from these the one that best resembled the polyphonic piece. All possible pairs were ranked.

We concluded that there is high intraclass coherence for both tasks. There is no significant difference in melody segmentation performance between experts and novices, and three algorithms model human performance closely. For voice separation, none of the algorithms is close to human performance.

ACE: Autonomous Classification Engine

Ichiro Fujinaga, Cory McKay; McGill University, Canada

`3AM1-R03-3`

Pattern recognition and automatic classification techniques are currently being used for a wide range of tasks in music research. Unfortunately, the variety and the technical sophistication of machine learning techniques available can make it difficult to choose the best approach for a particular problem. The aim of this research is to provide a tool to researchers in general, and in music researchers, in particular, an easy-to-use software that can empirically determine suitable solutions for the classification tasks at hand.

ACE automatically finds optimal or near-optimal classification methodologies for arbitrary supervised classification problems through experimentation. ACE includes implementations of a wide variety of machine learning techniques and provides interfaces intended specifically for the needs of music researchers. The effectiveness

of different approaches is analyzed by ACE in terms of classification accuracy, training time, and classification time. This allows users to experimentally determine the best set of techniques to use for their particular priorities.

By using this software, music researchers can reduce the time for selecting the suitable classification approach for a given music-related problem and help in terms of both increasing classification accuracy and saving significant amounts of development time.

Computational Modelling of the Cognition of Harmonic Movement

Raymond Whorley, Marcus T. Pearce, Geraint Wiggins; Goldsmiths University of London, UK

`3AM1-R03-4`

Our long-term aim is to investigate the extent to which statistical models of harmony can provide insights into the cognitive processes involved in the harmonisation of melodies and in harmonic expectancy. We have chosen to use multiple viewpoint systems to model harmonic movement. We shall propose a number of ways in which the multiple viewpoint framework can be developed, such that the complexities of harmony can be adequately addressed; after all, four-part harmony consists of four inter-related sequences. In this work, the linking of viewpoints is extended to linking between parts or layers; and this inter-layer linking evolves into a more flexible form, which has a number of advantages over the strict viewpoint linking of the original framework. For example, it allows context to be used which would be unavailable if conventionally linked to an undefined symbol. It also allows the formation of relatively sparse contexts, which cover a longer length of sequence than conventionally formed contexts containing the same number of symbols. Finally, Prediction by Partial Match, which combines the predictions of Markov models of different order, is now also able to make use of models employing differently shaped contexts of the same order.

3AM1-R04 : Memory and Imagery

Room 4, 8:30 – 10:30 Wednesday 27 August 2008, Oral session

Enculturation Effects in Music Cognition: The Role of Age and Music Complexity

Steven J. Morrison, Steven M. Demorest, Laura A. Stambaugh; University of Washington, USA

`3AM1-R04-1`

The purpose of this study was to replicate and extend findings from previous studies of music enculturation by comparing music memory performance of children to that of adults when listening to culturally familiar and unfamiliar music. Forty-three children and 50 adults, all born and raised in the United States, completed a music memory test comprising unfamiliar excerpts of Western and Turkish classical music. Examples were selected at two levels of difficulty — simple and complex — based on texture, variety of instruments, presence of simultaneous musical lines and clarity of internal repetition. All participants were significantly better at remembering novel music from their own culture than from an unfamiliar culture. Simple examples of both cultures were remembered significantly better than complex examples. Children performed as well as adults when remembering simple music from both cultures, while adults were better than children at remembering complex Western music. The results provide evidence that enculturation affects one's understanding of music structure prior to adulthood.

Beyond the Betts: Exploring Ecologically Valid Methods for Assessing Musicians' Imagery Abilities

Terry Clark, Aaron Williamon; Royal College of Music, UK

`3AM1-R04-2`

Research suggests that engaging in mental rehearsal can enhance performance of a skill. However, an individual's imagery ability can moderate its usefulness. This study sought to explore the efficacy of approaches for assessing imagery ability in musicians that go beyond self-report measures. The participants were 25 performance students recruited at the Royal College of Music. They completed a range of imagery questionnaires and gave two live and two mental performances of a two-minute extract of their choice. The Inter Onset Intervals (IOIs; i.e. the

beat-by-beat tempo) for all four performances were extracted and then averaged within each of the two conditions. Correlations between the averaged IOIs of the two conditions were calculated. These correlations were compared to scores obtained on the imagery questionnaires. A subset of 17 participants underwent a three-week imagery training programme and completed post-testing identical to that used in the pre-test. The participants' ability to produce significantly similar performances between the two conditions is discussed, as well as how these correlations relate to scores attained on the imagery ability questionnaires. Effects from engagement in the imagery training programme are reviewed.

Music in Everymind: Commonality of Involuntary Musical Imagery

Lassi A. Liikkanen; Helsinki Institute for Information Technology, Finland

`3AM1-R04-3`

A new topic within the psychological discipline concerns involuntary semantic memories. Initial research has suggested that musical memories are the dominant type of memories that are remembered involuntarily. Interestingly, no reliable information exists on how common this phenomenon of 'earworms', mental replay of music, is among people living in a western culture. Present study intended to investigate this issue by examining the topic in retrospect. Study conducted among 12,420 Finnish Internet users showed that 91.7% of people reported experiencing this phenomenon at least once a week. Several statistical procedures were used to relate the retrospectively reported frequency of the phenomenon to a set of background variables. This revealed a positive connection to increased music practice and listening, and sex (being a female). In contrast, with increasing aged, the frequency of the incidents decreased. The results are discussed in the paper revealing the most important factors underlying this non-volitional experience.

Music Engagement Predicts Verbal Memory as Effectively as Musicianship

T.C. Chin, N.S. Rickard; Monash University, Australia

`3AM1-R04-4`

Musicians have been reported to have significantly better verbal memory abilities than do non-musicians. In this study, we examined whether forms of music engagement other than formal music training might also predict verbal memory performance, after controlling for gender, educational level, and musicianship variables. We present the first evidence to date that music engagement (particularly affective engagement and listening frequency) predicts verbal memory measures to a similar degree as reported for music training. The findings extend previous research by suggesting that simply listening to or engaging emotionally with music may be sufficient to enhance cognitive performance.

3AM1-R05 : Performance IV

Room 5, 8:30 – 10:30 Wednesday 27 August 2008, Oral session

Coordination of Body Movements and Sounds in Musical Ensemble Performance

Peter E. Keller [1], Mirjam Appel [2]; [1] MPI CBS, Germany; [2] Eberhard Karls Universität Tübingen, Germany

`3AM1-R05-1`

The current study tested the reliability and validity of interpersonal body-sway coordination as an index of ensemble synchrony in piano duos. Seven pairs of pianists performed two unfamiliar classical duets on a pair of MIDI pianos, with and without visual contact. Pianists' body movements were recorded using a motion capture system. One-dimensional information about anterior-posterior body sway was extracted from the normalized movement data associated with a single marker positioned between each pianist's shoulder blades. The difference in pianists' body positions across time was estimated by cross-recurrence analysis with a moving window. Asynchronies between nominally synchronous sounds were computed from the MIDI data. Analyses of the pianists' movements revealed large inter-duo differences in the coordination of body sway. These differences provided an index of ensemble synchronization that was reliable (i.e., constant across contrasting musical pieces and independent of whether or not pianists were in visual contact) and valid

(i.e., body sway coordination was negatively correlated with the degree of asynchrony between sounds). The finding that body-sway coordination provides a reliable and valid index of ensemble synchrony has theoretical implications that bear upon the notion of music as an embodied phenomenon, as well as practical advantages for quantifying ensemble cohesion.

The Influence of Another's Actions on One's Own Synchronization with Music

Lena Nowicki, Peter E. Keller; MPI CBS, Germany
`3AM1-R05-2`
Despite of the wealth of insights into the mechanisms underlying sensorimotor synchronization with computer controlled sequences, little is known about interpersonal sensorimotor synchronization. In the present study, pairs of musically trained participants tapped the beat of tonal sequences either on their own or alternating with another person. In the latter 'joint' condition, the role of auditory feedback was studied by manipulating whether participants could hear percussive sound triggered by their own and/or their partners' taps. Autocorrelations of intertap intervals (ITIs) as well as means, variance and autocorrelations of asynchronies were analyzed as measures of the mutual influence of tap timing on sensorimotor synchronization. The lag-1 autocorrelations of ITIs were most negative in the joint tapping condition, which is suggestive of timekeeper coupling between the co-actors. Such coupling could be necessary to correct for the other person's errors as precisely as possible. The results of the asynchronies also show that acting with another person has an impact on one's own synchronization performance. Mean asynchronies and variance of asynchronies were highest in the joint condition and the autocorrelations revealed mutual error correction when acting with a partner. Further, auditory feedback was found to play an important role in interpersonal sensorimotor synchronization.

Plus Ça Change: Analyzing Performances of Chopin's Mazurka Op. 24 No. 2

Neta Spiro [1], Nicolas Gold [2], John Rink [1]; [1]Royal Holloway University of London, UK; [2]King's College London, UK
`3AM1-R05-3`
Performances of the same piece can differ from one another in innumerable ways and for many different reasons. Such differences are of considerable interest to musicologists and psychologists. The aim of the current study is to analyze the timing and dynamic patterns of numerous performances in order to explore the musical reasons for use as well as differences in use of those patterns. More specifically it investigates the relationship between 1) structural and thematic characteristics of a piece and the timing and dynamic characteristics of performances of that work and 2) the relationship between patterns of timing and those of dynamics. A new methodology is developed and applied which enables the systematic analysis and comparison of different performances by identifying patterns of performance, or performance motives, and their location in performance. The results show that, in general, the structure of a piece emerges from the performance patterns. The relationship between timing and dynamics is not direct and the sources for use of particular patterns seem to be many and varied, including structural and thematic considerations. However, the performance patterns at section ends seem to be most closely related to the surrounding long-term structural characteristics, while those within some sections seem to be closely related to the motivic patterns driven by genre-specific characteristics of the piece.

Spatio-Temporal Cues for Synchronization with Conductors' Gestures

Geoff Luck; University of Jyväskylä, Finland
`3AM1-R05-4`
The present study investigated the spatio-temporal characteristics of human movement that offer cues for between-person synchronization. The context chosen for the study was that of conductor-musician synchronization. Participants tapped in time with dynamic point-light representations of traditional conducting gestures in which the clarity of the beat and overall tempo was manipulated. A number of spatio-temporal features were computationally extracted from the movement data, and the relationship between the timing of participants' synchronizations and these features examined. A series of linear regression analyses identified absolute

acceleration along the trajectory as the main cue for synchronization, while beat clarity and tempo influenced the precise make-up of the emergent models. Overall, the regression models accounted for 48% – 73% of the variance in participants' responses. These results support previous work that has identified acceleration along the trajectory of a movement as a 'beat inducer' using simpler stimuli, and suggest that temporal features of a movement trajectory may offer more reliable and stable cues for synchronization than spatial features.

3AM2-R07 : Musical Scales and Melody / Harmony and Tonality / Timbre / Psychophysics and Music Acoustics

Room 7, 10:40 – 12:30 Wednesday 27 August 2008, Poster session

Musical Parameters and the Classification of Melodic Motives

Zohar Eitan [1], Roni Y. Granot [2]; [1] Tel Aviv University, Israel; [2] Hebrew University, Israel

`3AM2-R07-02`

Music theorists often maintain that the "primary" musical parameters of pitch and rhythm determine motivic categorization, while "secondary" parameters like loudness or timbre do not establish motivic categories. We examined systematically the effects of contrasts in "primary" vis-à-vis "secondary" musical parameters on listeners' melodic classification. Matrices of melodic patterns, each presenting 8 motives, were created by all interactions of two contrasting conditions in three musical features. In Experiment 1, four matrices manipulated pitch contour, pitch-interval class, and a compound feature involving the "secondary" parameters of dynamics, pitch register and articulation. In Experiment 2, four different matrices manipulated rhythmic structure (metrical and durational accent), pitch intervals, and the compound feature used in Exp1. Participants classified stimuli in each matrix into two equal-numbered (4-4) groups of motives "belonging together." In both experiments, most participants used contrast in "secondary" parameters as a basis for classification, while few classifications relied on differences in pitch interval (Exp2) or interval class (Exp2). Musically trained participants' classifications also applied melodic contour and rhythm. Results suggest a hierarchy of musical parameters that reverses that suggested by most academic music theory. We discuss the ramifications of this reversal on perceived musical structure and consequentially on cognitively-informed music analysis.

Key Perception in Encountering a Non-Scale Tone

Rie Matsunaga [1], Jun-ichi Abe [2]; [1] JSPS, Japan; [2] Hokkaido University, Japan

`3AM2-R07-04`

The present study investigated how a listener perceives a key when hearing a series of tones followed by an additional non-scale tone of the current perceived key. Here, we examined whether listeners always shifted their key responses in this circumstance. To accomplish this aim, we developed two cases: One case presented an additional tone that was not interpretable as a scale tone of the current key, but which did fit into the diatonic set of other keys. The other case, presented an additional, non-scalar tone, which did not fit into either the original key or any other diatonic key. Musicians and non-musicians had to respond by selecting a key (tonal center) category or an atonal judgment along with a confidence rating for given tone sequences. Responses made by the musicians and the non-musicians yielded essentially equivalent results. In both cases, participants did not always shift their responses to diatonic-congruent key categories (and atonal category), when a tone sequence was followed by an additional non-scale tone. This suggests that a non-scale tone is not always counted against evidence the current perceived key.

Ignore the First Chord, Just Appreciate the Second: Can Listeners Control the Predisposition to Process the Interrelationship Between Chords?

Hiroshi Arao; Hiroshima International University, Japan

`3AM2-R07-06`

The automaticity of processing is a crucial concept for understanding human cognition. Interference paradigms (e.g., the well-known Stroop and other tasks) generally

provided a good insight into the nature of such processing. In the field of music cognition, however, there are limited studies that directly examine the automaticity of processing. In the present study, the author examined the processing automaticity of the relationship between chords. A selective appreciation task, a time-domain extension of interference paradigms, was utilized. In each trial, listeners were presented with a first chord, a silence, and then a second chord. They were asked to ignore the first chord, to selectively attend to the second, and to rate the pleasantness of this chord alone. The rating regarding the second chord, which was influenced by its own consonance, was affected by the presence of the to-be-ignored first chord, or more precisely, by the relationship between the first and second chords. The results showed that listeners have difficulty in inhibiting the predisposition to process chordal relationships, even in a situation where a definite empty time interval is inserted between the chords. In music cognition, such sequential processing appears to be highly automatic and to exert an unavoidable influence on the appreciation of basic affective properties.

Using Kolmogorov-Smirnov to Determine the Effect of Interval Cycles on the Formation of Krumhansl & Kessler's (1982) Tonal Hierarchies

Matthew Woolhouse, Ian Cross; University of Cambridge, UK
3AM2-R07-08

To date, a number of statistical and psychoacoustic models have been proposed that attempt to account for the pitch hierarchy measurements of Krumhansl et al. in the 1980s. However, as Krumhansl has pointed out, none offers a complete or fully plausible explanation of the origin of Krumhansl's tonal hierarchies (or variations thereof), leaving open the possibility that, in addition to distributional and psychoacoustic factors, a further cognitive process may be involved in their formation. The analyses presented in this paper demonstrate that there is a strong statistical link between interval cycles and the perceptual ratings used by Krumhansl and Kessler to form their major and minor-key tonal hierarchies. (An interval cycle is the minimum number of iterations of an interval that are required for the original pitch classes to be restated — a property that is hypothesized to lead to abstract grouping and, subsequently, pitch attraction). Although correlations are not conclusive proof of causality, given the size of the data sets and the objective nature of the method, the evidence supporting a link is compelling. The results of the analyses are discussed with respect to Brown, Butler and Jones's *rare-interval hypothesis*. The important role played by the interval cycles of dominant harmonies is also be explored.

Sequential Grouping Based on Timbre: Effects of Differences in Size of Resonant Bodies

Chihiro Takeshima [1], Minoru Tsuzaki [1], Toshio Irino [2]; [1] Kyoto City University of Arts, Japan; [2] Wakayama University, Japan
3AM2-R07-10

Natural sounds contain information about the shape and size of the resonator, and humans perceive the sounds as timbre variation. We performed psychoacoustic experiments to measure the ability of auditory stream segregation (sequential grouping) based on the timbre change caused by size variation. In the first and second experiments, eight normal-hearing listeners were presented a six-vowel sequence, and were required to identify the vowel sequences in the correct order. Each vowel in the sequence was alternated in the speaker size (Experiment 1), or fixed to a constant speaker size (either large or small) (Experiment 2). The results of Experiment 1 showed that it became difficult to identify the sequences correctly as the size-alternation became faster and larger, while the results of Experiment 2 showed no significant deterioration due to the speaker size. In the third experiment, listeners were presented a target vowel sound in advance on visual display and asked to judge whether the size-alternated vowel sequence (as used in Experiment 1) contains the target. The results showed that the degree of deterioration caused by size-alternation was smaller than that in Experiment 1. These findings demonstrate that the size-alternation affects the temporal order judgment and does not significantly affect the individual vowel identification. Since this situation is typically observed when sequential grouping takes place, fast temporal alternation in size information would induce sequential grouping.

Inharmonicity of Sounds from Electric Guitars: Physical Flaw or Musical Asset?

Hugo Fastl, Florian Völk; Technische Universität München, Germany
3AM2-R07-12

Because of bending waves, strings of electric guitars produce (slightly) inharmonic spectra. One aim of the study was to find out — also in view of synthesized musical instruments — whether sounds of electric guitars should preferably produce strictly harmonic or slightly inharmonic spectra. Inharmonicities of typical sounds from electric guitars were analyzed and studied in psychoacoustic experiments. Strictly harmonic as well as slightly inharmonic spectra were realized and evaluated with respect to audibility of beats, possible differences in pitch height, and overall preference. Strictly harmonic as well as slightly inharmonic spectra produce essentially the same pitch height. Depending on the magnitude of the inharmonicity, beats are clearly audible. Low, wound strings (e.g. E2, A2) usually produce larger inharmonicities than high strings (e.g. E4), and hence beats of low notes are easily detected. The inharmonicity increases with the diameter of the respective string's kernel. Therefore, an unwound G3 string can show larger inharmonicity and more prominent beats than a wound D3 string. In a musical context, i.e. when playing short melodies with synthesized strictly harmonic versus slightly inharmonic string sounds, the latter are somewhat preferred, in particular by players of string instruments. The slight inharmonicity of sounds from electric guitars is not a physical flaw which should be avoided by synthesizing perfectly harmonic sounds, but can be regarded as a musical asset.

3AM2-R08 : Rhythm and Timing / Body Movement / Memory

Room 8, 10:40 – 12:30 Wednesday 27 August 2008, Poster session

Automatic Classification of Drum-Rhythm Patterns Employed in Popular Music

Yuki Murakami, Masanobu Miura; Ryukoku University, Japan
3AM2-R08-02

The various styles of drum-rhythm patterns that are often employed in popular music can roughly be classified into "basic rhythm" and "fill-in" patterns. Compared to the basic rhythm pattern, the fill-in is an improvised pattern and is usually employed to fill in blanks in accompanying melodies. However, no criteria for objectively classifying these patterns have been reported to date. This study describes a classification method based on similarity in neighborhood. We propose a method of classifying drum-rhythm patterns by automatically adjusting the criteria based on the context of excerpts. The method deals with symbolic representations, as provided by MIDI data. Each sequence of one-measure-length contained in the given excerpt is evaluated as corresponding to either a "basic-rhythm" or "fill-in" pattern. The characteristics of sequences for drum-rhythm patterns are obtained by classifying them. In addition, we implemented the method as a visual application system that plays back MIDI data and indicates fill-in patterns.

Longitudinal Study of Rhythm Tapping with Visual Feedback

Makiko Sadakata, Alex Brandmeyer, Renee Timmers, Akvile Miezlaiskyte, Peter Desain; Radboud University Nijmegen, The Netherlands
3AM2-R08-04

The aim of this study is to investigate the benefit of the visual feedback (VFB) on the imitation and discrimination of three-interval rhythms. A previous study indicated that short-term use of the VFB system facilitated learning to imitate loudness patterns, while it was not for timing patterns or for discriminating loudness and timing patterns. This study examines the effect of long-term use of the system which depicts timing information as the shape of a visual object. The experiment employed a pretest-posttest between-subject design. 24 non-musicians participated in 6–9 sessions of an imitation task, which took place in 3 weeks. During the test, participants imitated aurally presented rhythms on a touch sensitive pad. During the training, participants practiced imitating a subset of test rhythms that were presented aurally and visually (VFB group). The perceptual discrimination task took place at the beginning and end of the series of sessions. The analyses revealed (1) that

participants significantly benefited from the long-term use of the VFB system and (2) that the use of the VFB system did not result in superior perceptual sensitivity.

A Psychophysiological Approach to Auditory Temporal Assimilation

Takako Mitsudo[1], Yoshitaka Nakajima[1], Gerard B. Remijn[2], Yoshinobu Goto[3], Shozo Tobimatsu[1]; [1]Kyushu University, Japan; [2]Kanazawa University, Japan; [3]International University of Health and Welfare, Japan

`3AM2-R08-06`

We recorded event-related brain potentials (ERPs) to reveal the mechanisms of human auditory temporal perception utilizing phenomena of temporal assimilation. Stimulus patterns consisted of two neighboring time intervals marked by three successive tone bursts (20 ms, 1000 Hz). There were eleven stimuli: seven standard stimuli, where the first time interval (T1) varied from 80 to 320 ms, and the second time interval (T2) was fixed at 200 ms, and four dummy stimuli, where the combinations of T1 and T2 differed from those of the standard stimuli. Participants judged whether T1 and T2 had the same duration or not by pressing a button as quickly as possible. Behavioral data showed a clear asymmetrical temporal assimilation; the participants judged the two neighboring time intervals as the same when -80 ≤ (T1-T2) ≤ +40 [ms]. Electrophysiological data showed the following results: (a) A slow component in the frontal area, that was similar to contingent negative variation (CNV), emerged at approximately 300 ms after the 1st marker, and lasted until 300–400 ms after the 3rd marker; (b) the responses recorded from the right frontal electrodes were greater than those from the left frontal electrodes, but (c) within a range of 200 ms after the 3rd marker, the frontal areas' activation was smaller when the temporal assimilation took place. Our results suggest that the attenuation of the frontal negativity that took place immediately after the stimuli correlates with the perceptual assimilation of auditory temporal patterns.

