

ICMPC 11 ABSTRACTS

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Abstract Master: Causal Productions

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Welcome / Keynote Address

KANE 130, 09:00 – 10:30, Monday 23 Aug 2010

Singing: When It Helps, When It Hurts, and When It Changes Brains

Gottfried Schlaug; Beth Israel Deaconess Medical Center, USA

Opening, Time: 09:00

Singing, or making music with your own vocal apparatus, is a multimodal activity that involves the integration of auditory and sensorimotor processes. The ability to sing in humans is evident from infancy, and does not depend on formal vocal training but can be enhanced by training. Nevertheless, there are individuals who are unable to sing in tune, i.e. tone-deaf people, providing an interesting model to study a disordered auditory-motor brain network including its feedback components that facilitate singing. Given the behavioral similarities between singing and speaking, as well as the shared and distinct neural correlates of both, work has also begun to examine whether singing can be used to treat some of the speech-motor abnormalities associated with various neurological conditions. I will present the anatomical and functional components of an auditory-motor network that supports singing, show evidence that this network adapts and changes as a function of intense training, and reveal how singing and components of this auditory-motor network can be used to ameliorate some of the speech deficits associated with conditions such as acquired focal brain lesions and developmental disorders such as autism.

Invited Symposium: Effects of Musical Experience on Development During Infancy

KANE 110, 11:00 – 12:30, Monday 23 Aug 2010

Beat Induction as a Fundamental Musical Skill

Henkjan Honing; University of Amsterdam, The Netherlands

SYM031, Time: 11:00

In order to understand how humans can learn to understand music, we need to discover what perceptual capabilities infants are born with. In this paper we address beat induction: the ability to sense beat (a regular pulse in an auditory signal; termed 'tactus' in music theory) that helps individuals to synchronize their movements with each other, such as necessary for dancing or producing music together. A recent study tested beat induction in sleeping newborn babies (Honing et al., 2009; Winkler et al., 2009), by assessing whether or not the neonate auditory system forms expectation for the onset (downbeat) of the cycle in a regular rhythmic sound sequence. The results demonstrated that violating the beat of a rhythmic sound sequence is detected by the brain of newborn infants (showing a MMN). Apparently newborn infants develop an expectation for the 'downbeat', even when it is not marked by stress or other distinguishing spectral features. Omitting the downbeat elicits brain activity associated with violating sensory expectations. It appears that the capability of detecting a regular pulse in rhythmic sound sequences is already functional at birth. The potential consequences of these findings for musical development, biology of music, and the origins of music will be discussed (This research was supported by the European Commission. For credits see: www.musicognition.nl/newborns/).

New Perspectives on Consonance and Dissonance

Judy Plantinga, Sandra E. Trehub; University of Toronto Mississauga, Canada

SYM032, Time: 11:30

The prevailing belief is that the human preference for consonant music and distaste for dissonant music are innate. The evidence is based largely on sequences of consonant or dissonant *harmonic*, or simultaneously sounded, intervals, which are atypical in music. In the present study, we used more ecologically valid materials to investigate preferences for consonance by 6- and 12-month-old

infants — simple melodies or tone sequences in one experiment and simple melodies with chord accompaniment in another. Infants were tested with the headturn preference procedure. In Experiment 1, 16 6-month-olds and 16 12-month-olds heard a tonal melody with musically consonant intervals and an atonal melody with dissonant intervals. In Experiment 2, both age groups (16 per group) heard these tonal and atonal melodies with accompanying chords that were consistent with the tonal melody (i.e., consonant harmony for the tonal melody and dissonant harmony for the atonal melody). Neither age group showed any preference in Experiment 1. In Experiment 2, 12-month-olds showed a preference for the music that was moderately dissonant or discrepant from music ordinarily heard in their environment. Our findings are inconsistent with an innate preference for consonant music, either for sequential tone relations or for melodies accompanied by chords. Instead, they suggest that infants' apparent preference for consonance stems from properties unique to simultaneous tone combinations. Our results are consistent with variations in standards of dissonance across historical periods and cultures and with aesthetic preferences that arise from moderate pattern complexity. They also highlight the effects of early exposure.