Measuring Co-Operability in Tapping Dyads

Tommi Himberg; University of Jyväskylä, Finland

`3AM2-R08-08`

Co-operability between two drummers/tappers engaged in synchronised rhythm performance can be measured by looking at their phase error correction, and specifically the error correction coefficient (α). This coefficient refers to the proportion of the synchronisation error (SE) at beat t_n that is corrected at the next beat t_{n+1}. The model suggests that in co-operative correction, the tappers would correct the error by meeting each other half-way; in other words, error-correct by approximately equal amounts but in opposing directions. Vorberg (2005) and Repp & Keller (in press) have tested this model by asking people to synchronise with simulated computer tappers. In the current study, the model was applied post-hoc to co-operative tapping data, where two people were synchronising with each other, or with computer metronome. The α_h was estimated, and the premises of the model discussed in light of two-tapper data. It was then suggested that instead of the roles of leader and follower being fixed, the mutual adaptation to each other might change in the course of the trial. A method of calculating and visualizing the change in the dependency between tappers using windowed cross-correlation was then introduced.

The Beat Alignment Test (BAT): Surveying Beat Processing Abilities in the General Population

John R. Iversen, Aniruddh D. Patel; The Neurosciences Institute, USA

`3AM2-R08-10`

The ability to perceive a musical beat (and move in synchrony with it) seems widespread, but we currently lack normative data on the distribution of this ability in musically untrained individuals. To aid in the survey of beat processing abilities in the general population, as well as to attempt to identify and differentiate impairments in beat processing, we have developed a psychophysical test called the Beat Alignment Test (BAT). The BAT is intended to complement existing tests of rhythm processing by directly examining beat perception in isolation from beat synchronization. The goals of the BAT are 1) to study the distribution of beat-based processing abilities in the normal population and 2) to provide a way to search for "rhythm deaf" individuals, who have trouble with beat processing in music though they are not tone deaf. The BAT is easily implemented and it is our hope that it is widely adopted. Data from a pilot study of 30 individuals is presented.

The Development of Coordination and Expression in Duo Performance: Body Movements in Focus

Jane Davidson; University of Western Australia, Australia
`3AM2-R08-12`

This poster reports how a flautist and clarinettist came together in a rehearsal process to produce an agreed and coordinated timing and interpretation of an unfamiliar work. The current study builds on the foundations of previous studies to assess how musicians in a duo coordinate. Two professional musicians were asked to rehearse individually and then together a piece composed for the task. All was recorded on video and motion capture system. Results indicated that solo rehearsal offered a different core speed for each player: the flautist remaining close to the tempo and types of expressive musical effects she had set in her first solo run-through; the clarinettist experimenting extensively with different tempi and a range of effects. Each used their bodies very differently, the clarinettist using much more expansive movement than the flautist. The clarinettist explored the musical material in order to *find* an interpretation, whereas the flautist used the run-throughs to *consolidate* her interpretation. In duo, it was as if the clarinettist who tried to find how to "dance" (her words) with her duet partner, exploring the musical and physical space and noticing the flautist's responses. The flautist's movements became much more like those of the clarinettist, adapting and coming to focus on the tempo and expressive effects of the clarinettist.

3AM2-R09 : Music Listening and Preferences / Development / Performance / Audio-Visual Interactions / Psychoacoustics

Room 9, 10:40–12:30 Wednesday 27 August 2008, Poster session

Peak Experience in Music Performance: An Investigation of the Precursors and Nature Among Choral Performers

John Whaley; Keele University, UK
`3AM2-R09-02`

The study of Peak Experiences (Maslow, 1968) has received significant attention within music psychology as music is regarded as a reliable trigger of such experiences. Most literature, however, has focused on music listening and disregarded the potential of music performance to elicit the phenomenon. This study investigates both the causes and nature of peak experiences in music performance, with three fundamental aims: to demonstrate that peaks occur as a result of music performance, to investigate specific internal/personal and external/circumstantial precursors to these experiences, and to analyze features common to these experiences. Using a single concert performance of a collegiate Choir, the study pre and post-tested participants using Likert-scale items derived from both music and non music-related peak literature. Findings indicate that music performance can trigger peak experiences and the data reveal three distinct "types" of performance peaks: lost/carried away, perfection, and physical reaction. Findings also identify a number of precursors significantly associated with these experiences, including self-rated quality of performance, degree to which music is liked, perception of audience, attempts to 'send a message' to audience, and previous peaks in performance and during other activities. Discussion includes assessment of the quantitative approach to the Peak Experience and the implications of this research for both performers and future research.

The Musical Dimension of Daily Routines with Under-Four Children

Anna Rita Addessi; University of Bologna, Italy
`3AM2-R09-04`

This paper deals with a research project currently being undertaken about the observation of young children musical behaviours during the daily routine: changing the diaper, before sleeping, the lunch, free game.

The Impact of Severe Visual Impairment on Musical Development: A Comparison of Two Syndromes — Retinopathy of Prematurity and Septo-Optic Dysplasia

Adam Ockelford; Roehampton University, UK

3AM2-R09-06

Accounts from teachers have suggested that children born with little or no sight tend to exhibit more highly-developed levels of musicality than their fully sighted counterparts, as evidenced, for example, in the possession of 'absolute pitch', and precocious performing skills. However, until recently, no systematic research has been undertaken in this area. This paper reports on studies that examine the impact of severe visual impairment in the context of two syndromes. Questionnaires were distributed to three groups of parents, largely in the UK and the US, whose children had (a) retinopathy of prematurity; (b) septo-optic dysplasia; and (c) no known long-standing medical conditions. These were supplemented with visits to observe the children in action. The principal topics covered were parents' perceptions of: (a) their children's interest in everyday sounds and in music; (b) the importance of music to their children in different contexts; (c) the time they devoted to musical activity; (d) their musical abilities (including AP); and (e) learning, education and therapy. The results suggested that both level of vision and type of syndrome had an impact on developing musicality, as evidenced by the reported levels of AP and the levels of achievement in terms of performance skills and creative output, expressed through improvisation and composition.

A Longitudinal Study of the Process of Acquiring Absolute Pitch

Ayako Sakakibara; Ichi-onkai Music School, Japan

3AM2-R09-08

In the present paper, the process of acquiring absolute pitch was described. 24 young children (2~6 years old) were trained by a "Chords identification method" with an established success rate of greater than 90%. This method mainly consists of tasks for identifying some chords [Eguchi,1991; Sakakibara,1999,2004]. They need to remember 9 kinds of chords for white-piano key tones and 5–15 kinds of chords for black-piano key tones.

The purpose of this study was to investigate the transition of cognitive strategies longitudinally in this training process. According to the view that the attributes of tones have two components : "tone height" and "tone chroma", absolute pitch possessors were supposed to have a strategy depending on "chroma" in identification of pitch.

Results showed that 2 strategies were observed in the training process: one depending on "height" and the other depending on "chroma". A typical change profile over time was evident in virtually all subjects. Initially, subjects tried to identify chords only by pitch "height", but later they came to rely upon "chroma", especially as the number of chords increased. The tendency to depend on "chroma" increased over time in training. Finally subjects succeeded in correctly identifying chords by relying upon both "height" and "chroma". After the training in which chords change into single tones, every subject could identify single tones. Average length of the time it took to reach 100% accuracy in identifying single tones was 4 years and 5 months.

Towards an Ecological Evolutionary Psychoacoustics of Music

Richard Parncutt; University of Graz, Austria

3AM2-R09-10

Psychoacoustical principles shape and limit musical experience. Why do many music theorists and musicologists regard psychoacoustics as irrelevant? Here, I situate psychoacoustics and music in broader ecological and evolutionary contexts. What plausible evolutionary-ecological explanations for music-psychoacoustic phenomena can be developed, tested and applied in music education? Hearing is adaptive when it promotes recognition and evaluation of sound sources. Typical human environments contain multiple reflectors. The signal reaching the ear is often an unrecognizable superposition of direct and reflected/delayed sound. Frequency analysis enables source recognition: partial frequencies (and rhythmic patterns) are unaffected by reflection/superposition, amplitudes are somewhat affected, and phase relations are jumbled (at middle to high frequencies). Ecological-evolutionary theory thus explains why the ear is more sensitive to frequency (there are roughly 1000 JNDs in the audible range) than intensity (roughly 100 JNDs), and almost phase deaf. Thus, frequency and time are the most *reliable* auditory parameters for source

recognition (Terhardt) and the main axes of both the *auditory scene* and most music notation. Ecological-environmental arguments can also explain why a harmonic complex tone usually has one pitch although several partials are audible, why the pitch corresponds to the fundamental, and why critical bandwidth is around 2–3 semitones in the mid-high range and increases at lower frequencies — with important consequences for musical structure.

Effect of Music on the Performance and Impression in a Slot Game

Yuma Sakabe, Toshimitsu Katsuzaki, Masashi Yamada; Kanazawa Institute of Technology, Japan

3AM2-R09-12

It is often said that music affects the impression of our environment and also our behavior. This was evidenced in the context of the virtual environment of a video racing game. In the present study, we examined the effect of music on the performance and impression of a slot-machine game. Eight players were trained in a fairly simple mode called "avoiding the alignment" for at least 40 hours, then participated in the experiment. In the experiment, ten musical excerpts were prepared. One session consisted of 100 trials of playing the game in the "avoiding the alignment" mode with listening to a musical stimulus or without music. Each participant played two sessions for each condition. After each session the participants evaluated the impression of the game using semantic differential scales. They also evaluated the impression of each excerpt without playing the game. Results showed that there were no excerpts that increased the success rate from the no music condition. Moreover, principle component analyses and multi-regression analyses showed that an "agitated" musical excerpt provides "unpleasantness" to the game and, in turn, results in a negative effect on the performance of the game. The results in the present study were consistent with the results for the video racing game.

3AM2-R10 : Emotional Aspects / Rhythm and Timing

Room 10, 10:40 – 12:30 Wednesday 27 August 2008, Poster session

Emotional Connotations of Isolated Instruments Sounds

Tuomas Eerola, Vinoo Alluri, Rafael Ferrer; University of Jyväskylä, Finland

3AM2-R10-02

Considerable effort has been exerted towards understanding how performance of music and its psychoacoustic and structural features contribute to emotional expression, but relatively little attention has been paid to the role of timbre in communicating emotions in music. The aim was to investigate the role of timbre in the perception of emotions in music. Are the sounds played from regular instruments in isolation enough to convey a sense of emotional attribution to a listener? And if so, which acoustic correlates of timbre are responsible for these attributions? The role of timbre to emotional connotations of musical sounds was investigated in two behavioural experiments. In Experiment 1, musically trained participants rated valence, energy and tension of isolated instrument sounds. In Experiment 2, another set of sounds was rated to extend the results. Acoustic descriptors of the stimuli such as spectral measures (e.g. Brightness, Spectral flux, Irregularity, with separate descriptors for different parts of the envelope), and onset and decay measures were extracted in order to explain the perceived emotional dimensions. High agreement among the emotion ratings of the participants was observed, suggesting that even isolated instrument sounds carry cues about the emotional expression that are easily recognized by the listeners. These associations could be explained in acoustic features as strong correlations between the ratings and acoustic features were observed.

Japanese College Students' Emotional Responses to J-POP-Like Songs on Physiological and Psychological Measures

Kaori Iwai, Mayumi Adachi; Hokkaido University, Japan

3AM2-R10-04

We examined Japanese college student's emotional responses to J-POP-like songs by physiological and psychological measure. We had them listen to either an original song consisting of the same emotional values of a tune and lyrics or that consisting of contrasting emotional values of a tune and lyrics. First, we recorded each partic-

ipant's heart rate and blood pressure while listening to a song, and obtained their judgment for an emotional value of the song when the song ended. 1-2 days later, each participant recorded emotional impressions of the same song continuously while listening for the second time. Results showed that the overall emotional values of the songs had no significant effects on heart rate or blood pressure. However, the continuously recorded valence showed that happy and sad tunes (regardless of lyrics types) were clearly differentiated from each other regardless of the time location of a song. This indicates that Japanese college students tend to rely on the emotional value of a tune rather than that of lyrics. In the poster presentation, we also explore relations between physiological and psychological responses by mapping the two continuous data.

Affective and Perceptual Responses to Very Brief Musical Stimuli

Richard D. Ashley; Northwestern University, USA
3AM2-R10-06

The nature and time course of emotional responses to music is an open question (cf. Peretz et al 1998, Bigand et al 2005), particularly in the very earliest moments of a sound. This study aimed to (a) examine the time course of affective and other responses to very brief musical stimuli, and (b) investigate the influence of timbre and other acoustic features in such responses. Stimuli were a subset of those from Peretz et al 1998, with both positively and negatively valenced excerpts, in solo piano and orchestral textures, with durations of 25, 50, 100, 250, 500, and 1000 msec. Participants rated each excerpt on a number of 1-10 scales: sad/happy, slow/fast, dark/bright, bass/treble, heavy/light, thick/thin, and also as minor or major. The data indicate main effects of excerpt. In many instances, accurate identification of valence and mode were made below 100 msec. For some excerpts, judgments of valence reached the asymptote at 100 msec, but others showed no significant difference from 50 msec on. There was remarkable consistency as well in the other judgments, which again tended to resolve at or before 100 msec. Acoustic features, including register, spectral centroid, and attack time appear to be the underlying sources of many of these judgments.

Psycho-Physiological Patterns of Musical Emotions and Their Relation with Music Structure

Eduardo Coutinho, Angelo Cangelosi; University of Plymouth, UK
3AM2-R10-08

This study investigates the dynamics of psychological and physiological reactions during music listening to determine whether differentiated psychological and physiological patterns could be related with differentiated patterns of music variables.

We asked 39 participants to give continuous self-reports of the intensity (Arousal) and hedonic value (Valence) of the emotions felt while listening to 9 pieces of western instrumental art (classical) music. Simultaneously we recorded their Heart Rate (HR) and Skin Conductance Response (SCR) for the full length of the pieces.

Arousal was found to increase for higher levels of tempo, loudness, mean pitch, sharpness and timbral width, and Valence was correlated with variations in tempo and (tonal) dissonance. Psychological and physiological reports showed that increased Arousal and Valence are related with increased SCR, while increased HR related with higher Arousal. We also found a negative relationship between Valence and Heart Rate.

Our study supports the idea that significant patterns of interactions between music structure and differentiated levels of intensity and hedonic value do exist in musical emotions. Our study also shows differentiable physiological patterns across different emotions, supporting the claim that physiological arousal is also a component of musical emotions. We are currently creating a neural network model to analyse in detail such interactions.

Psychological Study of Strong Experiences in Listening to Music: Relationship Between Physical Reactions and Acoustic Features of the Music

Shoko Yasuda [1], Toshie Nakamura [1], Maria Raluca Draguna [1], Satoshi Kawase [1], Kenji Katahira [1], Haruka Shoda [2]; [1] Osaka University, Japan; [2] Hokkaido University, Japan
3AM2-R10-10

Many people have strong experiences with music (SEM), although the mechanism of SEM is still obscure. Our previous work that examined SEM quantitatively showed that at the conclusion of the music, ratings of SEM strongly related to ratings of five physical reactions: *goose pimples, lump in the throat, shivers down the spine, being close to tears*, and *arousal*. Other studies also suggested that ratings of such physical reactions for the entire music related to ratings for each part of the music. In this light, the present study aimed at clarifying the relationship between physical reactions and acoustic features, particularly dynamics, for each part of the music. 53 students participated in this study. They were required to listen to two musical pieces and evaluated how strongly they experienced the five physical reactions during each part of the music. As a result, the A-weighted sound pressure level strongly related to *goose pimples, shivers down the spine*, and *arousal*. Additionally, the ratings of these physical reactions during crescendo were significantly higher than during diminuendo. In addition, the dynamic range and magnitude of change in loudness within crescendo affected the ratings of these physical reactions. As the five physical reactions showed a relationship with SEM, this study contributes to a further quantitative clarification of SEM.

The Effect of Repetitive Music Listening for Days on Anxiety Reduction

Chiharu Araki[1], Hiroshi Shimazaki[2], Akira Imai[3], Yoshimi Ito[1]; [1]Nagoya University, Japan; [2]Taisei Gakuin University, Japan; [3]Shinshu University, Japan

`3AM2-R10-12`

This study investigated whether the different effect of repetitive music listening for three days on reducing state anxiety can be seen between high and low trait anxiety groups. Sixty undergraduate students classified into high and low trait anxiety groups were randomly assigned to one of three conditions (preferred music condition, selected music condition and white noise condition). One session consisted of 3 steps: (1) completing state anxiety scale of STAI (i.e., pre-test), (2) repetitive music listening for 10 minutes, (3) completing state anxiety scale of STAI (i.e., post-test). This session was repeated for three days. Results showed that only in preferred music condition, the state anxiety score in pre-tests reduced day by day. However, no different effect between high and low trait anxiety groups was found in all conditions. This study demonstrated that listening to preferred music repetitively for three days reduced state anxiety, regardless of the level of trait anxiety. One possible explanation is that the good effect of listening to preferred music was gradually accumulated as the days went on.

3AM2-R11 : Education / Performance

Room 11, 10:40 – 12:30 Wednesday 27 August 2008, Poster session

VEMUS: An Interactive Practicing Environment for Beginning Wind Instrument Students — First Year of Evaluations

Petri Laukka[1], Anders Askenfelt[2], Kjetil Falkenberg Hansen[2], Svante Granqvist[2], Kahl Hellmer[2]; [1]Uppsala University, Sweden; [2]KTH, Sweden

`3AM2-R11-02`

Virtual European Music School (VEMUS) is an EU-FP6 project aiming to develop and evaluate an interactive learning environment for wind instruments. Vemus addresses three complementary learning settings for students at beginning to intermediate levels: self practicing, classroom environment, and distance learning. The interactive self-practicing environment is based on a 'virtual teacher' interface where the 'teacher' listens to students' performances and gives feedback (including praise and tips on how to correct errors) based on automatic acoustic analyses of the performances. Here, we present results from the first evaluations of the effectiveness of self-practice using Vemus with regard to a) motivation for practicing, and b) uses of efficient practice strategies. Beginning music students (12 per instrument) were randomly assigned to either practicing with or without Vemus during a four-week period. The students' motivation and uses of various practice strategies were assessed at baseline and weekly throughout the study period using specially designed questionnaires. Performance improvement was assessed by observing the frequencies of performance errors detected by Vemus. Preliminary results from

recorder and flute students showed that Vemus-students reported significantly increased motivation compared to the controls, and also reported increased use of some efficient practice strategies. The students further found Vemus easy to use in everyday practicing. Analyses of the distribution of various performance errors are under way. By introducing educational technology, Vemus has the potential to facilitate practicing by making it more enjoyable and efficient during the first years of playing.

Teacher-Parent-Pupil Trios: The Impact of Interpersonal Interaction on Pupil Satisfaction, Enjoyment and Musical Attainment

Andrea Creech; IOE University of London, UK
`3AM2-R11-04`

Accounts of pupil-parent-teacher relationships within context of one-to-one instrumental lessons suggest that human interaction has the power to shape the musical perception and cognition of pupils. This paper tests the hypothesis that teacher-pupil-parent interpersonal interaction, in the context of musical instrument learning, has an impact on learning outcomes. 337 teacher-pupil-parent trios completed quantitative measures of control and responsiveness, pupil satisfaction with lessons, enjoyment of violin and musical attainment. A cluster analysis, using dimensions of control and responsiveness as predictors of cluster membership, revealed six distinct interaction types. Analyses of covariance, controlling for pupil age and testing for differences in satisfaction, enjoyment of violin and musical attainment between the six interaction types, revealed that where interaction was characterized by three-way collaboration pupils experienced the greatest enjoyment and satisfaction with lessons. Where pupils were in a subordinate relationship to a strong teacher-parent dyad relatively higher musical attainment was found. This research suggests that interpersonal interaction within instrumental learning contexts is a complex process that may have implications for musical attainment as well as for enjoyment and satisfaction experienced by pupils. The findings point to the need for future research that investigates whether interpersonal interaction may be re-framed by teachers in order to enhance musical perception and cognition amongst their pupils.

Increased Quality and Frequency of School-Based Music Program Has Limited Benefits on Self-Esteem and Social Skills

N.S. Rickard, P. Appelman, R. James; Monash University, Australia
`3AM2-R11-06`

Private music tuition has been demonstrated to have non-musical benefits for children, such as enhancing self-esteem and general intelligence. However, there has been limited experimental investigation of the effects of school-based music training. This research explored effects of a classroom based music programs on primary school children's self-esteem (Culture Free Self-Esteem Inventory-III) and social skills (Social Skills Rating Scales). A Kodaly program was introduced at Preparatory level (treatment n=52, control=25), while a string-based instrumental program was introduced at Grade 3 (treatment n=55, control=37). Control schools continued to receive their normal music curriculum. Once the effects of age and school were controlled, ANCOVAs revealed significant time by treatment interactions for both social skills ($F_{2,186}$=4.07, p<.05) and self-esteem ($F_{2,140}$=3.05, p=.05) in the younger cohort after two years of the program. These effects were largely attributable to improvements in the first year of the program, and did not persist into the second year. In older children, MT also countered a decrease in general self-esteem experienced by the control group in the first year (p=.055). Interestingly, the benefits observed after one year of the music program were not evident following introduction of an alternative novel arts-based program (juggling) into the older cohort of several schools for one year. Therefore, while transient, the music program had benefits that cannot be attributed to the novelty of introducing a new arts-based program. Music education may however need to be more intensive (private tuition) than is possible in large group situations to yield more persistent benefits.

Differences and Common Features of Performance Anxiety During a Musical and a Non-Musical, Social Performance

Susanne Gorges, Georg W. Alpers, Paul Pauli; University of Würzburg, Germany
`3AM2-R11-08`

According to questionnaire studies, social anxiety seems to be an important part of musical performance anxiety, but there is a lack of studies investigating this in an experimental design outside of the laboratory. In the current study we compared self-reported and physiological responses in 31 music students while playing in a concert or giving a speech in front of an audience, and during two baselines without an audience. Within a period of 90 minutes, participants repeatedly rated their performance anxiety as well as further positive and negative emotions. In addition, heart rate (HR) was measured. HR and anxiety ratings were significantly higher in the public performances compared to the baselines, and similar in both public performances. Performance anxiety during the speech and the concert correlated significantly. Whereas HR in the speech condition only correlated with anxiety ratings, HR changes in the concert condition were also associated with positive emotions. Results seem to confirm a classification of musical performance anxiety as a subtype of social anxiety, but some special features should be considered, especially with respect to possible interventions.

Effects of the Relationship Between Co-Performers' Body Movement on Coordination in Ensembles

Kenji Katahira [1], Toshie Nakamura [1], Satoshi Kawase [1], Shoko Yasuda [1], Haruka Shoda [2], Maria Raluca Draguna [1]; [1] Osaka University, Japan; [2] Hokkaido University, Japan
`3AM2-R11-10`

Performers often display similar body movements with their co-performers in ensembles. The occurrence of such distinctive behaviour may be explained by examining the role of body movement in the coordination of ensemble performances, which has been previously pointed out in research on body movement in musical performances (Davidson, 2002). The aim of this study was to investigate whether coordination during performances depends on the way in which performers use their body movement; our focus was on ensembles, in which information about co-performers' body movements is available to performers. Two participants were paired and instructed to synchronize their equal interval tapping on electronic drums in a face-to-face situation. 5 trials were applied. The synchronization score was examined based on their tapping timing, and body movements were investigated based on time serial data of their body movements. We examined the relationship between their synchronization score and the way they used their body movement throughout all trials. The results showed that within one pair, the relationship between the participants' body movements developed into two types, and a difference in the synchronization scores associated with these types was observed. Based on these results, the role of body movement was discussed.

The Relationship Between Body Types and Singers' Breathing in Classical Singing

Hyunhi Kim [1], Jane Davidson [1], Viggo Pettersen [2]; [1] University of Sheffield, UK; [2] University of Stavanger, Norway
`3AM2-R11-12`

This study aimed to examine the relationship between body types and singers' breathing in classical singing. Electromyographic activity (EMG) from the intercostals (INT1 & INT2) and in the lateral abdominal (OBL1 & OBL2) muscles was obtained from twenty four experienced singers (19 undergraduate students, 2 post graduate students, 2 singing teachers who had an international solo performing career) and 1 amateur singer with two years of private singing lessons. The INT and OBL muscles on the right side of the body were recorded by surface electromyography (EMG). The circumference of the lower thorax (LTX) and the abdominal region (ABD) (at the navel level) were sensed with two strain gauge sensors. The singers' bodies were mapped concerning: height, weight, lower thorax, mid-shoulder to mid point, mid point to hip distance and nipple to lower rib distance. This was done in order to calculate body type, height to weight ratio and lung volume to weight ratio of the upper body. Three different vocalization tasks were performed: (1) an aria, (2) a sustained tone, and (3) a glissando. The twenty four singers sang "Voi che sa pete", chosen from Mozart opera, *The marriage of Figaro*, by the author. The muscle activity was recorded in the performances of the repeated tasks. The hypothesis of this study was that classical singers' body types would affect the breathing apparatus, and that the different body types would cause differences in the use of muscles when breathing for classical singing. The results showed that singers with normal weight tend to use the intercostal muscles more than those with overweight or obesity.

3AM2-R12 : Performance / Neuroscience

Room 12, 10:40 – 12:30 Wednesday 27 August 2008, Poster session

Analysis of the Tuning Process in the Accompaniments

Noriyuki Takahashi[1], Yoko Oura[1], Minoru Tsuzaki[2]; [1]Niigata University, Japan; [2]Kyoto City University of Arts, Japan

3AM2-R12-02

In musical ensembles, it is necessary for players to anticipate their co-players' performances and accordingly coordinate their own performances in real time. This study was conducted to investigate real-time coordination processes in the piano accompaniments to a solo cello performance. Two university students (pianists A and B), majoring in piano music and experienced in accompaniment, were asked to thoroughly practice the accompaniment part of 'Le cygne' composed by Saint-Saëns. The melody played by a professional cellist was recorded in advance. In the experiment, the prerecorded cello performance was presented five times through the use of a monitor display and speakers, and upon each presentation, the pianists were asked to play the accompaniment part of the piece on a MIDI piano. The MIDI and sound data of each performance was recorded on a computer. An analysis of the onset timing error of the cello and piano revealed that the total timing error of pianist A was low, even in the first trial, while that of pianist B was considerably higher, and with every subsequent trial, it gradually decreased to end at same level as that of pianist A. Moreover, pianist A demonstrated relatively lower onset timing errors except at the beginning of the phrase, where the errors were found to be greater; in contrast, pianist B showed a higher errors not only at the beginning but also in the middle of the phrase, suggesting that it was not easy for her to flexibly coordinate her performance with that of the cello. Correlation analysis of the dynamics revealed that pianist A was significantly better than pianist B at harmonizing with the cello. In terms of the smoothness of the tempo change, pianist A was significantly better than pianist B. These results suggested that the soloist's skill is unrelated to his/her ensemble ability, and that playing in a musical ensemble would involve some unique skill.

Emotional Communication of a Pianist's Intended Expression via Acoustical and Visual Information

Haruka Shoda[1], Toshie Nakamura[2], Maria Raluca Draguna[2], Satoshi Kawase[2], Kenji Katahira[2], Shoko Yasuda[2], Mayumi Adachi[1]; [1]Hokkaido University, Japan; [2]Osaka University, Japan

3AM2-R12-04

We often experience different impressions from the same piece of music when performers change their expressions. Psychological studies suggest that performers' intentions are communicated via acoustical and visual cues. In this light, we aimed at clarifying whether visual information can communicate a performer's emotional intention. We conducted an experiment in which a pianist and 106 listeners evaluated their intended and perceived emotional expressions of two renditions (*deadpan* and *artistic*) for two musical pieces ("Etude Tableaux Op.39-1" and "Prelude Op.32-5" by Rachmaninoff). As a result, the core emotional components intended by the pianist were perceived accordingly by the audience in the sound only, and in the matched sound and vision modes. Although visual information could communicate such components, there were no visual effects on emotional communication of the performer's intentions in the matched sound and vision mode. In contrast, visual information affected the perception of mechanical performance.

Auditory Feedback-Based Error Monitoring Processes During Musical Performance: An ERP Study

Kentaro Katahira, Dilshat Abla, Sayaka Masuda, Kazuo Okanoya; RIKEN Brain Science Institute, Japan

3AM2-R12-06

Auditory feedback is important in detecting and correcting errors during sound production behaviors. In the context of vocal production, a forward model, in which a prediction of action consequence (corollary discharge) is created, has been proposed to explain the dampened activity of the auditory cortex while producing self-generated vocal sounds. It is unclear how auditory feedback is processed and

what neural substrate underlies the process during musical performances. Clarifying the similarities and differences between the modules for vocal production and music performance can help clarify the brain mechanisms involved in both cognitive functions. We investigated the neural correlates of human auditory feedback-based error detection using event-related potentials (ERPs) recorded during musical performances. Keyboard players of two different skill levels played simple melodies using a musical score. During the performance, the auditory feedback was occasionally altered. Subjects with early and extensive piano training evoked a negative ERP component N210, which was absent in non-trained players. When subjects listened to music that deviated from a corresponding score without playing the piece, N210 did not emerge but the imaginary mismatch negativity (iMMN) did. N210 may reflect a process of mismatch between the intended auditory image evoked by motor activity, and actual auditory feedback.

Neuromagnetic Alpha Desynchronization Reflects Auditory Processing to Musical and Non-Musical Sound Differently in Children

Takako Fujioka, Bernhard Ross; Rotman Research Institute, Canada
3AM2-R12-08

It is known that alpha-band (8–13 Hz) activities in auditory cortex are modulated by auditory stimulus in children, as in adults. The current study aims to retrospectively investigate alpha-band activities in our previous magnetoencephalographic (MEG) data which have shown that non-oscillatory brain response in children matures differently according to the stimulus-type (musical and non-musical sound) and child's musical experience in Suzuki music lessons (Fujioka, Ross, Kakigi, Pantev, & Trainor, 2006). Time-frequency analysis using Wavelet Transform was applied to single-trials of source waveforms observed from left and right auditory cortices in response to the violin tone and noise stimulus. The results show prominent alpha power decrease with a clear dissociation between the upper (12 Hz) and lower (8 Hz) range for both stimuli. Interestingly the alpha desynchronization lasted longer in the upper than the lower alpha band only for the violin tone, although the maturational change and group difference were absent. In general the time courses of alpha (onset around 300 ms, peak at 500 ms, offset after 1500 ms) were similar to those previously found for older children and adults with auditory memory related tasks.

Segmentation of Musical Sequence with Statistical Regularities: An Event-Related Potentials Study

Dilshat Abla, Kentaro Katahira, Kazuo Okanoya; RIKEN Brain Science Institute, Japan
3AM2-R12-10

Language and music share much in common structurally. To extract chunk as well as their organization from the speech stream or music, humans must possess efficient computational procedures. Several behavioral experiments have reported evidence that infants and adults readily learn statistically defined patterns in auditory input sequences. To investigate the neural processes involved in online segmentation and statistical learning, we recorded ERPs while adult participants were exposed to continuous, auditory sequences, the elements of which were organized into "tritone words" that were sequenced in random order, with no silent spaces between them. Participants were listening to three 6.6-minute sessions of sequences. Results showed that word onset (initial tone, the less-predictable position) elicited the largest N400 in the early learning session of high learners, but in middle learners, the word-onset effect was elicited in a later session, and there was no effect in low learners. The N400 amplitudes were correlated with the transitional probability of continuous tone streams. The results suggest that the N400 effect indicates not only online word segmentation but also the degree of statistical learning. This study provides insight into the neural mechanisms underlying online statistical learning processes.

The Brain Activation of Absolute Pitch Possessors: A Near-Infrared Spectroscopy Study

Shiho Miyazawa[1], Shozo Kojima[2]; [1]Waseda University, Japan; [2]Keio University, Japan
3AM2-R12-12

This study examined the characteristics of the cerebral hemodynamic responses to musical sound. We measured absolute pitch (AP) and non-absolute pitch (NAP) by

near-infrared spectroscopy (NRS). Absolute pitch (AP) is the ability to identify the pitch without any external reference. Previous studies, from neuroimaging results, has revealed that Broca's area is associated with phonetic and verbal process and, right medial temporal lobe is associated with melody retrieval. However, behavioural studies have shown that when they retain musical pitch, NAP group use sensory encoding, whereas AP group use verbal encoding. By using pitch memory task, we examined hemodynamic response during the task, and we focused Broca's area and the homologue in the right hemisphere. 23 volunteers participated this experiment and were classified by pitch naming test. The result is that AP's score of pitch memory test is greater than NAP's. Furthermore, a larger response to the AP group than to the NAP group changes occurred in Broca's area. These results demonstrated that the difference strategy was used between AP group and NAP group in pitch memory test by using neuroimaging method. We suggested that a new method of investigating music perception using NIRS.

3AM2-R13 : Neuroscience
Room 13, 10:40 – 12:30 Wednesday 27 August 2008, Poster session

Cortical Processing of Consonance of Pure-Tone Dyads: An Evoked Potential Study

Kosuke Itoh[1], Shugo Suwazono[2], Tsutomu Nakada[1]; [1]University of Niigata, Japan; [2]National Hospital Organization Okinawa Hospital, Japan

`3AM2-R13-02`

Multiple levels of auditory processing are believed to contribute to perception of consonance in music. Regarding peripheral processing, consonance has been successfully formalized as the absence of "roughness" perceived when two slightly mistuned simple tones are unresolved in the cochlea. By contrast, little is known about the later central processing. To investigate this issue, long-latency components of auditory evoked potentials (EPs) were recorded while listeners who had received five to sixteen years of training in Western music listened to dyads comprising two pure tones paired at various intervals. Symmetrically over frontal scalp, the amplitude of auditory EP was significantly more negative for dissonance than for perfect consonance at around the N2 latency, and the EP amplitude for imperfect consonance was intermediate. This effect was not significant at the N1 and P2 latencies, by contrast. Thus, the EP was modulated by the interval of pure-tone dyads in a manner that could not be accounted for by the cochlear "roughness theory" of consonance, which states that dissonance (or "roughness") of simple-tone dyads monotonically decreases with frequency separation. In addition to peripheral mechanisms, cerebral cortical processing likely contributes to perception of consonance in listeners who had received training in Western music.

Brain Activities Evoked by Musical Intervals in an Octave: Dissonant or Consonant

Reiko Shiba[1], Kazuhiro Hirai[2], Iku Nemoto[2]; [1]RIKEN Brain Science Institute, Japan; [2]Tokyo Denki University, Japan

`3AM2-R13-04`

The unpleasantness brought by dissonant cords is common to many people. This feeling is considered due to the beat of sounds. We suppose some innate structures in our brain to cause this feeling. In this study, we investigate the basic auditory processing mechanisms of the sensory dissonance perception of musical chords. (Exp. 1) Intervals synthesized of two pure tones ranging from unison to octave were presented to 13 adult musically naïve volunteers. Evoked magnetic fields for the intervals were recorded by whole head MEG system (Neuromag122). Eighty responses to each interval were averaged and low-pass filtered and then analyzed. (Exp. 2) The evoked magnetic fields for 3-tone musical chords (dissonant; C-C# D, C-C#-B, consonant; C-E-G, C-F-A) were recorded and analyzed similarly. A significant large response to the dissonant interval (minor second) was observed in the both auditory cortex from 200 to 400 ms after sound presented in experiment 1. The signal source of this activity existed in the vicinity of that of N1m. A relative large response to dissonant 3-tone musical chord (C-C#-D) was observed from 300 to 400 ms in experiment 2. These responses were supposed to be specific to the dissonant musical intervals.

The Time Needed to Make Decision for Musical Preference and EEG Activities

Tatsuya Iwaki, Tomohiko Makimori; Hiroshima International University, Japan

3AM2-R13-06

Likes and dislikes can be judged only from listening to the beginning of a music piece. Presented study tried to understand the question that how long did listeners need to listen to music to make decision for musical preference. Furthermore, there was a possibility that the brain activities during the time taken to decide the preference differed from that after the period. Twenty participants were asked to push the button when they could judge the preference for a music piece. Presented pieces were all classical music that were presented for each 100 s. Typical 21 channel EEGs were recorded through the experimental session. Mean time to need to judge the musical preferences were 25 s. This means listeners are able to anticipate their preference for each music piece at the beginning. Analyzing the correlation between EEG data and the score of musical preference, alpha band amplitude at frontal area during 25 s from the presentation of music pieces was lateralized with the greater score ratings of preference. Relating this difference of EEG amplitude, EEG coherence between left and right frontal-temporal sites was also increased. EEG changes implied the activation of frontal brain area reflecting the analytic state of musical preference.

Frontal Brain Activation During Listening to Negative vs. Positive and High vs. Low Arousal Music: The Moderating Effects of Impulsivity and Neuroticism-Anxiety Dimensions of Personality

Kari Kallinen; Helsinki School of Economics, Finland

3AM2-R13-08

A considerable body of research has found a relationship between emotions and frontal cortical activity. Some studies suggest that left and right frontal alpha activation is related to the experience of positive and negative emotions, respectively ("valence hypothesis"), while others have suggested that the right hemisphere processes both positive and negative information ("right hemisphere hypothesis"). In addition to emotional characteristics of music, it has also been suggested that there may be individual difference variables that affect the nature and magnitude of responses to music, although only a few studies have examined this issue in connection with music and brain activity. The purpose of the present study was to test the valence and right hemisphere hypothesis by examining the frontal brain activity during positive (i.e., joyful) vs. negative (i.e., sad and fearful) and high (i.e., joyful and fearful) vs. low arousal (i.e., sad) music. In addition we wanted to study whether the personality dimensions (i.e., impulsivity [Imp] and neuroticism-anxiety [N-Anx]) moderates the activity. The present study gave only partial support for the valence theory of frontal brain asymmetry, and demonstrated that the individual differences (such as personality) may have very fundamental effects on the brain activity observed in individuals. The results will be discussed from the valence and right hemisphere hypothesis point of view and the role of individual differences in brain responses to emotional music will be further explored.

Anterior Portion of Temporal Lobes Participates in the Perception of Chords: A PET Study

Masayuki Satoh; Mie St. Cross Hospital, Japan

3AM2-R13-10

I had experienced a case of amusia who showed the impairment of the discrimination of isolated chords (Satoh 2005). Using positron emission tomography (PET), I ascertained the activation of the anterior portion of the temporal lobes in the perception of chords in nonmusicians. Eleven right-handed male volunteers performed two kinds of musical tasks of identical musical pieces: harmony-listening and soprano part-listening. Six cerebral blood flow (CBF) measurements were determined for each subject — three during the harmony-listening and three during the soprano part-listening task. Employing the ^{15}O-labeled water (H_2^{15}O) intravenous bolus technique, I collected emission data for 90 seconds in each measurement following the intravenous bolus injection of 15~17 mL (40 mCi) of H_2^{15}O. PET data analysis was performed by using an automated PET activation analysis package (Minoshima 1993). Subtraction of soprano-part listening from harmony-listening task showed that significant increases in regional CBF were found in the anterior portion of the bilateral temporal lobes, bilateral cingulated gyri, and the cerebellum. Based on the

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results of case and activation study, it is reasonably concluded that the anterior portion of the bilateral temporal lobes is vital in the perception of chords.

3AM2-R16 : Demonstration III

Room 16, 10:40 – 12:30 Wednesday 27 August 2008,

"*Seeing Harmony*": A Computer Graphics System for Visualizing Harmony

Chikashi Fujimoto, Hiroo Konaka, Takefumi Hayashi, Norman D. Cook; Kansai University, Japan

`3AM2-R16-1`

Two independent acoustical features (dissonance and tension) contribute to the overall sonority of musical triads. These features can be calculated from the relative size of the intervals among the fundamental frequencies and their upper partials in any chord, and then plotted as 3D graphs. The strength of the major/minor "modality" of chords is also determined by the relative size of the two intervals in each three-tone combination. Precise, quantitative evaluation of these harmonic features allows for the visualization of chords both in terms of their resolved/unresolved character ("instability", defined as the sum of interval dissonance and triad tension) and in terms of their affective valence (the relative size of the upper and lower intervals among partial triads). Based on this model of harmony perception, we have developed an OpenGL visualization software system which displays harmonies as dynamic 3D patterns in response to the input of musical chords. The software has both visual and auditory output, allowing the user to perceive the relationship between auditory features and a visual analog that is constructed on the basis of the acoustical properties of the chords. Unlike familiar "screensaver" software that presents visual patterns in response to music, the **Seeing Harmony** software has a rigorous psychoacoustical foundation.

3AM2-R17 : Demonstration IV

Room 17, 10:40 – 12:30 Wednesday 27 August 2008,

A Psychoacoustical Toolbox for Sound/Music Analysis and Sound Design/Music Creation

Alexandre Torres Porres; University of São Paulo, Brazil

`3AM2-R17-1`

This demo session is about a Puredata Library of Patches. This project is still at its initial phase on a doctorate degree program at USP, under the supervision of Prof. Dr. Fernando Iazzetta and Prof. Dr. Marcelo Queiroz. The first Patch of this library was developed during a Master's degree, and was centred on the Psychoacoustical Model of Roughness. The software was adopted to analyse spectrum of sounds and derive a scale of consonant and dissonant steps. Such a procedure enabled the analysis behind the Poster presentation from the same author at ICMPC 10. Thus, more information about it can be found on the full paper submitted to the Proceedings. The software and user manual can be downloaded from http://porres.googlepages.com/home. Besides the Scale derivation from the Spectrum, this tool also analyses Roughness of audio signal over time. Because of its creative possibilities regarding the perception of tuning, the software has a section of Adaptive Tuning modules that work as pitch correctors, and were used with theremin-like sensors. The current state of development aims to include other Psychoacoustical Analysis of sound/music, as well as creative interactive tools for sound design and music creation.

3AM2-R18 : Demonstration V

Room 18, 10:40 – 12:30 Wednesday 27 August 2008,

Creating the Expression of *Cantablile* with Software

Tomoyasu Taguti; Taguti Laboratory of Computation and Analysis, Japan

`3AM2-R18-1`

Cantabile, or singing, is one of directions concerning the general character of a

piece or section of music, which necessarily directs the player to convey the implied emotion to the audience in his/her performance. Like other directions such as *dolce*, *amoroso*, *agitato*, *appassionato*, and others, the meaning is totally holistic as compared with the performance marks indicating the tempo, dynamics, articulation, etc. that are more concrete and directly related to the performance practice. The author will present a descriptive method to realize the desired musical expression with software. The essential point is a hierarchical superposition of performance variables corresponding to the dynamics, agogics, articulation, onset-shift, and pedaling. These performance variables, defined in the form of envelope functions in the beat variable, can be given to any musically meaningful units as well as to their subgroups, and sub-subgroups ... at arbitrary depths, of the entire note structure. The demonstration will be focused on the cantabile expression for *Andante cantabile con espressione*, Second Movement of Mozart's Piano Sonata No. 9 in A minor, KV 310, by making use of several simple envelop forms, or envelop elements, of the performance variables. Note that the set of the instances of the performance variables in hierarchical structure is viewed as a decomposition of the desired (complex) musical expression.

3PM1-R02 : Timing and Performance

Room 2, 13:30 – 15:30 Wednesday 27 August 2008, Oral session

Accuracy in Time-Interval Production with Contextual Sequences : A Comparison Between Trained and Untrained People

Tomoko Hashida, Takao Sato; University of Tokyo, Japan

`3PM1-R02-1`

The present study aimed at investigating whether musical training experiences effect on the accuracy of time-interval production when contextual sequences are presented, which may provide clues for the prediction of the beat timing and mental subdivision. We are interested in whether the abilities to use contextual sequences for producing time-intervals are different between trained and untrained people or not. In the experiment, participants were required to produce 4000ms inter-onset of tapping-intervals (ITIs) by using key. Seven types of contextual sequences were generated depending on the length of key press. Standard deviations of ITIs were calculated as a measure of production accuracy. The results indicate that people can produce time-intervals with contextual sequences accurately regardless of musical proficiencies and the types of contextual sequences don't effect on production accuracies. In other words, the abilities to produce time-interval by making use of hints for the prediction of beat timing and the mental subdivision provided by sequences are not different between trained and untrained people.