Active Participation in Infant Music Classes: Perceptual, Cognitive and Social Benefits

Laurel J. Trainor, David Gerry, Elaine Whiskin, Kristen Tonus, Adrienne Cheung, Andrea Unrau; McMaster University, Canada

SYM033, Time: 12:00

Compared to those not training musically, children taking formal music lessons show advanced brain organization, musical perception, and executive functioning. Here we test whether structured musical training between 6 and 12 months of age affects musical acquisition, brain development, language, social interaction, and joint attention. Infants (n = 30) were randomly assigned to either 6 months of a Suzuki early childhood music program or a passive music listening control program. In the former, infants and parents learned songs, played xylophones, and moved to rhythms. In the latter, "Baby Einstein" CDs were played while infants and parents played at ball, book, block, art, and stacking-cup stations. Compared to the control group, infants in the Suzuki group showed advanced brain responses at 12 months. Specifically, they showed significantly larger and earlier event-related potentials to melody notes and larger responses to pitch changes. In terms of musical acquisition, Suzuki infants preferred to listen to tonal compared to atonal music whereas control infants had no preference. Additionally, infants in the Suzuki group showed greater positive changes pre- compared to post-training on gesture measures of early communication, and on the smiling, distress to limitations, distress/latency to approach novel stimuli, and soothability scales of the Infant Behavior Questionnaire. The random assignment allows us to conclude that participation in an active Suzuki early childhood music program advances brain development, musical acquisition, communication and social/emotional development compared to participation in a passive listening program. We conclude that musical training can have benefits in infancy.

Music Therapy 1

GOWEN 201, 11:00 – 12:30, Monday 23 Aug 2010

A Theory of Music and Sadness: A Role for Prolactin?

David Huron; Ohio State University, USA

PA025, Time: 11:00

A theory of music and sadness is proposed. It is suggested that, for some listeners, nominally sad music actually evokes sad affect through a combination of empathetic responses to sad acoustic cues, through learned associations, and through cognitive rumination. Levels of the hormone prolactin increase when sad, producing a consoling psychological effect suggestive of a homeostatic function. It is proposed that prolactin plays an important role for those listeners who experience nominally sad music as pleasurable. It is suggested that the effect exhibits large individual differences.

Improvisational Psychodynamic Music Therapy for Depression: Randomized Controlled Trial

Jaakko Erkkilä, Esa Ala-Ruona; University of Jyväskylä, Finland

PA018, Time: 11:30

Clinical evidence, anecdotal findings, and couple of controlled studies conducted so far suggest that music therapy is a promising, even effective form of treatment for depression although there is little research on the effect of specific music therapy models and methods. The aim of this study is to examine whether improvisational, psychodynamic music therapy in an individual setting helps reduce symptoms of depression and improve other health-related outcomes. We conducted a single-blind randomized controlled trial with two parallel arms in Jyväskylä, Finland. A total of 79 people with depression (aged 18-50 years) participated in the study. Primary measure was change in score on a depression symptom scale. Secondary measures were changes in scores on anxiety, general functioning, quality of life, and alexithymia. Frontal alpha asymmetry (FAA) and frontal midline theta (FMT) in rest electroencephalography were also investigated. At 3 months, participants receiving IPMT showed greater improvement than those receiving standard care in depression symptoms, anxiety symptoms, and general functioning. Non-significant differences favoring IPMT were seen in quality of life and alexithymia. Response rate was significantly higher in IPMT than in standard care. Changes in FAA were different at F7-F8 electrodes. IPMT added to standard care for depression is more effective than standard care alone. Patients offered IPMT show greater improvements in depression, anxiety and functioning and have a greater likelihood of response in the medium term. The EEG findings may refer to increased emotional awareness and processing. Further research is needed to address the longer-term sustainability of its effects.

Depression and Music Therapy Treatment — Clinical Validity and Reliability of EEG Alpha Asymmetry and Frontal Midline Theta: Three Case Studies

Jörg Fachner¹, Christian Gold², Esa Ala-Ruona¹, Marko Punkanen¹, Jaakko Erkkilä¹; ¹University of Jyväskylä, Finland; ²Unifob Health, Norway