Multi-Feature Modeling of Pulse Clarity from Audio

Olivier Lartillot, Tuomas Eerola, Petri Toiviainen, Jose Fornari; University of Jyväskylä, Finland

`3PM1-R02-2`

This paper defines pulse clarity as an introspective understanding of the quality of the rhythmic structures not merely reduced to questions related to synchronization capabilities. The objective of this study is to establish a composite model explaining pulse clarity judgments from the analysis of audio recordings, and to ground the validity of the model through listening tests. The models used in this study are based on a range of musical features usually regarded as important in the perception of pulse clarity. Rhythmic periodicity is estimated via the autocorrelation of the amplitude envelope of the audio waveform. Statistical characterization of the autocorrelation function indicates the prominence of the main pulsation. Harmonic relations between the main pulsation and the secondary periodicities may also contribute to the rhythmic clarity. Besides periodicity, descriptors related to the amplitude envelope itself are also considered. The models have been written in Matlab using *MIRtoolbox*. To evaluate the models, 25 participants rated the pulse clarity of one hundred excerpts from movie soundtracks. The mapping between the model predictions and the ratings is carried out via regressions. Almost a half of the listeners' rating variance can be explained with a combination of periodicity-based and non-periodicity-based factors.

Effects of Physiological Arousal on Performing Tempo and Artistic Expression in Pianists

Michiko Yoshie, Takeshi Hirano, Akito Miura, Kazutoshi Kudo, Tatsuyuki Ohtsuki; University of Tokyo, Japan

`3PM1-R02-3`

The present study examined whether pianists' heightened physiological arousal in stressful performance situations can alter their performing tempo and artistic expressions. Seven music majors aged 21–37 years ($M = 28.4$, $SD = 5.9$) performed Chopin's Etude Op. 25-5 on a grand piano under two conditions: (a) In the *rehearsal* condition, participants played the piece alone in a practice room. (b) In the *competition* condition, participants performed in front of five judges and a large audience. During their performances, we recorded the mean heart rate (HR), sweat rate (SR), and electromyographic (EMG) activity from four muscles in the left arm and shoulder. The effectiveness of arousal manipulation was confirmed by the significantly increased HR, SR, and EMG activity in the competition condition. The total duration of the piece significantly decreased from the rehearsal to competition condition. Additionally, participants tended to hold the note under a fermata relatively longer in the competition condition, presumably in an attempt to relieve muscle fatigue. We conclude that the heightened physiological arousal due to psychological stress can accelerate the internal tempo (Boltz, 1994) and hence performing tempo in musicians, leading to the impairment of performance quality. Furthermore, the associated increases in muscle activity can alter the artistic expressions.

Effect of Pianists' Expressive Intention on Amount and Type of Body Movement

Marc R. Thompson, Geoff Luck; University of Jyväskylä, Finland

`3PM1-R02-4`

Body movement displayed in music performance is said to be an overt manifestation of the musician's expressive intentions and goals regarding the music being played. We are interested in studying if different levels of expression result in different amounts of body movement and gestures. For this study, musicians were asked in multiple sessions to play an excerpt from the same piece using three different levels of expression while their movements were recorded using an optical motion capture system. Statistical tests show that an increasing amount of expression resulted in more body movement and that the amount of expression and physical movement were inter-twined. Also, we present data suggesting that the head and shoulders travelled a further distance overall, and showed bigger differences between performance manners, compared to the fingers, wrists and lower back. We hypothesize that this is related to the contrasting roles these parts of the body play in piano performance.

3PM1-R03 : Music Listening III

Room 3, 13:30–15:30 Wednesday 27 August 2008, Oral session

Musical Preferences of Secondary and Post-Secondary Students in Singapore

Sun-Hee Chang [1], Eddy Chong [2]; [1] Seoul National University, Korea; [2] Nanyang Technological University, Singapore

`3PM1-R03-1`

This study seeks to investigate the effect of familiarity, age, gender, ethnicity, and academic group as well as their interactions on the musical preferences of secondary and post-secondary students in Singapore. The students whose responses were analyzed (n=1529) ranged from age 12 to 23. Five music categories were used in the listening survey — Jazz, Rap, Rock, Traditional music (comprising African, Chinese, Indian, Indonesian, Japanese, and Malay) and Western classical music. Mean preference results showed that western classical music was the most familiar (M=3.58, SD= .86) and most preferred (M=3.47, SD=.80) whereas traditional music was the least familiar (M= 2.80, SD= .87) and least preferred (M=2.41, SD= .66). The correlation between familiarity and preference is significant for all music categories; ANCOVA results further showed that familiarity of the corresponding music category was the most influential factor affecting preferences in all cases. Of the other four factors examined, interaction effects between gender and academic group, ethnicity and academic group, as well as gender and ethnicity were found to be significant,

affecting the different music categories in different ways. In terms of main effects, age was the only factor that did not significantly interact with the other factors in influencing preferences; on its own, it seemed to affect only students' preference for Jazz. Of the five music categories, Rap which was ranked second in terms of preference was more strongly preferred by the lower academic ability secondary-school groups (unlike with all the other music categories), and by both Indians and Malays (as with Traditional music but not with the others).

Relations Between Music Preferences, Personality Characteristics and Values in a Turkish Sample

Hasan Gurkan Tekman, Gaye Goklu, Vuslat Saglam; Uludag University, Turkey

3PM1-R03-2

Rentfrow and Gosling (2003) factor-analyzed reported preferences for musical genres and found that four dimensions (upbeat and conventional, intense and rebellious, energetic and rhythmic, reflective and complex) could summarize musical preferences of US samples. Preference for each one of these dimensions also had reliable correlations with some person variables including personality, political, and cognitive characteristics. We investigated the generality of the four dimensions discovered by Rentfrow and Gosling (2003) in a different culture and also aimed to see whether musical genres specific to this culture would fit into the same classification. Furthermore, we examined the relations between music preferences and person variables including value orientations. The four factors that were observed by Rentfrow and Gosling (2003) emerged in the data. However, some of the musical genres specific to Turkey combined in a fifth factor. Not only personality characteristics but also value orientations were related to music preferences. The correlations of music preferences and person variables showed that there may be differences as well as commonalities in the functions the same genres serve in different cultures.

Music Preference and Sensation Seeking Tendency in Various Age Groups

Marek Franěk; University of Hradec Králové, Czech Republic

3PM1-R03-3

Several studies reported that individuals, who score high in the sensation-seeking tend to prefer certain musical genres, in particular hard rock, punk, heavy metal, and reggae music. The association between sensation seeking and music preference was studied only in adolescents or young adults. There is a question, whether this tendency is also manifested in another age groups. Participants (N=521) were asked to complete the Sensation Seeking Scale V and the test of musical preference. The multiple regression analysis revealed that jazz, electronica/dance music (dance, techno, jungle etc.) and rock music was positively related to sensation seeking (SS). It was shown that in (1) adolescents and younger adults (16–25 years) preference of jazz and electronica/dance music was positively associated to SS, in (2) adults from 26 to 39 the preference of rock and electronica/dance music was positively associated to SS, and in (3) adults from 40 to 57 the preference of jazz and rock was positively associated to SS. The results showed that in adolescent and young adults group the preference of electronica/dance music and jazz was related to the high level of SS, while in middle age individuals SS was associated with the preference of rock. It seems that for middle age individuals rock could have a similar arousing effect as electronica/dance music for younger people.

Relating Personality to Reported Music Preferences and Listening Behaviour

Greg Dunn, Boris de Ruyter; Philips Research, The Netherlands

3PM1-R03-4

Though music is a ubiquitous and ingrained aspect of our daily lives, little is known about why people become fond of one music genre versus another. We aim to support previous results relating reported music preferences to personality, and further extend its validity to listening behaviour. To accomplish this, 395 participants (335 males) completed measures for music preferences and personality. Their listening behaviour was tracked using a music database for a minimum period of 3 months. Results indicated participants' reported music preferences were positively correlated to listening behaviour for 13 of 14 genres. Correlations between music preferences and personality were not consistent with previous research, however; neither for

reported music preferences nor listening behaviour. Thus, while reported music preferences reliably indicated listening behaviour, further study is required to fully establish how music preferences and listening behaviour are related to personality.

3PM1-R04 : Emotion in Music III

Room 4, 13:30 – 15:30 Wednesday 27 August 2008, Oral session

Dynamic Auditory Parameters and Perceived Musical Tension

Roni Y. Granot[1], Zohar Eitan[2]; [1]Hebrew University, Israel; [2]Tel Aviv University, Israel

3PM1-R04-1

Though the perception of musical tension has recently received considerable attention, the effect of interactions among auditory parameters on perceived tension has hardly been examined systematically. In this study, 72 participants (30 musically trained) listened to short melodic sequences which combined manipulations of pitch direction, pitch register, loudness change and tempo change, and rated each sequence for overall tension level and for direction of tension change (increasing or decreasing). For overall tension, repeated measures ANOVAs show main effects of loudness, pitch direction, and pitch register (lower more tensional), and several significant interactions (e.g., tempo and loudness, pitch direction and register). Tempo had only a weak effect on overall tension ratings but significantly affected ratings of tension change. Results indicate that the mutual effect of auditory parameters on perceived tension is often strongly interactive, rather than additive. In addition, pitch register is shown as a strong determinant of perceived tension; in contrast to previous findings, *lower* register enhances perceived tension. We discuss results in light of an ecological model, bearing on cross-modal and affective connotations of auditory qualities, in which the degree of tension is affected by auditory cues for impending threat.

Affective Response to Tonal Modulation

Marina Korsakova-Kreyn, W. Jay Dowling, Joseph Dunlop; University of Texas at Dallas, USA

3PM1-R04-2

This study investigated affective response to modulations to all 12 major and minor steps of the Western tonal schema. The participants were asked to listen to 48 brief chordal progressions and to indicate the intensity of their affective response to the concluding part of each progression on six bipolar adjective scales: *Happy-sad, Pleasant-unpleasant, Strong-weak, Firm-wavering, Bright-dark, Warm-cold.* These pairs represent three dimensions: the two semantic differential scales, Evaluation and Potency, and a category involving synaesthetic metaphors often involved in music perception. There were differentiated affective responses to the different modulations that depend on key proximity and mode, and, perhaps, stylistic familiarity. Listeners were sensitive to modulation to the Subdominant and Dominant, recognized the "negativity" of the tritone, and sensed as "positive" the popular modulations into major keys that ascend a half step or descend a major third. This investigation agrees with other studies on affective response to the major and minor modes. In addition, the study provides evidence that the Lerdahl-type system of tonal relationships involved in functional harmony needs to be supplemented with considerations of the importance of a semitone approaching the root of the tonic triad or the mode-defining third.

Music Emotion Classification by Audio Signal Analysis: Analysis of Self-Selected Music During Game Play

Don Knox, Gianna Cassidy, Scott Beveridge, Raymond MacDonald; Glasgow Caledonian University, UK

3PM1-R04-3

Music emotion classification algorithms seek to classify music files automatically by means of audio signal analysis. An overview of these methods is given, and an emotion classification algorithm is applied to the preferred music choices made by test subjects during a game play experiment. Results from the experiment are presented, in which test subjects were exposed to 3 sound conditions: preferred music, game soundtrack and experimenter-selected music. Obtained measures are heart rate, pedometer rate, game score, completion time and enjoyment. The

preferred music choices from the experiment are analysed and classified according to mood cluster, valence and arousal. Obtained measures for these music classifications are discussed, as are the implications for automatic mood classification in choosing music for future experiments. It is noted that such mood classification schemes are nascent. A means by which these schemes may be made more robust is proposed, and initial results toward this goal are presented.

Emotional Cues in Knocking Sounds

Renzo Vitale [1], Roberto Bresin [2]; [1]RWTH Aachen University, Germany; [2]KTH, Sweden

`3PM1-R04-4`

The object of this research is to describe how temporal and dynamic cues in knocking sounds can communicate emotions, just like in expressive musical performances. An experiment has been conducted where several emotions were supposed to be expressed by different performers. Participants were asked to knock on a wooden door according to instructions. Knocking sounds have been recorded both outside and inside the room, and afterwards they were rated in listening tests.

Together with acoustic measurements, arm movements during the knocking action were detected through a motion capture system, so that the body behaviour (visual component) could be correlated to the sound evaluation (acoustical component). Based on previous research on arm movements and music performance, ten different emotions were selected for investigation.

Results confirm the use of the same strategies in both expressive everyday body gestures and expressive music performance. Listeners were able to perceive emotions to a large extent. Strong similarities between the use of acoustical features in knocking and music performance were found.

The intended emotions were generally perceived correctly. Among the relevant acoustical features extracted from the recordings, rhythm and IOI as well as loudness revealed to be strong cues.

3PM2-R02 : Development II

Room 2, 15:45 – 17:15 Wednesday 27 August 2008, Oral session

Young Children's Rhythmic Behaviour in Singing: The Influence of Mother Tongue on Their Development

Nozomi Azechi; IOE University of London, UK

`3PM2-R02-1`

Different rhythmic behaviour in musical performances was reported in some cross-cultural studies. Dotted rhythm is one of the 'need to be trained' musical skills among Japanese music students, though it is a favorite rhythm for use in composition and improvisation among Japanese children. A 3:1 ratio dotted rhythm and a 2:1 ratio were found to be confused in Japanese students and children's musical performances. It has been believed that this phenomenon was caused by the effect of the Japanese language phonetic system and its rhythm. However, the developmental process of this rhythmic behaviour and influence of language rhythm has not been examined.

Japanese and English children aged 3–6 singing: "Twinkle, twinkle" (song1) and "If You're Happy and You Know It" (song2) were analyzed by nPVI. Preliminary analysis of song1 indicates that there is a difference between the two groups at age 4 and above. Further difference is expected on dotted rhythm in song2. However, the difference was found only between the age 5 groups. The nPVI value of the English 3-year-old group was lower than that of the Japanese. The results from the song1 suggest that there is a tendency for language effects to become more evident as the children grow up. However, many of singers from the English 3-year-old group sung dotted rhythm of the same length, which is different from the rhythm of mother language. There is a contradiction between results from two songs.

Development of Pitch Processing in Auditory Cortex Between 2 and 4 Months of Age

Laurel J. Trainor, Chao He; McMaster University, Canada

`3PM2-R02-2`

In the first months after birth, infants attend to the pitch patterns of music and

speech. While it is known that auditory cortex undergoes large maturational changes between 2 and 4 months of age, little is known about how this affects pitch processing. We are using event-related potentials (ERPs) derived from EEG recordings to track the development of the brain's response to changes in pitch and pitch patterns. We have measured ERP responses to (a) changes in a repeating tone of one pitch, (b) changes in a pitch pattern (order of the tones), (c) changes in a melody that is transposed to a new key, and (d) the pitch of the missing fundamental. Responses to a change in the pitch of a single tone change dramatically between 2 and 4 months of age, with 2-month-olds showing an increase in a positive slow wave and 4-month-olds a negative mismatch (MMN) response similar to adults. By 4 months, robust responses to changes in pitch pattern and to the pitch of the missing fundamental can be seen. We conclude that pitch processing in auditory cortex changes dramatically between 2 and 4 months, with adult-like responses emerging around 4 months.

A Day in the Life Project: Everyday Musical Experiences Among Two Year Old Girls in Seven Different Locations

Susan Young; University of Exeter, UK
`3PM2-R02-3`

Interest in the everyday musical experiences of children is growing, receiving impetus from recent activity in the social and anthropological study of childhood. In this study, a single day of home-care for seven two-and-a-half-year-old girls living in different countries (Canada, Italy, Peru, Thailand, Turkey, UK, USA) was video-recorded by project researchers. In an ecological approach to research other data was also collected including preliminary interviews, field notes and mappings of the home environment. The project has been long-term and the music strand [one of many strands being researched by the project team] has evolved into several lines of interest including: technology assisted musical activity; music as parenting practice; and the home as a site for young children's entertainment through music. This presentation will give an overview of these lines of interest and illustrate them with examples from the video data. Developmental psychology has tended to be insufficiently interested in the wider cultural processes which contribute to children's musical development. Ethnomusicology and the sociology of music have been insufficiently interested in children's musical activities. It will be argued that the integration of interdisciplinary accounts of young children's musical experiences is essential if we are to acquire fuller understandings of their musicality, the diversity of musical practices and how children develop musically within heterogeneous contexts.

3PM2-R03 : Audio-Visual Interaction

Room 3, 15:45 – 17:15 Wednesday 27 August 2008, Oral session

Experiencing Musical Performance: The Effect of a Visual Component on Appreciation of Complex Musical Sound

Scott D. Lipscomb, Guerino Mazzola; University of Minnesota, USA
`3PM2-R03-1`

The purpose of this study was to determine whether the presence of the visual aspect of music performance enhances to a significant degree the experience of the listener-viewer in response to a variety of musical styles.

Participants in the study were assigned to one of three conditions (audio only, audio with visualization, or audio with visual performance) and were then presented with examples selected from each musical genre. Musical examples were selected from both traditional (relatively "simple") and modern ("complex") musical contexts. The stimuli were presented in a random order to each group of participants. After experiencing each stimulus, every participant responded on a series of 8-point verbal scales. Selection of these verbal scales was determined by a preliminary study, the results of which were presented at SMPC 2007.

Based on the results of the present study, the authors will propose potential applications for visual analogues of musical examples from a wide array of musical repertoires to facilitate the music learning process and influence the evolution of musical preferences.

The Effects of Diegetic and Non-Diegetic Music on Viewers' Interpretations of Film

Siu-Lan Tan [1], Matthew P. Spackman [2], Elizabeth Wakefield [1];
[1] Kalamazoo College, USA; [2] Brigham Young University, USA
`3PM2-R03-2`

245 participants viewed a film excerpt, accompanied by diegetic music (presented as if originating from within the world of the film characters) or the same music presented as if an external dramatic score. Diegetic and non-diegetic presentations of the same music led to different interpretations with respect to characters' emotions, relationship between characters, and the overall mood of the scene.

The Effect of Music on the Fear Emotion in the Context of a Survival-Horror Video Game

Masashi Yamada; Kanazawa Institute of Technology, Japan
`3PM2-R03-3`

The effect of music on the fear emotion is investigated using a survival-horror video game, in the present study. Eight male and two female players participated in the experiment. Two scenes without music were selected from the game, and eight musical excerpts composed for the series of the survival-horror game were selected. In the first part of the experiment, the participants listened to each of the excerpts only and then evaluated the impression of it using semantic differential scales. In the second part, each combination of scenes and excerpts was presented to the participants. Then they evaluated the impression of the audio-visual stimulus and also rated their fear emotion. Principle component analyses and multi-regression analyses showed that the impression of the game is largely determined by music, not visual information. Moreover, a "heavy" music provides the "potency" and "darkness" to the game and, in turn, evokes a strong fear emotion for the players. These results are consistent with a previous study which used a roll-playing game. However, there were no significant differences between male and female players in the fear emotion and impression of the game, in the present study. This was inconsistent with the results for the roll-playing game, in which males were more deeply affected by music than females.

3PM2-R04 : Music and Language

Room 4, 15:45 – 17:15 Wednesday 27 August 2008, Oral session

Language, Music, and Modularity: Evidence for Shared Processing of Linguistic and Musical Syntax

L. Robert Slevc [1], Jason C. Rosenberg [2], Aniruddh D. Patel [3]; [1] Rice University, USA; [2] University of California at San Diego, USA; [3] The Neurosciences Institute, USA
`3PM2-R04-1`

The extent to which syntactic processing relies on special-purpose cognitive modules has attracted considerable debate. The current experiments address this issue by simultaneously manipulating syntactic processing demands in language and in music. Participants performed self-paced reading of garden-path sentences in which a structurally unexpected word caused temporary syntactic processing difficulty. As participants read, each button press triggered a musical chord, with the resulting sequence forming a coherent Bach-style chord progression. When a harmonically unexpected chord was paired with a structurally unexpected word, participants showed substantially enhanced garden-path effects (as measured by reading times), suggesting that language and music were competing for similar processing resources. No such interaction was observed when the critical word violated semantic, rather than syntactic, expectancy, nor when the critical chord violated timbral, rather than harmonic, expectancy. These results support a prediction of the *shared syntactic integration resource hypothesis* (SSIRH, Patel, 2003), which suggests that music and language draw on a common pool of limited processing resources for integrating incoming elements (such as words and chords) into syntactic structures.

Towards an Ecological Theory of Musical Semantics

Ghofur Eliot Woodruff; University of Cambridge, UK
`3PM2-R04-2`

Despite the intimate link between music and language, and the conviction voiced by many that music has meaning, its semantic content continues to elude scholars in all fields. A preliminary aim of this paper is to survey current theories of linguistic and musical meaning, and thereby consider how meaning may be sought more profitably. One solution is to examine non-verbal communication within evolutionary paradigms. The recent work of Ian Cross on motivational structures in music, derived from Eugene Morton's model of animal communication, is cited as exemplary in this respect. The central theme of this paper is dedicated to a theory of representation developed by Ruth Millikan in which sound is simultaneously descriptive and directive. It is argued that the semantic mapping functions for this representation derive from evolutionary, biological, and physical principles as outlined by Morton and others. Finally, it is proposed that Millikan's theory accounts for simple satisfaction conditions in music. These conditions are explored in relation to three forms of musical engagement: music as cinematic experience, music as social interaction, and music as autonomous activity.

Cognitive Musicology, Automata Theory, and the Empirical Testability of the Language and Music Faculty Hypothesis

Uwe Seifert; University of Cologne, Germany

`3PM2-R04-3`

Like for cognitive science the epistemological framework of cognitive musicology is automata theory. Concerning language and music there are at present two research programmes within this cognitive science framework: the generative approach inaugurated by Noam Chomsky and the approach based on findings on mirror neurons and Michael A. Arbib's Mirror System Hypothesis. Empirical research on the evolution of the language and music faculty or on language readiness within these programmes relies on the idea of recursion, discrete infinity, and self-embedding. In this paper, the results of this empirical research are discussed and it is argued that recursion based on a discrete infinity assumption for cognitive domains is a theoretical concept which is empirically not directly observable and testable. This claim is made evident by showing that the main assumption made by empirical researchers — natural languages are not finite state languages — can only be established by proof. Furthermore, it is argued that only computational modeling — especially with robots — might bridge the gap between automata theory and empirical research. The argument is based on the result that computers *are* finite automata and the assumption that within the epistemological framework of cognitive science computational systems like humans are at present best considered of as finite automata.

3PM2-R05 : Harmony and Tonality I

Room 5, 15:45 – 17:15 Wednesday 27 August 2008, Oral session

Revisiting Local versus Global Processing of Cadences in the Solution of Musical Puzzles

Benjamin Anderson, Richard D. Ashley; Northwestern University, USA

`3PM2-R05-1`

Many recent studies have used musical puzzles to evaluate the local or global importance of cadence structure. In one study (Tillmann, Bigand, & Madurell 1998), participants chose two puzzle pieces to assemble a musical piece that conformed to what normally occurs in music. The authors concluded that participants (1) were sensitive to temporary modulations, (2) perceived the syntactic function of half and authentic cadences, and (3) had more difficulty with modulating minuets than minuets with half cadences. Looking at their results in terms of surface cues and associational structures yields clues into how listeners make order judgments. Lerdahl and Jackendoff (1983) briefly acknowledge the importance of associational structures in grouping structure, but otherwise deal little with the notion. Using discourse theory (Wolf & Florian 2005) as a guide, the model introduced here fills this gap in theoretical understanding using network hierarchies rather than strict hierarchies to model listener perception. Relationships between themes and motives can be established and then adapted throughout a piece even if the two statements are not adjacent. These relationships can demonstrate the difference between primed expectations and their later fulfilments and offer new insight into puzzle solving tasks.

Statistical Properties of Tonal Harmony in Bach's Chorales

Martin Rohrmeier, Ian Cross; University of Cambridge, UK

3PM2-R05-2

This study aims to contribute empirical computational results to the understanding of tonality and harmonic structure. It analyses aspects of tonal harmony and harmonic patterns based on a statistical, computational corpus analysis of Bach's chorales. This is carried out using a novel heuristic method of segmentation developed specifically for that purpose. Analyses of distributions of single pc sets, chord classes and pc set transitions reveal very different structural patterns in both modes, many, but not all of which accord with standard music theory. In addition, most frequent chord transitions are found to exhibit a large degree of asymmetry, or, directedness, in way that for two pc sets A,B the transition frequencies f(A→B) and f(B→A) may differ to a large extent. Distributions of unigrams and bigrams are found to follow a Zipf distribution, i.e. decay in frequency roughly according to $1/x^2$ which implies that the majority of the musical structure is governed by a few frequent elements. The findings provide evidence for an underlying harmonic syntax which results in distinct statistical patterns.

A subsequent hierarchical cluster analysis of pc sets based on respective antecedent and consequent patterns finds that this information suffices to group chords into meaningful functional groups solely on intrinsic statistical grounds without regard to pitch content.

Is There a Relationship Between Pitch Attraction and Generative Grammar in Western Tonal Music?

Matthew Woolhouse, Martin Rohrmeier; University of Cambridge, UK

3PM2-R05-3

Despite recent theoretical and empirical advances linking language and music, an important question remains unanswered: how is a particular chord and/or tone allotted to a particular position within a grammatically structured musical phrase? For example, in a statistical study by Rohrmeier of the frequencies of diatonic chord progressions in Bach chorales, chord II was five times more likely to follow chord IV than to precede it; chord I followed chord V twice as often as preceding it, and so on. This research draws together two existing lines of research with the aim of showing how local and possibly global dependency relationships specified in Rohrmeier's generative grammar may be linked to and supported by chord attraction levels as specified in Woolhouse's pitch attraction model. It is argued that, to a significant degree, the transitional regularities of chords in tonal music can be explained and understood in terms of generative rules of tonal harmony and pitch attraction. Empirical evidence is provided which supports the notion that chord transition asymmetries in Bach chorales are linked to chord attraction, mediated by an underlying syntactic process.

4AM1-R02 : Timbre II

Room 2, 8:30–10:30 Thursday 28 August 2008, Oral session

Investigating English Violin Timbre Descriptors

C. Fritz, A.F. Blackwell, Ian Cross, B.C.J. Moore, J. Woodhouse; University of Cambridge, UK

`4AM1-R02-1`

Performers often discuss the sound quality of a violin or the sound obtained by particular playing techniques, calling upon a diverse vocabulary. But how do those words relate to each other? How consistent are they between players? How reliably can they be used by teachers, or performers explaining to violin makers what they want? This study explores the verbal description of the distinctive timbres of different violins: what descriptors are used by performers to characterise violins? 61 common descriptors were collected and then arranged by violinists on a map, so that words with similar meanings lay close together, and different meanings far apart. The results of multidimensional scaling demonstrate consistent use among violinists of a previously informal vocabulary and highlight which words are used for similar purposes. These terms and their relations will be useful for violin makers and luthiers, especially specialists in setting up and adjusting instruments during discussions with performers. They provide a tool for acoustical research into the quality of instrumental sound. Furthermore, identifying word consistency between players can contribute to development of pedagogical and directorial methods, as well as ways of annotating music scores for composers and arrangers.

Aggressiveness of the Growl-Like Timbre: Acoustical Features and Biomechanical Mechanisms

Chen-Gia Tsai, Shwu-Fen Wang, Yio-Wha Shau, Tzu-Yu Hsiao; National Taiwan University, Taiwan

`4AM1-R02-2`

The term *growl* is originally referred to as low-pitched, rough sounds uttered by animals. Humans occasionally use growl-like voice to express excessive emotions. Growl can be found in singing styles of ethnic and pop musics such as Chinese opera and death metal. Some rockmusicians believed that death growl is distorted by use of the guts, although the abdominal function has been unclear. The present study showed that the deepest abdominal muscle, transversus abdominis, was significantly activated during growling. We proposed a biomechanical model to relate the aggressive characteristic of growl-like timbre to the motor mechanisms underlying growl production in humans.

Perception of Wind Instrument Vibrato Sounds

Michael Oehler [1], Christoph Reuter [2]; [1]IAMP, Germany; [2]University of Cologne, Germany

`4AM1-R02-3`

In several experiments it has been shown, that vibrato is an important factor for the perceived naturalness in wind instrument sounds. In the presented study vibrato and micromodulations were investigated from a source oriented perspective along the natural sound generating process. This approach seems to be promising, since a deeper insight into the typical behavior of modulations and the relevance of each individual vibrato parameter can be provided. Modulated bassoon and oboe sounds were synthesized by means of a currently developed synthesis and analysis framework. Based on the pulse forming principle, realistic source-oriented modulations as well as often used AM and FM-modulations were produced and subsequently rated in a listening test. A conducted ANOVA showed ($p < .01$) that the different types of modulation significantly affect the perceived naturalness. The stimuli with combined pulse width and cycle duration modulation were perceived as natural as the original sounds, whereas all other stimuli were perceived significantly less natural. The results support the hypothesis, that source-affected timbre modulation is an important factor for the perceived naturalness of double reed woodwind vibrato sounds. Further investigations may as well be useful for exploring new sound synthesis algorithms as for other experiments in the field of timbre research.

Do Key-Bottom Sounds Distinguish Piano Tones?

Werner Goebl, Ichiro Fujinaga; McGill University, Canada

`4AM1-R02-4`

The timbre of a single piano tone as well as its loudness is primarily determined by the speed at which the hammer hits the strings (final hammer velocity). However, the overall sound may also be influenced by impact sounds such as the hammer-string or the finger-key impact sounds. Especially the latter can be varied with playing technique (touch) and is easily perceptible. Little is known about the nature of sounds that emerge from the interaction of key and keybed. In this study, we investigate whether the absence or presence of a key hitting the keybed makes two otherwise identical piano tones distinguishable by expert listeners. A skilled pianist produced a number of isolated tones on a computer-monitored Boesendorfer grand piano ("CEUS") that measures the loudness and onset timing of the tones as well as the continuous position of the keys. 19 musically trained participants rated tone pairs that were identical in pitch, loudness, and tone length, but with or with out a key-keybed contact with regard to their identity (same or different). Overall, the participants performed the task very well, significantly better than chance. Even though the investigated key-bottom sounds are subtle compared to other sound components, our results confirm that they can audibly influence the timbre of a piano tone. The investigated effect may indeed have ecological relevance, as many important listening situations occur in the vicinity of the piano keyboard (e.g., piano practicing and piano lessons).

4AM1-R03 : Performance V

Room 3, 8:30 – 10:30 Thursday 28 August 2008, Oral session

It's All in the Timing: Interpersonal Synchrony Increases Affiliation

Michael J. Hove[1], Jane L. Risen[2]; [1]Cornell University, USA; [2]University of Chicago, USA

`4AM1-R03-1`

The tendency to mimic and synchronize with others is well established. Although mimicry has been shown to lead to affiliation between co-actors, the effect of interpersonal synchrony on affiliation remains an open question. The authors investigated the relationship by having participants match finger movements with a visual moving metronome. In Experiment 1, affiliation ratings were examined based on the extent to which participants tapped in synchrony with the experimenter. In Experiment 2, synchrony was manipulated. Affiliation ratings were compared for an experimenter who either a) tapped to a metronome that was synchronous to the participant's metronome, b) tapped to a metronome that was asynchronous, or c) did not tap. As hypothesized, in both studies, the degree of synchrony predicted subsequent affiliation ratings. Experiment 3 found that the affiliative effects were unique to *interpersonal* synchrony. We interpret these results in terms of perception/action links and self/other overlap and suggest that music and dance evolved as a means for social bonding.

The Visual Feedback System with Interactive Contrast Training for Fluent Finger Piano Exercises

Makiko Sadakata, Alex Brandmeyer, Renee Timmers, Peter Desain; Radboud University Nijmegen, The Netherlands

`4AM1-R03-2`

Finger exercises are important for piano students at all skill levels for developing and maintaining their motor skills. Many exercises aim at improving fluency; that is, to play materials evenly in timing and loudness. However, both the materials and the training procedures are often monotonous. To make them more interesting, we developed and evaluated a VFB system for two-finger trill exercises with interactive contrast training. 24 conservatory piano students participated in the experiment. Fluency in each trill was tested 5 times with 4 short imitation trainings in between. The training conditions included 2 within-subject factors: 1) the presence of VFB and 2) the type of target performance (contrast/even). The system visualized fluency in timing and loudness as the orientation and size of visual objects. Timing and loudness of target trills were unequal for contrast conditions while they were equal for even conditions. The preliminary analyses showed that even advanced piano stu-

dents improved their fluency in trills over multiple tests and trainings. Furthermore, both VFB and contrast training seemed to help this improvement. Qualitative data indicated that most participants considered the VFB system and training useful.

Fingering Forces in Violin Playing

Hiroshi Kinoshita, Satoshi Obata; Osaka University, Japan
`4AM1-R03-3`

When playing the violin, the left fingers press the string against the fingerboard and make a temporary termination of the string to control the pitch of the sound. The temporal and spatial features of the string-pressing force (fingering force) can be an important source of information for understanding sound control by the violinists. However, the nature of fingering force is totally unknown. A violin that permitted the online measurement of 3D fingering forces was developed, and the effects of musical tempo, sound dynamics, and the fingers used on the nature of fingering force were studied. Trained violinists performed repetitive A-tone (open) and D-tone production (force measurement) using the ring finger at the tempi of 1, 2, 4, 8, and 16 Hz with p, mf, and f dynamics. The force profile was clearly tempo-dependent. At slow tempi, the profiles were characterized by an initial pulse-like force, followed by leveled force during the finger contact period. At tempi higher than 2 Hz, only pulsed profiles were observed. The maximum finger force exceeded 4.5 N at 1 and 2 Hz and decreased with increases in tempo. The minimum fingering force required for sound production was assessed to be less than 0.7 N, indicating that the violinists use an attack force well above the minimum force, most likely reflecting their intention to secure rapid and steady production of a target sound. The sound dynamics as well as the finger used also influenced the magnitude of fingering force.

The Influence of the Stage Show on the Evaluation of Rock Guitar Performance

Reinhard Kopiez, Marco Lehmann, Christian Kopp; Hannover University of Music and Drama, Germany
`4AM1-R03-4`

Acting on stage (posing) plays an important role in the live performance of popular music. However, there is only little knowledge about the influence of stage performance on the spectators' evaluation. In our exploratory study we assume that there is a positive correlation between the rated degree of posing and the perceived instrumental virtuosity. It is also assumed that the rating will be influenced by a spectator's own instrumental expertise. A selection of 15 video samples (duration: 15–20 s) of outstanding rock guitarists were used as stimuli. Independent variables were "instrumental expertise" (music students vs. pupils) and "presentation mode" (audiovisual vs. audio only). 18 music students from a German university of music and 41 high school pupils with low or no instrumental education (mean age: 16.0) participated in the group experiment. Evaluation was conducted by means of an answer sheet, using 11 items on a 6 point likert scale. Stimuli were presented on a large scale screen (2×2 m). Ratings of the show factor significantly correlated with nearly all averaged items related to "virtuosity", such as "challenging" (r = .69, p < .01) and "impressive" (r = .84, p < .01). Music students were influenced more strongly by the audiovisual information than were the pupils. This mechanism is independent of a rater's own instrument.

4AM1-R04 : Neuroscience II

Room 4, 8:30–10:30 Thursday 28 August 2008, Oral session

Does Program Music Induce Visual Imagery Better Than Absolute Music? — An EEG Study

Jun-ok Kim, Moo Kyoung Han, Dongil Chung, Yeojeong Choi, Jaeseung Jeong; KAIST, Korea
`4AM1-R04-2`

Program music is a form of Western classical music that carries extra-musical meanings. Compared with absolute music in which artistic interest is supposedly confined to abstract constructions in sound, it is well known that program music elicits more visual imagery in listeners than does absolute music. Despite the significance of this long belief in music aesthetics, it has not been proved yet and its underlying neurophysiological mechanism is unclear. The aim of this study was to examine

whether the program music indeed evokes more activations of cortical regions involved in visual imagery than does absolute music using electroencephalograms (EEG). 20 participants of non musician were asked to listen 4 program music and 4 absolute music pieces. And their EEGs recorded. Significant activation of cortical regions was estimated using sLORETA. After the EEG recording session, participants reported their appreciation of visual images if they have. We found that program music pieces tended to evoke more visual imagery than absolute music (p<.01). sLORETA analysis revealed that beta band (13 – 30Hz) activation was significant in the cuneus and occipital lobe. Self-report analysis showed that absolute music also evoked visual imagery in listeners which is associated with their own previous experiences, whereas visual images in listeners during perception of program music are associated with the theme of music.

Musical Experience Influences Subcortical Encoding of Pitch, Timing and Timbre in Vocal Expressions of Emotion

Dana Strait, Nina Kraus, Erika Skoe, Richard D. Ashley; Northwestern University, USA

`4AM1-R04-3`

Musicians exhibit enhanced perception of emotion in speech, although the biological foundations for this advantage remain unconfirmed. In order to gain a better understanding for the influences of musical experience on neural processing of emotionally salient sounds, we recorded brainstem potentials to affective human vocal sounds. Musicians showed enhanced time-domain response magnitude to the most spectrally complex portions of the stimulus and decreased magnitude to more periodic, less complex portions. Enhanced phase-locking to stimulus periodicity was likewise seen in musicians' responses to highly complex portions. These results suggest that musical training engenders both enhancement and efficiency of neural response that is intricately connected with acoustic features important for the communication of emotional states. Our findings provide the first biological evidence for behavioral observations indicating that musical training enhances the perception of vocally expressed emotion in addition to establishing a subcortical role in the auditory processing of emotional cues.

Automatic Movie Themes Playlist Generation Through Gaps Across Emotion Loci and Curve of GAEL versus Preference

Tien-Lin Wu, Yuna-Pin Lin, Shyh-Kang Jeng, Jyh-Horng Chen; National Taiwan University, Taiwan

`4AM1-R04-4`

An automatic movie-theme playlist generation approach is proposed to achieve enjoyment of listeners through integration of music-expressed (musical features) and user-felt emotions (physiological signals) to create a varying music-expressed playlist based on two music-psychology theories as recommendation criterion: "Gap across emotion loci (GAEL)" and "Ω-shaped emotional similarity-preference curve)". The music-expressed emotion ground-truth is constructed by 328 users' 8-emotion categories' online taggings on two hundred 30-s movie-themes and the user-felt one is collected by playing sixteen representative themes to 26 subjects and simultaneously and continuously measuring their Electroencephalography (EEG) signals. Other social and cultural factors on judging the corresponding movies are extracted by collecting IMDb's metadata. Then, these three heterogeneous feature sets (musical acoustics and psychoacoustics, EEG asymmetry indices, and moviegoer' tastes) are selected and integrated to reach the best recognition accuracies for both user-felt (97.5%) and music-expressed (93.2%) emotions based on the proposed latent music emotion taxonomy. The combined GAEL-Ω function grasps three qualities of music-listening, especially on emotion gaps, musical familiarity, and preference. Finally, the two users' subjective evaluations all show a promising result on experiencing the automatic generated playlists.

4AM1-R05 : Body Movement

Room 5, 8:30–10:30 Thursday 28 August 2008, Oral session

Quantifying Children's Embodiment of Musical Rhythm in Individual and Group Settings

L. De Bruyn, M. Leman, Dirk Moelants; Ghent University, Belgium

`4AM1-R05-1`

We empirically quantified the impact of social interaction on movements made by children while listening and responding to music. The methodology was based on wireless motion capturing, using Wii Nintendo Remote sensors, and subsequent statistical analysis. We investigated intensity of movement and the amount of synchronization with the beat in two conditions: individual, separated by screens, and social, moving together in groups of four encouraging social interaction. Data analysis showed that there is a social embodiment factor which can be measured and quantified. Furthermore there is also an effect found of the type of music on the gesture response, both in the individual and social context of the experiment.

Spontaneous Movement with Music: Searching for Common Kinetic Patterns

Petri Toiviainen, Geoff Luck, Marc R. Thompson; University of Jyväskylä, Finland

`4AM1-R05-2`

Music listening is often associated with spontaneous body movements, frequently synchronized with the musical beat. Premised on the notions of embodied cognition and action-perception coupling, one could postulate that these movements facilitate the perception of the temporal structure of music. We investigated the kinematic and kinetic aspects of spontaneous movements using a high-resolution motion-capture system. Various kinematic variables were estimated from the data, while body-segment modeling was utilized to obtain estimates of kinetic variables. Although the participants produced a wide variety of movement patterns, some commonalities between them were found. On the kinematic level, it was found that musical beat was most clearly represented by movements in the vertical direction, with the points of beat being associated with high downward velocity of the torso. Movements in the horizontal direction displayed longer periodicities, typically two beats. On the kinetic level, the instantaneous internal power of the body showed clear peaks at the instants of musical beat. The results indicate that, regardless of the wide variety of spontaneous movement patterns, musical beat tends to be associated with bursts of instantaneous muscular power. This could suggest that the perception of the temporal structure of music is associated with imitation-based corporeal representations.

Analysis of Contemporary Dance Movement in the Presence and Absence of a Musical Soundscape

Catherine Stevens[1], Christian Kroos[1], Shaun Halovic[1], Johnson Chen[1], Emery Schubert[2], Shuai Wang[2], Kim Vincs[3], Julien Tardieu[1], Garth Paine[1]; [1]University of Western Sydney, Australia; [2]University of New South Wales, Australia; [3]Deakin University, Australia

`4AM1-R05-3`

Perception of dance, like live music, is multimodal. Participants and/or beholders, at the very least, respond to visual, temporal, and auditory cues. An experiment was conducted during a live performance and under controlled conditions to investigate the effect of the presence and absence of a musical soundscape on the kinematics and dynamics of a male contemporary dancer. In addition to the recording of dance movement using 10 Vicon cameras, 20 audience members recorded their emotional reaction to the work in real-time under visual only, auditory only and auditory-visual conditions. We asked: does dance movement vary as a function of the presence or absence of a musical soundscape and what is the effect of the presence/absence of music on audience response? As anticipated, the synchronization of the three dancers in the visual only condition was good although there was some 5% time compression. Judged arousal recorded from audience members was comparable across conditions while valence diverged. Arousal reflected the choreographic structure of a generally more dynamic first half compared with the second half. The ultimate goal

is to use motion capture data to predict and aid interpretation of audience response. Further strategies for analysis of this rich data set — analysis of specific sections and contraction-expansion segments, individual points and distances between specific points — are discussed.

The Role of the Body Movement in Listening to a Musical Composition

Keiko Asakura; Teikyo University of Science & Technology, Japan

`4AM1-R05-4`

Cross-modal functions have attracted interest. The interest has focused on researches into interaction between auditory and visual sensation. We have the sixth sensation, proprioception that gathers information from our body. The addition of proprioception increases the amount of sensory information, which leads to the reliable musical perception. The aim of this research is to examine the hypothesis that in listening to a musical composition, body movements representing its structure would help us to feel and understand it profoundly. Participants were asked to write down their feelings, the title they gave in listening to a piece. After practicing body movements they were asked to do the same again. Comparing the two descriptions, I examined how the proprioception could influence upon the audition. The data showed certain characteristics. Eighty-six percent of descriptions changed from the images related to water, quiet scenes and something moving, to the images of small and mysterious creatures, pretty children and someone moving or cooperative movements, and from consolatory and tender feelings to cheerful and pleasant feelings. The number of participants who spotted some musical structure increased from 60 percent to 86. These findings that body movements play such an important role in listening to music should lead to body involvement in music education.

4AM2-R02 : Harmony and Tonality II

Room 2, 10:40–12:40 Thursday 28 August 2008, Oral session

Virtual Pitch and the Classification of Chords in Minor and Major Keys

Ludger J. Hofmann-Engl; Croydon Family Groups, UK

`4AM2-R02-1`

This paper makes use of the virtual pitch model as developed by Hofmann-Engl in order to demonstrate that Hugo Riemann's functional harmonic system has a psychological basis and that is can be considered to be superior to the Roman numeral system.