PA080, Time: 12:00

Physiological measurements may be a promising addition to traditional clinical depression assessments if clinical validity can be demonstrated. We aimed 1.) To examine the relationships between EEG measures (frontal alpha asymmetry, FAA; and frontal midline theta, FM theta) and psychiatric test; 2.) to explore whether changes in those measures were congruent with clinical case descriptions by the attending music therapists. 79 adults diagnosed with a depressive disorder were included in this study Resting EEG and psychiatric tests (MADRS; HADS-A) were administered at intake and after 3 months. FAA was calculated at three electrode pairs (Fp1-Fp2, F3-F4, F7-F8), and FM theta (F3/4, Fz). EEG was transformed into z-scores (compared to a normative EEG database). Correlations between EEG and psychiatric tests were examined statistically. Psychometric properties of FAA and FM theta were also explored. Therapy processes of selected cases were analysed narratively and compared to the observed changes on EEG and clinical assessments. FAA on F7-F8 electrodes at intake was significantly related to anxiety ($r = .29, p < .05$; z-scores: $r = .33, p < .01$) but not to depression level. No significant correlation was found between FM theta and psychiatric tests. Z-scores of FAA were within the normal range, whereas z-scores of FM theta were higher than in the age-matched normal population. Test-retest reliability at 3 months was good for most measures. Comparisons of EEG and psychiatric measures with narratives of three selected cases yielded mixed results. FAA and FM theta demonstrate some potential as biomarkers in music therapy studies.

Social Psychology 1

GOWEN 301, 11:00 – 12:30, Monday 23 Aug 2010

Modeling Musical Structure from the Audience: Emergent Rhythmic Models from Spontaneous Vocalizations in Samba Culture

Luiz Naveda¹, Fabien Gouyon², Marc Leman¹; ¹Ghent University, Belgium; ²INESC Porto, Portugal

PA021, Time: 11:00

The access to subjects' representations of musical structure is a persistent challenge to the research in music. Vocalizations may be able to provide a more direct access to personal accounts of music engagement, which may be less biased by symbolic representation and more spontaneously performed in several cultural backgrounds, such as the Hip-Hop's *beatboxing*, the *Bols* in India or the vocal percussion of *Samba* rhythms in Brazil. In this study, we analyzed the musical structure of spontaneous vocalizations of Samba rhythms collected from a random selection of subjects in Brazil. The results show that spontaneous vocalizations provide an alternative to the study of musical structure based on data collected from acculturated subjects, musically trained or not. The combination of this method with audio analysis provides a promising balance between ecological validity and analytic tool. The study also shows that entrained rhythmic models in Samba are coherent with expected musical characteristics described in the literature.

Influences of Minority Status and Social Identity on the Elaboration of Unfamiliar Music by Adolescents

Marco Lehmann, Reinhard Kopiez; Hanover University of Music & Drama, Germany

PA110, Time: 11:30

Adolescents highly appreciate music and use it as a badge of identity. They elaborate on music-related topics in their own terms regarding two informational qualities: musical knowledge in terms of descriptive categories and musical meanings as they relate to the self and to social groups. This study investigates adolescents' ($N = 101$) music elaboration in the social context of minority status, social identity and expert status. In a controlled experimental setup, subjects listened to unfamiliar music and obtained discussion topics from an alleged group of earlier participants. In turn, they indicated their interest in the topics and invented their own. We report empirical effects on interest in discussion topics about music and on the initiative for the subjects' own contributions. The results are discussed regarding theories in social psychology and also the status of the music teacher in school.

A Comparative Research About Social Representations of "Music" and "Musical Child" Held by University Students

Anna Rita Addessi¹, Rosane Cardoso de Araújo², Assumpta Valls³, Claudia Gluschkof⁴; ¹University of Bologna, Italy; ²Federal University of Paraná, Brazil; ³Autonomy University of Barcelona, Spain; ⁴Levinsky College of Education, Israel

PA175, Time: 12:00

This paper deals with a comparative study about teachers' implicit music knowledge. Our hypothesis is that music knowledge can be investigated as a social and psychological construction as described by the theory of social representations (Moscovici 1981). The pilot study has been realized in Italy with university students that will become general teachers at the nursery and compulsory school (Addessi, Carugati, Selleri 2007; Addessi & Carugati 2010). We investigated the concepts of music, musicality, musical child, music teacher and music education held by the participants, by means a questionnaire. In this paper we introduced the comparative research carrying out with the same questionnaire in Brazil and Spain.

Tonal Perception 1

SMITH 120, 11:00 - 12:30, Monday 23 Aug 2010

The Effect of Structure and Rate Variation on Key-Finding

Morwared Farbood, Gary Marcus, Panayotis Mavromatis, David Poeppel; New York University, USA