It will be shown that the comparison of tonal chords within a given key, produces high similarities between the set of virtual pitches of chord I to VI, of chord IV to II and of chord V to III. Additionally, the tension between chord I and V can be explained by its high degree of dissimilarity. This adds momentum to Riemann's terminology by relating the tonic (I) to the parallel tonic (VI), the subdominant (IV) to the subdominant parallel (II) and the dominant (V) to the dominant parallel (III). The closing effect of the perfect cadence can be seen as an effect of tension and resolution.

These results act in a dual fashion. They add further support to the validity of the Hofmann-Engl pitch (virtual pitch according to Hofmann-Engl), and suggests at the same time that the international community might profit from adapting Riemann's system.

Key-Profile Comparisons in Key-Finding by Correlation

Craig Stuart Sapp; Stanford University, USA

`4AM2-R02-2`

Several improvements to the key-profile weightings used in the Krumhansl-Schmuckler key-finding algorithm have been proposed over the past decade. This paper describes several tests which can be used to compare the performance of these new weightings amongst themselves and against the original weights derived from probe-tone experiments. The proposed tests may also be use to compare different key-finding algorithms to each other. Weightings are then evaluated using five composition cycles in all 24 major and minor keys: Chopin's op. 28 preludes, and J.S. Bach's Well-tempered Clavier preludes and fugues (books 1 & 2).

Nonlinear Time-Frequency Transformation: Implications for Pitch & Tonality

Marc J. Velasco, Edward W. Large; Florida Atlantic University, USA

`4AM2-R02-3`

A growing body of evidence is consistent with the possibility of nonlinear oscillation in both the peripheral and central auditory nervous systems. We aim to understand the implications of nonlinear resonance for the perception of pitch and tonality in music. Our goals are 1) to introduce a network of neural oscillators, each tuned to a distinct frequency, arrayed along a frequency gradient; 2) to describe how gradient-frequency networks of nonlinear oscillators transform sound; and 3) to spell out the predictions of nonlinear resonance for the perception of pitch and tonality in music. We show how a network of neural oscillators transforms sound stimuli. We derive predictions about general properties of nonlinear time-frequency transformation, including amplitude saturation, frequency detuning and higher-order resonances (harmonics, sub-harmonics, integer ratios and combination tones). The perception of pitch is predicted to arise as a consequence of higher order resonances of nonlinear oscillators. The perception of tonality is predicted as a global pattern of resonance regions at frequency relationships of small integer ratios. Neural oscillation provides a substantive, potentially universal principle underlying the basic materials of music, namely pitch and tonality. This framework may ultimately be extended to provide the building blocks of a universal grammar for music.

Can Statistical Language Models be Used for the Analysis of Harmonic Progressions?

Matthias Mauch[1], Daniel Müllensiefen[2], Simon Dixon[1], Geraint Wiggins[2]; [1]Queen Mary University of London, UK; [2]Goldsmiths University of London, UK

`4AM2-R02-4`

The availability of large, electronically encoded text corpora and the use of computers in recent decades have made Natural Language Processing (NLP) a flourishing research area. A wealth of standard techniques has been developed to serve use cases like document retrieval, identification of a finite vocabulary and synonyms, and the collocation of terms. Similarly, social networking among musicians in internet forums and the advent of automatic chord extraction have led to the establishment of chord databases, if on a smaller scale. Comparatively little research has been carried out on these growing corpora of chords. We suspect that one reason for this lack of research lies in the difficulty to decide if chords or other harmonic elements can be treated like lexemes in a text corpus. More simply, the question is: What is a word in terms of harmony? In this paper we propose a bottom-up approach. In order to find harmonic units whose distributions resemble distributions of words we consider chord elements differing in (a) length of chord sequence (counted in chord symbols), and (b) chord alphabet. Using lengths from 1 to 4 and two different chord alphabets we obtain a parameter space of size 8. For each of the parameter settings we compute statistical summaries of the resulting frequency distribution of the harmonic unit. As results, we report the parameter settings for two different chord corpora (2500+ songs each) that generate a frequency model corresponding most closely to the Brown Corpus, a general text corpus of American English.

4AM2-R03 : Music Listening IV

Room 3, 10:40 – 12:40 Thursday 28 August 2008, Oral session

Linguistic Description and Musical Experience

Elizabeth Hellmuth Margulis; University of Arkansas, USA

`4AM2-R03-1`

Perhaps no outreach effort is as ubiquitous as the program note: a practice which relies on the assumption that extramusical information affects musical experience. Yet the psychological mechanisms underlying the use of linguistic information during musical listening remain under-examined. How can reading about a piece affect the meaning it seems to confer, the enjoyment it makes possible, and the trace it leaves in memory? More broadly, how can experiences outside of musical listening come to transform musical experience itself?

In this study, nonmusicians heard excerpts from Beethoven String Quartets prefaced by either a dramatic description, a structural description, or no description. They

were asked to rate their enjoyment of the music, and in a later stage, to recall excerpts and descriptions.

Results showed a complex pattern of interaction between description, enjoyment, and memory. Conceptualizing listening by connecting it to linguistically named correlates (a practice fundamental to music training) may have more multifarious (and not always straightforwardly beneficial) effects on musical experience than commonly assumed.

A Global Model of Musical Tension

Morwaread Farbood; New York University, USA

4AM2-R03-2

Musical tension is a high-level concept that is difficult to formalize due to its subjective and multi-dimensional nature. This paper presents a quantitative, parametric model of tension based on empirical data gathered in two experiments. The first experiment is an online test with short musical excerpts and multiple choice answers. The format of the test makes it possible to gather large amounts of data. The second study requires fewer subjects and collects real-time responses to musical stimuli. Both studies present test subjects with examples that take into account a number of musical parameters including harmony, pitch height, melodic expectation, dynamics, onset frequency, tempo, and rhythmic regularity. The goal of the first experiment is to confirm that the individual musical parameters contribute directly to the listener's overall perception of tension. The goal of the second experiment is to explore linear and nonlinear models for predicting tension given descriptions of the musical parameters for each excerpt. The data from these two experiments are then correlated to musical features and finally used to train and test linear and nonlinear predictive models of tension.

The Nature of Stylish Expressiveness in Performing Baroque versus 19th-Century Music

Dorottya Fabian, Emery Schubert, Richard Pulley; University of New South Wales, Australia

4AM2-R03-3

There has been a growing emphasis on playing European art music according to the performing traditions of the era when any given piece was composed. There is a claim that compositions sound more stylish, when performed according to the stylistic conventions of their time of origin.

We wanted to find out whether baroque performing conventions can be applied to a romantic piece, just like late 19th-century stylistic mannerisms are often used when performing early 18th-century pieces. We also wanted to know the aesthetic response of listeners to such renderings.

We asked a professional violinist to record *Träumerei* (by Schumann) played (a) according to romantic and (b) baroque performing conventions. 28 participants (music students and professional players) listened to the randomized stimuli and rated 20 parameters (e.g. vibrato, portamento, phrasing, tempo preference, expressiveness, stylishness, etc.).

Results confirmed the different performance means that create baroque as opposed to romantic expressiveness. A performance in the baroque style is characterized by short phrases, detached articulation, frequent punctuation, added ornaments and relatively strict metre. The romantic style is created by long phrases, prominent vibrato, legato articulation and strong emotionality. Listeners are able to detect these differences. Romantic pieces performed the romantic way were regarded stylish and expressive.

Listeners prefer historically informed renderings and judge them as being more stylish than those that employ a generic style of expressiveness. Mainstream performers should take note, as well as psychologists and computer scientists investigating and modelling expressiveness in music performance.

Bimusicality: A Dual Enculturation Effect on Non-Musicians' Musical Tension and Memory

Anil Kumar Roy [1], Elizabeth Hellmuth Margulis [2], Patrick C.M. Wong [1]; [1] Northwestern University, USA; [2] University of Arkansas, USA

4AM2-R03-4

We seek to investigate the effects of mono- and bi-cultural musical exposures on non-musicians' responses to music from different cultures, effects that could be analogous to bilingualism. We examined three groups of non-musicians on tasks related to musical tension and memory (W: Exposure to Western music and minimal exposure to Indian music, WI: Exposure to Western and Indian music, I: Exposure to Indian music and minimal exposure to Western music). Musical stimuli consisted of short unfamiliar Indian and Western melodies. We found significant interaction effects for both tasks: non-native music was judged to be significantly tenser, and native music showed higher accuracy on the memory task. Interestingly, the WI (bicultural group) did not differentiate the tension or show increased accuracy for Indian or Western music, suggestive of a dual enculturation effect in music ("bimusicality"). These results suggest that dual perceptual expertise is not confined to experiences that include receptive and expressive components as in the case of bilingualism, but can be observed in simple passive exposure as in the case of non-musicians whose expressive musical abilities are relatively limited. [supported by a grant from the Center for Interdisciplinary Research in the Arts at Northwestern University, and by NIH]

4AM2-R04 : Emotion in Music IV
Room 4, 10:40 – 12:40 Thursday 28 August 2008, Oral session

Individual Difference in Music Perception: The Influence of Personality and Cognitive Style on the Perception of Musical Melodies

Kyungil Kim[1], Sung Yub Kim[1], Yang-Eon Kim[2]; [1]Ajou University, Korea; [2]Hochschule für Kirchenmusik, Germany

`4AM2-R04-1`

This study suggests that, first, chronic individual difference factors strongly influence music perception, and, second, these effects are very specific and independent. Further, personality and cognitive style can be used as markers of music perception.

To demonstrate these arguments, college students completed cognitive strategy-related personality tests, language use test, state emotion scale. Then a 2 (mode: major vs. minor) $\times$ 2 (texture: nonharmonized vs. harmonized) $\times$ 3 (tempo: 72, 108, 144 bpm) within participants experimental design was employed, in which the participants rated subjective happiness.

The results show that the participants' ratings for the three musical dimensions are individually and independently correlated to different personality traits and/or linguistic variables in meaningful ways. For example, participants' ratings of subjective happiness for major mode were positively correlated with cognitive strategy whereas those for minor mode showed significant relationships mainly with anxiety-related personality. More individual relationships were found between participants' music perception and their language use. Participants' responses for tempo dimensions were observed to be related with cognitive factors in language use rather than with personality factors. People's perception of harmonized melodies was correlated with social anxiety whereas their responses to nonharmonized melodies were influenced by cognitive strategy-related factors both in personality tests and language use.

An Intercultural Study of Ecstasy and Trance in Music

Anita Taschler, Richard Parncutt; University of Graz, Austria

`4AM2-R04-2`

Ecstacy and trance have diverse institutionalised religious and healing functions. In many cultures, hallucinations, synaesthesia and intense emotions are deliberately induced by music and dance. We investigated ecstatic experiences in musical performance. Participants were twelve musicians with at least six years professional experience. They were living and working in Graz, and had been born in Austria, Germany, Italy, Senegal and Morocco. Their main instruments were voice, piano, keyboard, bass, dance, drums or percussion, and they mainly performed jazz, world music and African folk. Interviews were held after live performances, and content analyses were compared with results of Gabrielsson and Lindstrom (2003). All participants reported altered states of consciousness that involved intense and mainly positive emotion (including subjective, physiological and behavioural correlates) and supported the performance process, including thinking, time perception, and physical control. Altered states generated confidence, motivation, and personal,

social and musical insights, and were promoted or inhibited by physical/mental exertion, degree of preparation, stage fright, competition among musicians, setting, individual mood, and identification with music. Results suggest that altered states induced by music promote recovery, healing, creative insight, spirituality, identity, and motivation — and hence survival in dangerous situations.

The Minor Third Communicates Sadness in Speech and Music

Meagan E. Curtis, Jamshed J. Bharucha; Tufts University, USA

`4AM2-R04-3`

Musical intervals are associated with emotions, but the origin of these associations hasn't been sufficiently explained by current theories. For instance, the minor third is associated with sadness in Western cultures, but the origin of this association is a matter of debate. The current experiments explore the intriguing possibility that the associations between intervals and emotions are also present in the prosody of human vocal expressions. Bi-syllabic speech samples conveying happiness, anger, pleasantness, and sadness were recorded by nine actresses. The speech samples were rated for perceived emotion. Acoustic analyses were conducted on the speech samples, and the prosodic contours of the sad speech samples revealed that the relationship between the two salient pitches tended to approximate a minor third, which is consistent with the emotional associations in the domain of music. Other patterns were observed for the other emotions. Regression analysis of the speech sample emotional ratings revealed that the minor third was the most reliable acoustic cue for identifying sadness. The results suggest that there are correspondences across domains in the use of pitch contours to encode and decode emotion. These findings support the theory that human vocal expressions and music share an acoustic code for communicating emotion.

The Perception of Structure and Affect in Contemporary Sound-Based and Serial Compositions as a Function of Musical Expertise, Liking and Familiarity

Freya Bailes, Roger T. Dean; University of Western Sydney, Australia

`4AM2-R04-4`

Electroacoustic sound-based music is stylistically unfamiliar to most, and it typically contrasts different timbres and textures rather than clear rhythms and discrete pitches. This study extends our previous investigations of listener perceptions of electroacoustic stimuli, to determine the relationship between continuous measures of perceived structure and affect (arousal, valence) in full-scale electroacoustic and atonal compositions. We also examine the roles of musical expertise, liking, and familiarity for the music. Participants listened to compositions by Dean, Webern, Wishart and Xenakis. Each piece was presented once in each of a counterbalanced structure task (continuous indication of perceived change in sound while listening) and affect task (continuous indication of perceived arousal and valence of the music while listening). After each item, listeners rated their familiarity with the piece and/or style of piece, and their liking of it. Early results suggest that changes in continuous ratings of perceived affect coincide with changes in perceived structure. Arousal ratings are largely independent of expertise, liking or familiarity, and represent a relatively stable dimension of affect. Conversely, valence ratings are positively related to prior experience with the sounds.

4AM2-R05 : Neuroscience III

Room 5, 10:40 – 12:40 Thursday 28 August 2008, Oral session

Affective Responses to Music Performance: An fMRI Study

Heather L. Chapin, Edward W. Large; Florida Atlantic University, USA

`4AM2-R05-1`

Our goals were to determine the influence of performance expression on listeners' emotional responses and neural activity. Ten musically trained and ten untrained participants listened to two versions of a romantic piano composition. The expressive performance included natural variations in timing and sound intensity. The mechanical performance, generated by computer, maintained constant tempo and sound intensity throughout. Participants reported emotional responses in a 2-dimensional response space (emotional intensity and valence) before and after fMRI scanning. In the fMRI scanner, participants listened to both versions without reporting emotional

responses. Ratings of emotional intensity correlated significantly across trials and were positively correlated with tempo in 19 subjects. The fMRI analysis revealed a main effect of performance, showing an increased BOLD response for the *expressive* performance in an emotion-related network. A main effect of training showed an increased BOLD response for trained participants in brain areas associated with emotion processing and reward. We also observed increases in BOLD responses that were temporally correlated with tempo fluctuations. In summary, performance expression predicted listeners' dynamic ratings of emotional intensity. Moreover, limbic areas responded to *expressive* versus *mechanical* performances, and dynamic BOLD changes tracked performance expression and reported emotional intensity over time.

fMRI Study of Diatonic Triads

Norman D. Cook; Kansai University, Japan
4AM2-R05-2

The basic facts concerning the perception of diatonic harmonies are well established from both laboratory experiments and the statistics on the use of chords in popular and traditional classical music. What has remained unclear, however, is the different contribution to harmonic "stability" of so-called "sensory dissonance" — due primarily to the presence of small intervals — and so-called "musical dissonance", i.e., the inherently unstable, unresolved quality of certain chords that do not contain small intervals (notably, the diminished and augmented chords). In order to determine the effects of sensory dissonance and musical dissonance, we have run behavioral experiments using isolated chords and 2- and 3-chord sequences and have developed a psychophysical model of harmony perception that includes both a traditional 2-tone (dissonance) factor and a 3-tone (tension) factor. We have also studied the brain response to isolated chords and 2-chord sequences using fMRI in order to determine the brain localization of cortical regions involved in (1) the perception of dissonance and harmonic tension, and (2) the perception of major and minor chords. The first fMRI experiment showed differential brain activation to (1) chords containing dissonant intervals and (2) unresolved "tension" chords. We interpret this dissociation as clear indication that sensory dissonance can be distinguished from the musical dissonance produced by triads with two equal intervals (the two 3-semitone intervals in a diminished chord in root position and the two 4-semitone intervals in an augmented chord). The second fMRI experiment showed that the strongest response to 2-chord sequences was when the first chord was an unresolved tension chord and the second chord was a resolved major/minor chord that differed from the first chord by one semitone. I conclude that the fundamentals of traditional harmony theory have a clear acoustical basis that can be quantitatively modeled provided that the effects of 3-tone combinations are considered.

Focal Activations and Properties of Functional Brain Networks Derived from MEG Data While Listening to Music

Andreas A. Ioannides, Armen Sargsyan, Marotesa Voultsidou, Mari Aoki; RIKEN Brain Science Institute, Japan
4AM2-R05-3

In our earlier study of how "real" music engages the brain we extracted regional brain activations from the magnetoencephalographic (MEG) signal recorded while subjects listened to music as it unfolded over a few-second-long periods of time (Popescu et al., NeuroImage, 2004). We compared the music score with the timecourses in a small set of pre-defined brain areas using rhythmogram analysis. Using the average response of 20 music score presentations, we showed that motor related areas played pivotal role during the music listening experience that depended on the musical expression. Here, we use the rhythmogram analysis for every voxel in the brain and carried out the analysis for each presentation of the music score. The new analysis demonstrated that in areas usually associated with linguistic and music processing like Broca's area the pattern of activity as captured in the rhythmogram correlates with the pattern of the music score as long as the music plays. Surprisingly, other areas correlate with the pattern of activity of the music score immediately before the onset of the music, while after the music has stopped, the activity in some areas of the brain correlates with derivatives of the patterns in the music score.

Detecting Imagined Music from EEG

Rebecca S. Schaefer[1], Marcos Perreau Guimaraes[2], Peter Desain[1], Patrick Suppes[2]; [1]Radboud University Nijmegen, The Netherlands; [2]Stanford University, USA

4AM2-R05-4

Previous work has shown a varying, but well above chance result in detecting heard words and sentences, internally spoken words, and internally imagined rhythms from EEG [cf. PNAS 94, (1997), 14965; PNAS 95, (2005), 15861, Proc. ICA2004. Kyoto, Japan, (2004)]. To extend these findings, we have carried out experiments that aim to replicate the above results for both heard and imagined music, hypothesizing that the temporal structure in music may increase the accuracy of detection.

Two common stimuli and two self-selected stimuli were used for each of six participants, in a perception and an imagery condition, allowing classification between 4 different musical phrases. Preliminary results show classification above chance level (25%) for all participants in the perception condition (38–68%), and for 4 participants in the imagery condition (33–43%).

Although promising (and still likely to be improved upon) these results are not as striking as those found for auditory perception (spoken words, up to 97% with 7 classes) or imagination (rhythm, 37% with 5 classes). Further analyses will however finetune these results and create a clearer image of the brain signature associated with hearing and imagining music.

5AM1-A01 : Ethnomusicology

Atrium 1, 9:15 – 10:45 Friday 29 August 2008, Oral session

Psychoacoustical and Cognitive Basis of *Sutartinės*

Rytis Ambrazevčius; Kaunas University of Technology, Lithuania
5AM1-A01-1

The measurements of pitches and intervals in *Sutartinės* (Lithuanian type of vocal *Schwebungsdiaphonie*) reveal that this style of singing is based on the psychoacoustical principle of maximum roughness. This principle is at work, first of all, for the central pitches (the "double tonic" composed of two colliding voices) which form the nucleus of the scale. The stability and salience of the pitches decreases towards the margins of the scale. The sequential movements of the vocal dyads create the impression of melodic contours that are akin, in a general sense, to the melodic contours found in monophony. Thus the element of linear thinking in *Sutartinės* is revealed. On the other hand, the tension-resolution patterns analogous, in deep structure, to the patterns known in the Western music, can be envisaged. The further comparisons of *Sutartinės* with other musics in the Baltics might be quite promising in the discussion on their origins.

Experimental Investigation of Relative Pitch Salience in Northern Mozambican Damba

Lydia Slobodian, Ian Cross; University of Cambridge, UK
5AM1-A01-2

A series of experiments conducted in Cabo Delgado Province, Northern Mozambique, investigate perception of pitch change by students of Damba, a musical form taught in madrassas along the coast. To determine relative salience of pitches in short Damba melodies, we altered the pitches of different tones in each melody by +/- 1.0 semitone. Participants listened to the original followed by an altered or unaltered version and had to determine whether the two melodies were the same or different. Responses show that in most cases participants were better able to hear pitch change in higher tones and final tones, regardless of tone length. Analysis also suggests consistent hierarchies within certain melodies, as well as the possibility of an overall tonal hierarchy. These findings can inform analyses of individual Damba pieces and performances in the absence of an explicit music theory. This project illustrates both the constraints and potential inherent in cross-cultural experimentation.

What Emotions do *Raags* Evoke? An Internet-Based Survey of Listener Responses

Parag Chordia, Alex Rae; Georgia Institute of Technology, USA
5AM1-A01-3

Raag is the melodic framework that forms the basis of Indian music. Raags are thought to consistently elicit certain emotions, with different raags creating different moods. We investigate whether this correspondence truly exists cross-culturally.

We undertook a web-based survey (http://paragchordia.com/survey/raagemotion2) in which participants were asked to listen to ten raag excerpts and rate the extent to which twelve emotions were evoked. A total of 553 subjects participated.

ANOVA analysis showed that raag was a significant factor in emotion responses (p < .001). Using confidence intervals adjusted for multiple comparisons (p < .05), we found that a clear distinction could be made between many raags. Across many emotions, raags clustered into groups with positive (Khamaj, Desh and Bageshri), medium (Bhimpalasi and Yaman), and negative valence (Gujari Todi, Marwa, Shree and Darbari).

Familiarity with Indian music was a significant main effect for many emotions. Experienced listeners tended to rate the excerpts as more intensely emotional than did listeners with little or no prior exposure.

There is a clear correspondence between valence and scale degrees used. Raags using 'minor' notes are considered negatively valenced, while raags using 'major' notes tend to be positively valenced, giving further evidence for this cross-cultural phenomenon.

Detailed data and graphs can be found at http://paragchordia.com/research/raagEmotion/.

5AM2-S01 : Psychoacoustics II
Space 1, 11:00 – 13:00 Friday 29 August 2008, Oral session

They Were Playing Our Song: A Psycho-Acoustic Explanation of Why Non-Vocal Musical Instruments Determined How We Sing

Joe Wolfe, Emery Schubert; University of New South Wales, Australia
`5AM2-S01-1`
In the last few centuries, musical instruments have influenced the styles of singing. This paper uses acoustical arguments to suggest that, even in prehistory, musical instruments may have influenced singing. The codings of speech and music are different and in some ways complementary. The voice operates on acoustical principles distinctly different from those of (other) musical instruments. We conjecture that the pitch stability and the independence of pitch and loudness — features very important in much music — may have come from imitation of or performing with musical instruments. Lomax proposed that aspects of a culture are reflected in the music they make. We suggest that peoples exposed to manually played instruments exhibiting discrete, stable pitches are more likely to sing using categorical pitch. Peoples who are exposed only to less resource rich, non-musical instrument bearing regions are more likely to sing in a manner that suits their biological speech apparatus and therefore to sing with more portamento and with correlations between pitch and loudness. Evidence is presented though sound recording made by Australian Aboriginal people who had varied access to physical resources in their differing native environments.

Evaluations of Proficiency of Fluctuating Musical Sounds Using Fluctuation Strength

Nozomiko Yasui, Masafumi Kinou, Masanobu Miura; Ryukoku University, Japan
`5AM2-S01-2`
The tremolo played on the mandolin is a continuous sound produced by the repetition of attenuating sounds. The amount of acoustic amplitude of tremolo is usually fluctuated in terms of time, so it is said to be a fluctuating continuous sound. Therefore, the tremolo is assumed to give a listener the feeling of fluctuation, which is thought to be concerned with subjective evaluation for performance proficiency. Introduced here is an evaluation method that strongly depends on the "Fluctuation Strength (FS)", which has been suggested as an index for evaluating the hearing sensation produced by fluctuating sounds at low frequencies. Past studies have investigated the index for modulated pure tones and broadband noise. In this study, tremolo fluctuations are described by FS, and the relation between them and evaluations of tremolo proficiency was investigated through evaluation experiments. Specifically, a relation between factors of fluctuation feeling and subjective evaluation of performance proficiency is investigated using simulated sounds. Highly rated tremolos had a relatively low physical FS, which suggests that the physical FS can be used as an index to evaluate tremolos played on the mandolin. It is thought that a skillfully played tremolo satisfies both a playing restriction and a psychoacoustical criterion.

Dynamic Changes of Intensity, Duration and Timbre: Effects on Judged Loudness and Emotional Arousal

Kirk N. Olsen, Catherine Stevens, Julien Tardieu; University of Western Sydney, Australia
`5AM2-S01-3`
Two experiments investigate loudness, intensity *change* and emotional arousal in a simple musical context and builds on recent findings of a perceptual bias to tones of increasing intensity. This bias involves an overestimation of loudness change for increasing intensities (ramps), relative to decreasing intensities (damps) of identical spectral content. Experiment 1 (n=32) tested this hypothesis by systematically manipulating independent variables of stimulus timbre (vowel; violin), layer (monotone; chord) and duration (1.8 s; 3.6 s), presented as counterbalanced pairs of items over linear intensity sweeps of 60–90dB and 90–60dB. In Experiment 2 (n=17), Galvanic Skin Response (GSR) was measured as an indicator of emotional arousal as participants heard singular ramped or damped items while judging loudness change. In Experiment 1, the bias for rising intensities was recovered and extended

using musical timbres over various durations. The magnitude of this difference significantly increased as a function of stimulus duration. In Experiment 2, GSR indicated that both ramped and damped musical stimuli elicit increases in physiological arousal. Our results support the claim that an illusory perceptual response is elicited by simple musical stimuli of gradually increasing intensity. This response is correlated with physiological change, namely increased arousal. The implications of this fundamental, and possibly adaptive, perceptual and physiological response to simple musical stimuli are discussed.

5AM2-S02 : Music Therapy / Evolutional Perspective / Development / Neuroscience and Disorders / Computational Models and Analyses

Space 2, 11:00 – 13:00 Friday 29 August 2008, Poster session

The Effect on Cognition and Ability by Learning to Play the Piano in Senior Year

Jie Ren[1], Xiaoping Luo[2]; [1]South China Normal University, China; [2]Xinghai Conservatory of Music, China

5AM2-S02-01

There are 47 subjects who come from Guangzhou Elder College in this study. They have different degrees on playing the piano: never played(Group I), have played for less than 2 years(Group II) and have played for 2 or more than 2 years(Group III). We measured all subjects cognitive processing speed, working memory capacity, and fluid intelligence by experimental and testing methods. The results are: Subjects in each group have faster VPS than APS (d=941.58ms, d=917.86ms,d=866.97ms; respectively) and subjects in Group II have larger AWMC than VWMC(d=1.10). Subjects in Group II and Group III have faster VPS (562.33ms,567.74ms respectively) and larger AWMC (7.60, 7.47; respectively) than those in Group I (638.94ms; 5.17, respectively). Subjects in Group III have faster APS than those in Group I (1434.71; 1580.52; respectively). There is no significant difference between VWMC and CRT-IQ in three groups. CRT-IQ closely correlated with VPS and VWMC(r=-.294,r=.289; respectively). We concluded that learning to play the piano have positive effects on the development of cognition abilities and a limited effect on Fluid intelligence of the elderly people.

A Comparison of the Psychosocial Effects of Music Therapy, Animal-Assisted Therapy and a 'Discussion Group' in Cognitively Intact, Elderly Participants

S.R. Toukhsati, G. King, L. Greenfield; Monash University, Australia

5AM2-S02-03

The aim of this study was to evaluate the psychosocial effects of exposure to music therapy in cognitively intact (MMSE $\geq$ 24), elderly individuals. The effects of music therapy were compared with an alternative therapeutic (animal-assisted therapy) and 'non-therapeutic' (discussion group) intervention in 31 participants (Mean Age = 86.16 years, SD = 5.64). Each treatment was randomly assigned to two Aged Care facilities and implemented in small groups, twice weekly for 30 minutes for a period of four weeks. A nested, mixed-model design compared pre- and post-intervention cognition, depression, quality of life and physical and emotional well-being scores between the three treatment groups. The findings showed a significant improvement over time (p < .01) in cognition (Total MMSE and Recall subscale scores), depression, and physical well-being (RAND-36 Physical Health subscale), but no significant group or interaction effects. There were no significant main or interaction effects with regard to quality of life. These findings indicate that there was no significant advantage of exposure to music therapy in comparison to animal-assisted therapy or involvement in a discussion group. Non-significant trends did, however, show evidence of a greater improvement in cognition and quality of life following music therapy. Theoretical implications and suggestions for methodological refinements in future research are discussed.

An Interpretative Phenomenological Analysis (IPA) Study of Musical Participation by Individuals with Mental Health Problems

Julie C. De Simone, Raymond MacDonald; Glasgow Caledonian University, UK

`5AM2-S02-05`

This is a joint study between Glasgow Caledonian University, Greater Glasgow Health Board and a music charity, *Polyphony* that provides access to a wide range of music activities for individuals with mental health disabilities in a large psychiatric hospital in the west of Glasgow, Scotland. This paper investigates, from a qualitative perspective, the subjective experiences of individuals with mental health problems who participate in structured musical activities. Six community patients took part in this study. All participants were interviewed and interviews were transcribed and analysed using Interpretative Phenomenological Analysis (IPA) as a theoretical framework. This paper will discuss some of the key issues involved in IPA, a modern approach which is an increasingly popular qualitative approach to research within health care contexts. Recurrent and emerging themes will be presented highlighting key subjective issues for the participants with reference to the music intervention and also with reference to the importance of music in their lives. This research highlights a number of subjective issues for individuals with mental health problems who participate in music interventions, signalling a range of possible benefits from a subjective perspective such as reduced isolation and improved mood. It also highlights the utility of IPA as a research approach in this area.

Evolutionary and Neurobiological Foundations of Speech and Song Development

Wilfried Gruhn; Freiburg University of Music, Germany

`5AM2-S02-07`

Evolutionary psychologists have suggested that music and language evolved from a common ancestor and share the same neural resources. Therefore, an evolutionary aspect is evident as well as the neurobiological supposition that resource sharing networks (RSN) enable humans to speak and sing. Music and language are cultural phenomena which incorporate a broad variety of arbitrary pattern characteristics. These are aurally learnt, vocally performed, and cognitively discriminated. Vocal learning g, i.e. the ability to imitate arbitrary sounds, is supported by a neural mechanism that directly connects auditory and motor areas. It basically consists of an anterior and a posterior pathway which perform a phonological loop. By this, the aural perception immediately stimulates a sensorimotor activation in the vocal tract which then controls the vocal production with the final intent to match the aurally perceived pitch or sound. Neurobiological research on vocal learning in animals, namely in songbirds, and young children, will be reviewed. By this an evolutionary perspective will be introduced to the neurobiological foundations of speech and song acquisition. The underlying neural mechanisms and structural properties are integrated into a common model of audio-vocal learning which develops at a very early age when song and speech are not yet separated.

The Role of Musical Environment at Home in the Infant's Development (Part 2): Exploring Effects of Early Musical Experiences on the Infant's Physical and Motor Development During the First 2 Years

Izumi Kida, Mayumi Adachi; Hokkaido University, Japan

`5AM2-S02-09`

The purpose of this study was to examine effects of early musical experiences on infants' physical and motor development through a longitudinal study. 31 infants and their mothers began participating in this study when the infants were 3- to 4-months old; data collection for each infant continued for two years. The participants were assigned randomly one of the two conditions: Musical Interaction and Control. The mothers in the Musical Interaction group were asked to play with their infants while singing Japanese traditional play songs. The mothers in the Control group were requested nothing special. Data of infants' physical and motor development and information of their home musical environment were collected through semi-structured interviews with the mothers. Permutation tests on the motor development data up to 12 months revealed no effects of requested musical interaction but significant effects of home musical environment. Infants raised in richer musical environment acquired gross motor skills earlier than those raised in

ordinary environment. Richer musical environment gives infants more opportunities in paying attention to music, exploring sound objects, and moving their own body to the beat with their parents even without external requests. These opportunities may facilitate infants' gross motor development during the first year. The poster presentation includes results of later analyses up to 24 months, and our discussions for the overview of longitudinal effects of early musical experiences on infants' motor development.

The Role of Musical Environment at Home in the Infant's Development (Part 4): Japanese Mothers' Involvement in Music and Its Effects on Parenting

Kumi Matsuda [1], Mayumi Adachi [2]; [1] Sapporo Specialty School of Welfare and Child Care, Japan; [2] Hokkaido University, Japan
5AM2-S02-11

In the present study, we considered the Japanese mothers' everyday involvement in music as a part of their personal values, exploring how the degree of their musical involvement would be related to their attitude and affection toward their child as well as to their beliefs in childrearing. We asked 31 Japanese mothers with 3- to 4-month-olds the types of musical activities they were involved in and the frequency of each musical activity in their daily lives. As a result, two groups of mothers were identified: "musically active" (MA) and "musically passive" (MP). Semi-structured interviews revealed that all the mothers in this study held relatively positive attitudes toward their children and their childrearing. MA mothers held lesser negative feelings toward their own child than MP mothers, and took their stress on their child less frequently than did MP mothers. MA mothers wished to expose their child to music and the arts more strongly than MP mothers. These results may suggest that the mother's own active involvement in music can release her stress and tension, being able to control her emotion positively toward her child. Alternatively, those who can control their emotions and manage their stress and tension may bring music into their lives more actively than their counterpart. Even though the directionality of the results cannot be determined, this study illuminates that music accompanies Japanese mothers' childrearing, at least for music lovers.

Deficits in Detecting Pitch Violations in Music and Language in Patients with Right Temporal Lobe Lesion

Kohei Adachi [1], Takayuki Nakata [2]; [1] Nagasaki Junshin Catholic University, Japan; [2] Future University-Hakodate, Japan
5AM2-S02-13

We investigated if music and language pitch processing differs for three patients with lesion on the right temporal lobe. Ninety four undergraduates served as the control group. Using eight short Japanese sentences with five syllables, sung and spoken versions were recorded as the base stimuli. For each trial, short melody or utterance was repeated twice with half trials repeating the same melody/utterance. For the other half, the last syllable of the second melody's or utterance's F0 was shifted upward for .25, .5, 1, or 2 semitones. After listening to each pair of stimuli, participants were asked to judge whether the last syllable was the same or different. For all of the three patients, percentile ranks relative to the control group were lower for language excerpts than music excerpts at .5, 1, and 2 semitones. One of the three patients had lesion on Heschl's gyrus on the right temporal lobe and his performance at two semitones for language excerpts, but not for music excerpts, was lower than the other two patients with Heschl's gyrus intact. Our results support previously reported findings that right temporal lobe is involved with the detection of pitch deviation both in music and language. Interestingly, we also found that, in detecting pitch contour violation, trauma on the right temporal lobe, including Heschl's gyrus, may lead to a greater increase in threshold for language than music.

The Influence of Weak Central Coherence in Auditory Processing

Hayato Watanabe, Harumitsu Murohashi; Hokkaido University, Japan
5AM2-S02-15

The autism spectrum disorder (ASD) is a pervasive neurodevelopmental disorder characterized by impairments in social interaction, communication, and by restricted repetitive patterns of behavior. It is thought that the weak central coherence (WCC) influences these features which are appeared as local bias in ASD. We used Autism-spectrum Quotient (AQ) measure to investigate whether the performances vary

according to their AQ scores in hierarchical melody discrimination task. Participants: typically developed 19 males and 5 females participated in this study. They were classified as high AQ group and low AQ group by AQ score. Stimulus: Nine tones were grouped sequentially to form a melody. These tones were arranged to form rising-falling or falling-rising contour of the melody. Condition: All tasks consisted of same-different judgements of pairs of melodies. There were 4 kinds of conditions; global and local que condition, global cue condition, local cue condition, and no cue condition. Performance of low AQ group was improved in global cue condition regardless of local cue. It was suggested that local cue was important to recognize global cue for high AQ group. Therefore, it is suggested that the individuals with high AQ can not understand global aspect in the melody sufficiently.

Change of Movement and Behavior by Music in Patients with Rett Syndrome

Tohshin Go, Yukuo Konishi; Tokyo Women's Medical University, Japan
`5AM2-S02-17`

Rett syndrome is a neurodevelopmental disorder characterized by stereotyped hand movement such as wringing. Although patients with Rett syndrome typically have no verbal skills, they are reported to respond well to music. Therefore, a questionnaire was sent to participants in an annual summer camp for them in Japan to study their movement and behavior, and their change by music. The answer was obtained from 34 patients. All were female aged from 4 to 30 years (11.5 +/- 8.1, mean +/- standard deviation). Age of onset was 1.5 +/- 0.7 years. Ambulatory patients with and without help were 32% and 38%, respectively. Stereotyped hand movements and body swinging were observed in 76% and 38%, respectively. Major response to music was described as follows. Smile was observed in 85% of patients. Body swinging started with music in 35% and stopped in 12%. On the other hand, stereotyped hand movements started in 12% and stopped in 35%. Seizure was induced in 9%. In conclusion, many patients with Rett syndrome seemed to be pleased with music and music had different effect on stereotyped hand movement and body swinging.

Chord Estimation Using Chromatic Profiles of Sounds Played by an Electric Guitar

Yasushi Konoki, Norio Emura, Masanobu Miura; Ryukoku University, Japan
`5AM2-S02-19`

This paper describes a system that estimate a chord label in real-time for sounds played with several electric guitars. We had studied a chord estimation system for MIDI signals in previous study. Chord labels are estimated by considering the combination of pitch classes and validity of performed chord progression. We aim at extending our previous system to be able to use in more practical situations, by dealing with acoustic signals instead of MIDI signals. Performed pitch classes are estimated by converting input sounds into the chroma vectors and selecting strong pitch classes depending on intensity relations in these vectors. Finally, a chord label for performance is estimated for obtained pitch classes.

Jazzbot: An Anthropomorphic Music Cognition Research Tool

Charles Hart, Michael Connolly Brady; Indiana University, USA
`5AM2-S02-21`

Recent years have seen a shift in cognitive science where the autonomous robot has begun to supplant the symbol-processing computer as dominant metaphor. The time has come to consider music processing and interaction in terms of the behavioral robot. We introduce JAZZBOT, a saxophone-playing automaton. It uses an air compressor, an electro-pneumatic breath system, and a mechanical mouthpiece to vibrate the saxophone's reed and generate a sound source. It then uses solenoid-controlled mechanical fingers to manipulate the keypads and thus the resonant dynamics of the saxophone's cavity. We first report insights from these fabrication efforts. For instance, the embouchure mechanism is extremely sensitive to combinatorial changes in air pressure and saxophone fingering. The embouchure control that a professional saxophonist acquires through years of practice becomes somewhat automated and reflexive or "sub-cognitive," yet it is very difficult to implement this kind of control in terms of a well-specified executive signal. This prompts the question: what form should an executive signal take? Furthermore, based on numerous conversations and critiques, we came to realize the importance of a social presence in musical

performance. As a result, we provide the robot with animatronic facial features to allow for the impression of shared attention and to facilitate eventual musical turn taking.

A System Generating Jazz-Style Chord Sequences for Solo Piano

Junko Watanabe [1], Kaori Watanabe [1], Norio Emura [2], Masanobu Miura [2], Masuzo Yanagida [1]; [1]Doshisha University, Japan; [2]Ryukoku University, Japan
5AM2-S02-23

In composition and arrangement of tonal music, it is important to give appropriate harmony to a given set of melody and its chord name sequence, though that is a tough task for non-professionals. Then there are a lot of research works and commercially available systems, such as systems for automatic arrangement of music pieces given as note sequences for solo pianos into a piano score in a specific style. These systems, however, are usually designed to generate music by concatenation of existing arrangement patterns. Such systems can not meet user requirements. This paper proposes a system that generates jazz-style chord sequences taking the structure of the input set of melody and chord name sequence into account reflecting user requirements. The system is implemented in an integrated modular structure based on the classical theory of harmony and several jazz arrangement techniques described in Jazz theory.

The performance of the proposed system is evaluated by comparing the results given by the proposed system with those given by a popular arrangement system available on the market. Experimental results show that the proposed system yields more preferable outputs then a commercial system available on the market.

MusicKiosk: When Listeners Become Composers — An Exploration into Affective, Interactive Music

Laurence Pearce [1], Lassi A. Liikkanen [2]; [1]XIM Ltd, UK; [2]Helsinki Institute for Information Technology, Finland
5AM2-S02-25

Music has for long been a one-way medium where professionals compose and others enjoy. However, with new interactive applications, listeners are receiving a novel opportunity to shape music in real time. Emotions are at the core of music appreciation and thus it appears natural to examine the discipline of affective computing to unite these two themes.

We present a case study of an interactive, assisted composition system called MusicKiosk. The system creates a composition based on the emotional states detected from users' voices. The experience is augmented by visualizing the music with interactive, animated characters. Custom made musical elements are added or removed dynamically according to the detected mood. The input for emotion detection is derived from the fusion of emotional speech recognition and keyword spotting. In upcoming user evaluation, we will use this system to explore natural interaction and the capacity of the system ot create emotional feedback loops.

Our presentation will demonstrate how this system is going to be implemented and investigated in detail. We attempt to show that developing an interactive, affective music composing system is becoming feasible with the state-of-the-art technology. We aim to display MusicKiosk in a museum environment by the end of 2008.

5PM1-S01 : Performance VI
Space 1, 14:10 – 15:40 Friday 29 August 2008, Oral session

Communication of Emotions with Different Intensities Through Performances of Professional Musicians and Non Musicians

Teruo Yamasaki; Osaka-shoin Women's University, Japan
5PM1-S01-1

This study focuses on the relation between the intensity of intended emotions and music performance and consists of two experiments. First experiment was a performance experiment, in which two professional drummers and ten non musicians expressed three emotions ('joy', 'anger', and 'sadness') at three degrees of intensity by playing a MIDI drum improvisationally. Second experiment was a listening experiment, in which musically untrained listeners heard the performances in the first

experiment and judged their emotional intentions. In experiment I, performances by both types of players were compared and analyzed in terms of various acoustic features. As the results, the close relation between the types of emotions and two acoustic features, i.e. sound level (MIDI velocity) and interval of beats, were found. The intensities of emotions were mainly related to sound level and duration between onset time and offset time. These findings were common to professional musicians and non musicians. On the other hand, professional musicians were different from non musicians in that sound level and interval of beats varied considerably. As the results of experiment II, the average rate of correct response for the performances of professional musicians was 41.5% and that for the performances of non musicians was 21.9%. Not only rate for professional musicians but also rate for non musicians exceeded the chance level significantly.

Gestures and Music Analysis in Piano Performance

Roberto Caterina, Mario Baroni, Luisa Bonfiglioli, Maria Teresa Storino, Michele Privitera, Iolanda Incasa, Fabio Regazzi; University of Bologna, Italy

`5PM1-S01-2`

In our work we tried to see how body expressions in musical performance are important elements of the interpreter musical thinking. We asked 7 professional piano players to perform twice two pieces belonging to different historical periods and styles. The performances were videotaped by 3 cameras in different positions (face, body, back). A special device, called Moog PianoBar, was put on the piano keyboard in order to get data about some interpretative variables. A special grid was prepared to compare musical aspects with body and facial expressions.

The first results of our analyses indicate that facial and body movements are strictly connected with dynamic profiles and phrase segmentations. Not all the interpreters use the same signals, but they do use body expressions to stress the same main points of articulation of musical structure. Body expressions seem to be more appropriate to express music segmentation, while facial expressions seem to be linked with expression of dynamic and agogic qualities, as we could observe in a previous study (Caterina et al. 2003).

Discovering the Body: Insights into Music Performance and Education from Highly Practiced Musicians

Shin Maruyama; Rikkyo University, Japan

`5PM1-S01-3`

The aim of this study is to describe a role that the sense of bodily movement plays in the production of music with reference to the theoretical framework of the ecological approach. To do so, I individually interviewed prominent musicians (instrumental conductor, violinist and cellist) who have rich experience of teaching and asked them questions about the role of body movement in their performance and about instructional techniques they usually use when teaching. I report four cases implying that knowing physics of the body is a fundamental skill to reach a right expression of music. These examples strongly support the speculation that the sense of bodily movement is a necessary element to musical activity. This implies that, without learning about such physical solutions, we might not access the deeper meaning of music. Although further study is required empirically to qualify the practical relationship between the body and music, we need to discuss an alternative pedagogy that enables students to discover and enhance the sensitivity to their own body.