PA027, Time: 11:00

While substantial evidence suggests that key perception depends in part on the statistical distribution of pitch classes in a given piece, it has also been suggested that structural factors may play an important role. To further the understanding of what such structural factors might be, we conducted two experiments using statistically ambiguous yet structurally unambiguous stimuli that consisted of a uniform distribution of diatonic pitches drawn from the union of two neighboring keys, sequenced to clearly imply one particular key. In Experiment 1, subjects with substantial music theory training were asked to listen to melodic sequences and identify the key. The results indicate that purely structural factors can greatly influence key perception when statistical information about overall key profile is highly ambiguous. In Experiment 2, we examined the temporal psychophysics of structurally-based key induction by systematically varying the tempo of a subset of the statistically ambiguous/structurally unambiguous materials presented in Experiment 1 at rates ranging from 7 BPM to 3400 BPM. Twenty-two musically trained subjects were asked to indicate whether each sequence sounded resolved (ending on an implied tonic) or unresolved (ending on an implied dominant). The results agree strongly with those from Experiment 1 and show a preferred range of tempi in which participants provide robust key judgments (30 BPM - 400 BPM). This suggests that structurally-based key-finding can be accurately computed by trained listeners in as little as 150ms per note or 1.2s for an entire sequence of eight notes.

Common and Rare Musical Keys Are Absolutely Different: Implicit Absolute Pitch, Exposure Effects, and Pitch Processing

Moshe Shay Ben-Haim¹, Eran Chajut², Zohar Eitan¹;
¹Tel Aviv University, Israel; ²Open University, Israel

PA057, Time: 11:30

It is widely accepted that stimuli's frequency of occurrence has an effect on perceptual processes. In Western tonal repertory, some musical keys are extremely more frequent than others. Given recent studies showing that implicit "Absolute Key" aptitude (long-term memory for absolute key identity) is widespread, we hypothesized that keys common in tonal music would be processed more efficiently than rarer ones. 156 participants with no explicit Absolute Pitch abilities (including 36 musicians) were presented with a pitch identification learning task. Four pitches, establishing scale degrees 1, 2, 3, and 5 in a major key, were presented to each participant in one of 6 keys — three common (C, G, and D major) and three rarer (Ab, Db, and Gb major). Each pitch was assigned a number and a corresponding key on the computer keyboard. In three experimental stages, participants heard the pitches in random order and were requested to press each pitch's assigned number-key rapidly. Steeper learning curves were observed for common musical keys, producing faster reaction times and fewer errors for these keys in the final test phase. This novel exposure effect implies that absolute key identity may partake significantly in the processing of music, giving perceptual advantage to music in frequently-heard keys. This striking finding may suggest a revision in paradigms of tonal pitch processing, currently based exclusively on relative pitch.

Diatonic Categorization in the Perception of Melodies

Jason Yust; University of Alabama, USA

PA111, Time: 12:00

Previous research has shown that musicians skilled at interval identification categorize intervals according to their approximate size in

semitones to perform interval discrimination tasks. The hypothesis that listeners have a similar strategy, diatonic categorization (a categorization scheme with seven rather than twelve categories within the octave), available to them for a range of other musical tasks neatly explains some phenomena of musical practice and some previous experimental results. Diatonic categorization would be a particularly effective strategy for music based on diatonic scales, and because it is a more efficient representation, it might be useful to listeners with less musical training and for musical tasks that are more complex than simple interval identification. I tested the specific hypothesis that musicians with moderate training would use diatonic categorization as a strategy in a short term memory task for transposed "melodies" (tone sequences) using two types of stimuli, one with diatonic stimuli in a familiar twelve-tone equal tuning (12-tET) and one with mock-diatonic stimuli in an unfamiliar thirteen-tone equal tuning (13-tET). The results show that subjects used diatonic categorization in the unfamiliar tuning condition as the only effective strategy to recall the interval content of melodies. In the familiar tuning, diatonic categorization appeared to be accompanied by other strategies, though more intersubject variability made these results less clear.

Invited Symposium: Perspectives on the Development of Expertise

KANE 110, 14:00 - 16:00, Monday 23 Aug 2010

Perspectives on the Development of Expertise

Susan Hallam; IOE University of London, UK

SYM040, Introduction

This symposium brings together research considering the development of expertise across a range of different age and instrument groups adopting different methodologies. The first paper reports a questionnaire rating scale study with over 3,000 participants aged 4-19 representing a broad range of instruments and levels of expertise from beginner to entry to higher education exploring reported practicing strategies. The second paper explores the role that interpersonal interaction plays in supporting pupil attainment in instrumental learning. Survey responses from 337 violinists revealed that interpersonal factors accounted for significant differences in examination grade attainment. The third paper considers issues of conceptual understanding with three groups of students also representing different ages and levels of expertise. Three levels of conceptual understanding were identified as expertise developed: 'direct-interpretative', interpretative-constructive, and 'constructive'. The final paper considers expert level preparation for performance based on a single case observational study of a singer and pianist/conductor as they prepared for a performance of the first *Ricercar 1* from Stravinsky's Cantata for soloists, women's choir and ensemble. Taken together the papers provide insights into different aspects of expertise development, the role of generic practicing strategies, the relationship between amount of practice and interpersonal interactions on attainment, changes in conceptual understanding and the use of performance cues in experts.