5PM1-A01 : Cognitive Processes and Music Psychology

Atrium 1, 14:10 – 15:40 Friday 29 August 2008, Oral session

Differences in the Cognitive Processing of Music and Soundscapes Revealed by Performance on Spliced Stimuli

Jean-Julien Aucouturier; University of Tokyo, Japan

`5PM1-A01-1`

Considerable effort is spent optimizing computational techniques to simulate human perception of music and environmental sounds. Most of these techniques take no account of time, but rather focus on global statistical distributions. In other words, machines listen in effect to *spliced* audio signals, i.e. signals which frames have

been shuffled randomly in time. In this study, we investigate how well humans perform on such kind of signals. We compare human and machine performance in both a similarity and a categorization task, for spliced versions of both music and soundscape signals. Splicing is found to significantly degrade human categorization performance, both for music and soundscapes. Concurrently, splicing also degrades similarity, but significantly more so for music than soundscapes. This establishes that humans are capable of comparing soundscapes in a timeless, amorphous way which resists well to splicing. On the other hand, humans perform very poorly on the kind of musical data we typically expect algorithms to succeed on — in fact they're even worse than machines. Finally, good human performance for soundscape similarity doesn't appear to require identification of e.g. constituent sound sources, which suggests that, contrary to music, soundscapes can be compared in an acoustic-only manner, without much semantic analysis.

"Imagery" and "Force": Conceptual Metaphors in the Early Music Psychology of the Late Nineteenth and Early Twentieth Centuries

Youn Kim; University of Hong Kong, China

5PM1-A01-2

This paper deals with the early music psychology of the late nineteenth and early twentieth centuries (e.g., Herbart 1824–25; Helmholtz 1863; Stumpf 1890; Riemann 1884, 1916; Kurth 1931). It analyses conceptual metaphors found in these writings, particularly the spatial metaphor of "imagery" (Vorstellungen) and the dynamic metaphor of "force" (*Kraft*). The examination of the linguistic and metaphoric formulations in the early music-psychological discourse reveals differences and changes in conceptions of music and the mind. The change from imagery to force and the use of two different notions of force (i.e., physical force and life-force) can be construed signifying a shift from the mechanistic to the holistic, more intuitive conception of music and the mind — in Berman's (1984) words, a shift from "disenchanted" to "re-enchanted" music psychology).

Our eyes are not exclusively set on the past: Both imagery and force are frequently found in the present-day discourses (e.g., Howell, West & Cross, 1991; Godøy & Jørsensen, 2001; Larson 1993; Larson & VanHandel 2005). How do we conceptualize music and how does this conception shape the field of music psychology? Reflections on the early music psychology from the historical and critical perspective may well serve to provide an opportunity of rethinking current psychology of music.

Cognitive Processes During Piano and Guitar Performance: An Eye Movement Study

Satoshi Kobori, Katsunori Takahashi; Ryukoku University, Japan

5PM1-A01-3

The purpose of this study is to clarify the cognitive processes during music performance, namely how the players view the music and make the fingers move. This paper focuses on preview time (hand eye span) in piano and guitar playing. Two experiments were conducted, one was for piano and the other was for guitar. In both experiments, musical score was presented on a computer screen, and subject was required to play the instrument fluently. The music pieces were well-known piece, unknown piece and difficult piece, and all were single melody music. The basic characteristics of eye movements during piano and guitar playing were analyzed. Also, the preview times were estimated using relation between eye tracking data and finger movement data. The preview for the music was observed in all experimental conditions for both instruments, but the preview times were different among subjects, music pieces, and trial numbers. The preview times were longer in the higher skill subjects than in the beginner skill subjects. Also, the preview times were longer for difficult pieces than for easier pieces. The results suggested that skill level of performers, difficulty of music pieces and knowledge for music pieces were crucial factors which influenced the preview time.

5PM1-S02 : Music Listening and Preferences / Development / Methodology

Space 2, 14:10 – 16:00 Friday 29 August 2008, Poster session

Perceived Fitness of Music and Film Genre: Color, Light, Style and Period Combinations

Blas Payri; Universidad Politécnica de Valencia, Spain
5PM1-S02-02

This experiment studies whether musical features are systematically associated with visual features in an audiovisual context. The visual material consisted in 72 still pictures from recent (2004–2007) Japanese animation series, as animation has clear genre codes (color palette; character, place and time period design). We used stills rather than video to avoid interferences of speech, sound, gestures and shot changes with the music. Music material included 72 excerpts from electroacoustic, classical instrumental, classical Japanese and pop music works. 288 image-music combinations were divided in 5 sets and were presented to 5 groups of subjects (130 audiovisual communication). Subjects saw an image while listening to the music during 15s, then they rated from 1 to 5 the fitness music-image if it were a film music. They rated also music tension and liveliness from 1 to 5.

Results show that 19th European classical music was better accepted for every image style. Electroacoustic music was associated with futuristic images and with dark and faded colors; 17th and 18th music with historic images, while pop music to bright and light colours regardless of time and location. Different codes are used depending on the music genre and results basically agree with film music handbooks.

Development of Infant Cry Acoustics: A Basis of Musical and Linguistic Skills

Yulri Nonaka, Kentaro Katahira, Reiko Shiba, Kazuo Okanoya; RIKEN Brain Science Institute, Japan
5PM1-S02-06

Infant cry gains complexity in acoustic and syntactical properties as it develops. This complexity may be useful for the care giver to identify the need of the infant. Also, intentional control of vocal apparatus to change pitch and rhythm maybe considered as an origin of musical skills. In the present study, we obtained developmental recordings of infant cries from two babies. We analysed unit sounds of cry through the development and examined the nature of developmental changes and situational specificity. Our analyses revealed that the acoustics of infant cry is monotonous during the first month. When overall tendency is considered, these parameters show systematic U-shaped changes as the infant mature: duration becomes longer and entropy decreases first and then increase. When situational specificity is considered, each of these parameters showed specific pattern of development through which cries gain individuality and situational specificity. Voco-motor skill necessary to express situational specificity maybe a basis of later musical skills.

The Role of Musical Environment at Home in the Infant's Development (Part 1): Japanese Mother's Understanding and Practice of *Taikyo* and Its Effects on the Mother's Labor and the Infant's Development

Akio Akasaka [1], Mayumi Adachi [2], Hitoshi Chino [2]; [1]Kodoryoku Kenkyukai, Japan; [2]Hokkaido University, Japan
5PM1-S02-08

In Japan, the word *taikyo* (prenatal training) is often heard among pregnant women and their families. Some people believe and share their experiences that *taikyo* can lead to the safe delivery and the healthy birth of the child, as well as the child's language and intellectual development. Do internet self-reports represent average experiences of pregnant women in Japan? Can anecdotes of *taikyo* be verified scientifically? To answer these questions, we conducted two studies, focusing on effects of the mother's private music listening, playing music to the fetus, and singing to the fetus. In STUDY 1, 30 mothers with children up to age 4 were interviewed at home. All the mothers knew about the word *taikyo* during their pregnancy. The majority considered *taikyo* as the mother-child interaction in the womb. Private music

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listening was practiced by 10 mothers (3 as *taikyo*), playing music to the fetus by 11 mothers (6 as *taikyo*), and singing to the fetus by 12 mothers (7 as *taikyo*). Effects of *taikyo* were examined on the mother's labor and on the child's physical and other forms of development. Children whose mothers listened to favorite music during pregnancy came to understand easy words faster than their counterpart. In STUDY 2, we replicated the same study with 31 mothers and infants whose development of vocal expressions and motor skills were recorded longitudinally during the first two years. In the poster, we report results from both studies, discussing implications of the present study.

The Role of Musical Environment at Home in the Infant's Development (Part 3): 3-Month-Olds' Responses to Music and Their Subsequent Motor Development

Mayumi Adachi[1], Akio Akasaka[2], Izumi Kida[1], Shunsuke Kon-no[1]; [1]Hokkaido University, Japan; [2]Kodoryoku Kenkyukai, Japan

`5PM1-S02-10`

Earlier studies suggest that music elicits repetitive body movements in 12-month-old infants, and that it functions differently in 3-month-olds, depending on their preferred body positions when they are placed alone. The purpose of this study was three-folds: (1) to confirm that music reduces 3-month-olds' movements in a supine position and increases their movements otherwise, (2) to examine whether 3-month-olds' individual differences in response to music or in their preferred position would relate to the musical environment at home, and (3) to explore whether such individual differences could predict the course of their motor development later in infancy. Total of 63 college students watched 5s-long video clips of 10 3-month-olds lying in a supine position and 5 lying or sitting in different positions. They judged how much an infant was moving in each video clip on a 6-point scale with 1 as "not moving at all" and 6 as "moving a lot." For 10 infants in a supine position, their movements with music were judged less than those without music, supporting the earlier study. Data analyses for 5 infants in other positions (e.g., lying in a prone position, sitting on the mother's lap) are still in progress at the time of this writing. In the poster presentation, we will provide a full picture of what music can afford to young infants.

Interpretative Phenomenological Analysis and Music Psychology: An Overview

Raymond MacDonald, Paul Flowers, Jane Oakland, G.N. Caldwell, Julie C. De Simone; Glasgow Caledonian University, UK

`5PM1-S02-12`

Qualitative methods are now firmly established as an important approach to research within the psychology of music. Over the past 15 years there has been a significant increase not only in the volume of published research adopting qualitative methods but also in the range of different qualitative approaches that can be legitimately utilised. This paper overviews Interpretative Phenomenological Analysis (IPA) as a methodology for collecting and analysing qualitative data in Music Psychology Research. The key elements of IPA are outlined and compared to other forms of qualitative analysis such as thematic analysis and discourse analysis. A review of existing studies within music psychology is presented along with key challenges to researchers interested in developing IPA. The paper will demonstrate how IPA, as a rigorous, innovative and now well established methodology can be employed within music psychology research to further our knowledge over a range of diverse but related areas. Its utility as a research approach across a range of topics areas such as musical identities, music therapy, music education and motivation and music will be presented. This paper highlights the potential to develop IPA as a valuable research tool that could make a considerable contribution to the growing body of qualitative work within the field of Music Psychology.

The Complex Dynamics of Repeated Musical Exposure

Patrick C.M. Wong[1], Anil Kumar Roy[1], Elizabeth Hellmuth Margulis[2]; [1]Northwestern University, USA; [2]University of Arkansas, USA

`5PM1-S02-14`

Repetition is a fundamental part of engagement with the auditory world; it influences what gets perceived as important and selected for attention. It also influences the

mysterious phenomenon of aesthetic enjoyment. This project aims to identify the perceptual and cognitive non-linearities that underlie changes in preference across multiple musical exposures.

We report on a set of experiments that used behavioral measures to assess perceptual changes across multiple exposures (five over one week) of a twenty-minute orchestral piece. The behavioral tests included tasks related to preference, memory, attention, affect, syntax, and error detection. Participants performed these tasks after each of the five exposures in response to stimuli drawn from the exposure piece and from a control piece.

Across the five exposures, we found an inverted U-shape preference response, which possibly is decomposable to the complex interaction of multiple nonlinear components, represented by performance on tasks relating to memory, attention, affect, syntax, and error detection.

We argue that musical preference has remained a puzzle because the behavior depends on an underlying complex system with numerous nonlinear cognitive components revealed by our results. [Work supported by a grant from the Center for Interdisciplinary Research in the Arts at Northwestern University, and by NIH]

A Ground-Truth Experiment on Melody Genre Recognition in Absence of Timbre

José M. Iñesta, Pedro J. Ponce de León, José L. Heredia-Agoiz;
Universidad de Alicante, Spain
`5PM1-S02-16`

Music genre or style is an important metadata for music collections and database organization. Some authors claim for the need of having ground truth studies on this particular topic, in order to compare results with them and lead to sound conclusions when analyzing software performances. When dealing with digital scores in any format, timbrical information is not always available or trustworthy so we have avoided this information in our computer models, using only melodic information. The main goal of this work is to assess the human ability for recognizing music genres in absence of timbre in order to assess comparatively the performance of computer models for this task.

For this, we have experimented with fragments of melodies in absence of accompaniment and timbre, as our computer models do. For this particular paper we have worked with two well-established genres in the music literature, like classical and jazz music.

A number of analyses in terms of age, group, education, and music studies of the people subjected to the tests have been performed. The results show that, on average, the error rate was about 18%. This value shows the base line to be improved for computer systems in this task without using timbrical information.

The Role of Music in Videogames: The Effects of Self-Selected and Experimenter-Selected Music on Driving Game Performance and Experience

Gianna Cassidy, Raymond MacDonald; Glasgow Caledonian
University, UK
`5PM1-S02-18`

Videogames present a uniquely interactive yet relatively untapped platform for musical experience, with music providing a means of communication, interaction and expression (Lipscomb & Zehnder, 2004; 2006; Whalen, 2004). This raises two relatively unexplored areas of interest for the psychology of music (1) the uses and functions of music during gameplay, and (2) the elucidation of music's contribution to gameplay performance and experience. The present paper addresses both these needs through a summary of (1) a survey study, and (2) a series of three experimental studies, which adopted a listener-centred approach to establish investigation of music in videogames. Experiment 1 compared the effects of exposure to self-selected and experimenter-selected music on driving game performance and experience. The findings of Experiment 1 were extended in the subsequent studies, with Experiment 2 focusing on the role of tempo, and Experiment 3 focusing on the role of vocal content. The collective findings highlight the efficacy of self-selected music as a tool to optimise both performance and experience in the gameplay context. Additionally, the survey findings highlight the pervasive and highly personalised nature of music listening during gameplay, and the genre dependent nature of its use.

When do People Feel a Sense of Incongruity in Listening to Music?

Takashi Taniguchi; Osaka Gakuin University, Japan
5PM1-S02-20

The purpose of this paper is to collect and classify events and situations related to music and a sense of incongruity in order to investigate on what and when people feel a sense of incongruity in musical behavior, especially listening to music. In Study 1, 118 participants were asked to describe when they feel a sense of incongruity in listening to music, singing songs, and playing instruments on a free narrative form of questionnaire. Total descriptions were 181 in listening, 170 in singing, and 151 in playing instruments. Free descriptions showed 6 categories of a sense of incongruity in music. In Study 2, on the basis of the descriptions collected in Study 1, another questionnaire was constructed of 80 items about a sense of incongruity in listening to music. Other 141 graduates participated to fill in the questionnaire. Factor analysis yielded 7 factors: playing deviation, image inconsistency, situational incompatibility, unnatural performance, noise and interruption, displeasure, and off-balance. It shows various factors contribute to a sense of incongruity in listening to music. The factor pattern suggests the sense is experienced as a result of interaction between listening situation and listeners' condition in addition to musical and acoustical quality.

Musical Trends Among Japanese Young People: The Boom of 'J-Pop'

Junko Matsumoto [1], Shoko Kobayashi [2]; [1] Nagano College of Nursing, Japan; [2] Suzaka Municipal Office, Japan
5PM1-S02-22

This study investigated preferences with respect to music in the daily lives of young people and the attraction of Kumi Koda who has become popular among the youth of Japan, aiming to reveal a relationship among these variables. Results indicated that most participants preferred listening to music, listened to music frequently, and felt it necessary to have music in their daily lives. There were positive and significant correlations among the items related to music, but the correlation between interests in trends and the items related with music was small. Favorite musicians were almost always 'J-pop' musicians, and participants were attracted to 'J-pop' music, including both words and melodies. Factor analysis of the attraction to Kumi Koda yielded three factors: Healing, Appearance, and Fashion. There were few significant correlations between the attraction of her and the items related to music; however, there were positive, significant correlations between the attraction of her and interests in trends. These results suggest that most young people in Japan listen to music in their daily lives and prefer the music of 'J-pop' musicians. However, the results also suggest that, with regard to musicians who are currently part of a boom, young people may prefer them due to their trendiness rather than their music.

Short Term Memory for Music in Patients with MCI and Early Stage of Dementia

Manuela Kerer, Josef Marksteiner, Elisabeth Weiss; Medical University Innsbruck, Austria
5PM1-S02-24

There is evidence from a variety of sources that the system for short term memory for pitch is precisely and systematically organized, in several ways along the same lines as the system that processes pitch information at the incoming level. In this study we tested short term memory for music in patients with MCI (Mild Cognitive Impairment) and early stage of dementia. The most noticeable deficit in these patients is short-term memory loss and the consequent problems to acquire new information. Although memory span varies widely with populations tested and with material, human short-term memory in general has a forward memory span of approximately 7 items ± 2.

A new test was created with 7 tone-lines and 6 intervals. Subjects were presented to these test items, which were followed by 3 similar and 1 identical items. They were instructed to choose the right one. 10 patients with MCI and 10 with diagnosis of early stage of dementia were compared with 23 controls.

Results are in accordance with the proposed hypothesis that subjects with diagnosed MCI and early stage of dementia show significantly lower results for almost all presented tasks than controls. Respectively, MCI patients showed better results than early-stage-patients.

Thinking in Two vs. Three Beats: Metric Structure is Represented in Multiple Cortical Areas as Revealed by Magnetoencephalography in Skilled Musicians

Takako Fujioka, Benjamin Zendel, Bernhard Ross; Rotman Research Institute, Canada

5PM1-S02-26

People tapping to music often tap to metric structure, defined by strong and week accents, rather than to each pulse. This internalized metric structure is influenced by individual experience involving body and head movement. The current study investigated where and when different brain areas are involved in metric processing when tapping experience defines meter even if stimulus are unaccented using mag- netocephalography (MEG). Skilled musicians tapped for twelve clicks to every second (2-beat) or third (3-beat) click, alternated with a subsequent resting period of the same length. Time-averaged MEG data during the resting period were transformed to source activities in brain volume using beamformer technique to extract multiple sources without a-priori assumptions about number and configuration of sources. Results show that in addition to bilateral auditory activities, bilateral sensori-motor, prefrontal, left inferior gyrus, left pre-supplemental motor area, and then sensori- motor areas became active even before the next click. Similar periodic pattern of activation was observed in left angular gyrus, and supra marginal gyrus, cerebellum but peaking around between the clicks. We suggest that metric interpretation has a top-down effect on neural activities in multiple cortical areas, likely reflecting motor imagery and timing encoding.

5PM2-S01 : Neuroscience and Pathology
Space 1, 16:10 – 17:40 Friday 29 August 2008, Oral session

A Role for Pitch Memory in Congenital Amusia

Lauren Stewart[1], Claire McDonald[1], Sukhbinder Kumar[2], Diana Deutsch[3], Timothy D. Griffiths[2]; [1]Goldsmiths University of London, UK; [2]Newcastle University, UK; [3]University of California at San Diego, USA

5PM2-S01-1

Congenital amusia (CA) is a perceptual agnosia, defined as abnormal musical perception in the presence of normal hearing and otherwise preserved cognition. The disorder has been characterized by elevated thresholds for the discrimination of changes in pitch direction. The present study tested the hypothesis that CA individuals also have difficulty with the retention of pitch over time. A group of CA participants (n=16) was compared with a matched group of non-amusic controls. Two tones were presented over headphones with an intervening silent pause of variable duration (2s, 5s, 8s). The tones were either the same or differed in pitch by two semitones (suprathreshold for pitch discrimination in both groups). There was a significant main effect of group, a significant main effect of condition and an interaction between group and condition. The CA group performed significantly worse than the control group in all conditions, despite normal performance on digit span — test of verbal working memory. This indicates that pitch retention, and not only pitch perception, is deficient in amusia and suggests that the disorder might be considered a deficit of dynamic pitch tracking. Ongoing studies will determine whether this memory deficit relates to an impairment of storage or rehearsal of pitch information.

Investigating the Language and Music Lexicons Using Repetitive TMS

Rebecca Sussex[1], Sarah Wilson[1], David Reutens[2]; [1]University of Melbourne, Australia; [2]Monash Medical Centre, Australia

5PM2-S01-2

Repetitive transcranial magnetic stimulation (rTMS) is a technique used to briefly disrupt brain activity in small areas of the neocortex. It can be used to determine whether a particular area is necessary for a cognitive function. The current study is the first to use rTMS to disrupt singing and speaking by stimulating regions in the temporal lobes thought to underpin the music and language lexicons. Participants underwent a structural MRI scan which was used to co-register scalp locations with

underlying neocortex sites. During two subsequent testing sessions participants produced three highly familiar excerpts (song, text & melody) while receiving sham and active rTMS on the left and right temporal lobes. Performances were video and audio recorded for the purposes of analysis. Recruitment for the study is ongoing and will be completed by July 2008. Pilot data indicates that rTMS of the right temporal lobe interrupted singing but not speaking. In contrast, rTMS of the left temporal lobe selectively interrupted speaking, although the disruption was more subtle than that seen for singing after right rTMS. Further data will determine the robustness of this effect. These preliminary findings support the results of previous studies that indicate that music and language functions may in part be mediated by separate neural networks.

A Neurobiologically Plausible Schema for Auditory Information Processing Including the Auditory Cortex

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The broad range of neural responses observed in studies of the auditory cortex will be better understood in relation to a model of neural mechanisms. This paper presents a first approximation to such a model which can be tested by specific experimental studies. The principle feature of the model is a mechanism of streaming information based on stored templates of activation while the echoic trace is formed. It is proposed that the echoic trace is formed along an array of neural circuits in the thalamus that are sequentially activated by quality specific disinhibition from classification hierarchies in the primary auditory cortex. The streamed pitch, loudness and direction information is accumulated in neural arrays in the primary auditory cortex before being associated with source identity in the associative cortices in the superior temporal and other brain regions. A successful model will enable an artificial listening system to be developed to provide objective and reproducible predictions of human responses to acoustic stimuli. This will have applications in the analysis and composition of music outside the Western tonal cannon, the design and analysis of musical instruments, and automatic music transcription. Such a model will also have implications in a wide range of fields including hearing disorders, environmental acoustic monitoring and robotic sensing.

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