The Development of Practicing Strategies in Young People

Susan Hallam; IOE University of London, UK

SYM041, Time: 14:00

There has been considerable research considering how instrumental practice changes as expertise develops. Much of that research has been small scale and restricted in the range of instruments included. This paper explores the development of practicing strategies and motivation to practice as expertise develops. Over 3,000 young participants aged 4-19 representing a broad range of instruments and levels of expertise from beginner to those about to enter higher education completed a rating scale questionnaire relating to the strategies that they adopted when practicing. There were highly statistically significant differences between students at different levels of expertise in response to all but one statement relating to practicing strategies. These differences did not consistently demon-

strate a trend towards the adoption of more effective strategies as expertise developed. Factor analysis with varimax rotation revealed seven factors. Factor 1 had high weightings on statements relating to practicing sections slowly, repetition, and recognizing errors. Factor 2 had high weightings for items relating to the organization of practice, Factor 3 the use of recordings to provide feedback, getting a recording of a piece to be learned, and practicing with the metronome, Factor 4 the acquisition of an overall conception of the piece aurally and structurally and attempting to identify difficult sections, Factor 5 the strategy of repetition of entire pieces, Factor 6 concentration, and Factor 7 correcting a single wrong note if a mistake was made. Analysis of variance of Factors in relation to the nine levels of expertise revealed highly statistically differences.

The Role of Interpersonal Interaction in Supporting Progression in Instrumental Learning

Andrea Creech; IOE University of London, UK

SYM042, Time: 14:30

The principal research question addressed in this paper is whether interpersonal factors may account for variability in progression, amongst young instrumentalists. Three hundred and thirty-seven violin pupils aged between six and eighteen, their parents and their violin teachers each completed a survey comprising measures of interpersonal interaction. Data relating to pupil attainment (instrument grade level) and hours of practice per week were also collected. A cluster analysis was carried out and a model of six interpersonal types was proposed. In order to explore the principal research question, comparisons were made between the instrumental examination grade levels of pupils representing these contrasting teacher-pupil-parent interpersonal types. A two-by-two between-groups analysis of covariance (ANCOVA), controlling for pupil age, was carried out, where the independent variables were 'interpersonal type' (six groups) and 'hours of practice' (3 groups). The dependent variable was 'grade level' (Associated Board of the Royal Schools of Music). The ANCOVA revealed main effects for interpersonal interaction type and for hours of practice per week, but no significant interaction effect. Specifically, the lowest attainment was found amongst pupils from clusters distinguished by high pupil-parent autonomy and low receptiveness to parental involvement on the part of the teachers. Higher attainment levels were found amongst clusters where parents offered high levels of support and teachers were enthusiastic, valued high musical standards and were highly responsive to the pupils' and parents' points of view. The effect size for interpersonal interaction type, as measured by partial eta squared, was higher (.07) than that for hours of practice (.05).

How Does the Development of Expertise Influence Instrumental Students' Conceptions of Learning and Instruction?

Alfredo Bautista; University of Victoria, Canada

SYM043, Time: 15:00

Many research studies carried out from the expertise paradigm have focused on describing how instrumental practice changes as musical expertise develops. However, the conceptions of music learning and instruction held by instrumentalists with different levels of expertise still remains as an understudied area, even among researchers specifically concerned with conceptual change. By adopting the frame of *implicit theories*, the present study addresses the conceptions of learning and instruction held by instrumental students at professional conservatories of music. More specifically, our main purposes were to study the conceptions of learning, teaching, and assessment/evaluation held by piano students at three developmental/instructional stages, and analyze whether their conceptions were organized in the form of theoretically consistent profiles. The participants were 215 students of Intermediate and Tertiary degrees. The construct "expertise" was operationalized by collapsing the variables "Age" and "Level of Instruction" in three levels. Data was collected by means of a multiple-choice questionnaire, and analyzed with descriptive and non-parametric statistical methods. The findings suggested that: a) students' conceptions are more sophisticated as both their age and education level increase; b) each developmental/instructional group is typically associated to different

conceptions of learning, teaching, and assessment/evaluation; and c) three increasingly sophisticated profiles, quite consistent from a theoretical perspective, can be identified among these students. Similarities and differences among our findings and those from studies focused on the development of students' learning practices are elaborated. Implications for conceptual change research and limitations of the study are discussed, and further lines of research are suggested.

Learning More About Practice and Recall: Comparing Self-Reports for Works by Stravinsky and Schoenberg

Jane Ginsborg¹, Roger Chaffin²; ¹Royal Northern College of Music, UK; ²University of Connecticut, USA

SYM044, Time: 15:30

Longitudinal case studies have shown that certain musical features to which performers attend during practice and rehearsal are retained as cues for retrieval during performance from memory. Nevertheless some features can be retained for many years post-performance despite not having been identified explicitly as performance cues (PCs). We examined the implications of this finding for the theory of PCs by extending previous research on a singer's memorization and recall for Stravinsky's *Ricercar 1* to her preparation of Schoenberg's *Songs Op. 14*. The singer reported features and PCs for the Stravinsky immediately after the public performance. These were used as predictor variables in regression analyses in which the dependent variables were starts, stops and repetitions of each beat during practice and subsequent recall. She identified features of the Schoenberg after the final rehearsal, and PCs after the performance. More interpretive and expressive cues were reported for Schoenberg than Stravinsky. Reports per beat were comparable. For the Schoenberg, nearly a quarter of all features and cues were noted concurrently with one or more other features (e.g. basic and interpretive) and PCs (e.g. interpretive and expressive). While half the features were retained as PCs of the same type, others disappeared or became different types of PC. Further, as the performance progressed, additional cues emerged that did not appear to originate in features. The singer's approach to the two tasks was generally consistent, reflecting earlier findings for professional musicians. Inconsistencies are attributable to differences between the two works influencing the nature of preparation.

Emotion 1

GOWEN 201, 14:00 – 16:00, Monday 23 Aug 2010

Musical Induction and Persistence of Moods

Marjolein D. van der Zwaag, Joyce H.D.M. Westerink; Philips Research Europe, The Netherlands

PA020, Time: 14:00

Music is a powerful and popular technique to regulate mood in everyday life. A better understanding of the relation between music and mood is valuable as it would help to use music to consistently direct mood to a positive state, which improves several cognitive processes. This study investigated whether music can induce moods in each quadrant of the valence-energy model, and whether these moods last when music is presented in the background.

Twenty participants received four mood inductions. Music was selected based on the most distinctive songs in each quadrant of the valence-energy model for each individual participant. Eight minute musical mood induction and five minute task execution took place while music was presented continuously. Participants rated their emotional state using valence and energy ratings.

Results show that the musical mood induction was successful. The four musically induced moods differed on valence ($p < .001$) and energy ($p < .001$) ratings. When music was presented in the background of the task execution, valence and energy ratings remained distinguishable over the four induced moods, although the differences between them reduced. Thus this study shows that moods from each quadrant of the valence-energy model can be successfully induced using music, and persist when music is presented in the background.

This study extends current knowledge on the impact of music on mood and emphasizes the valuable power of music to induce mood.

Mood and Personality Influence the Perception of Musical Emotions

Jonna K. Vuoskoski, Tuomas Eerola; University of Jyväskylä, Finland

PA067, Time: 14:30

Temporary mood states as well as stable personality traits have been shown to influence emotional processing, but this phenomenon has been neglected in the field of music and emotions. The aim of this study was to explore how listeners' personality and mood influence their evaluations of discrete emotions represented by music, as well as their preference ratings for different types of excerpts. 67 participants evaluated 50 film music excerpts in terms of perceived emotions (happiness, sadness, anger, fear, and tenderness) and liking. Their current mood and Big Five personality traits were also assessed. The results suggest that both mood and personality play a role in the perception of musical emotions, although the effect of mood seems to be stronger. Participants in negative mood evaluated music excerpts as sadder, whereas participants in positive mood evaluated the excerpts as happier. Although personality traits predispose to certain mood states, Moderated Multiple Regression analysis revealed that personality also moderates the way mood effects emotion perception. For example, extraversion had a significant moderating effect on the relationship between depressed mood and sadness ratings. Interestingly, personality and liking ratings appeared to be strongly connected: Agreeableness and Extraversion correlated with liking for happy-sounding music, and Openness to Experience with liking for sad- and fearful-sounding music. The results suggest that mood has a stronger role in cognitive evaluations of emotional information, but personality traits moderate its effects of emotional processing and appear to be more important for self-referential evaluations such as liking for happy- or sad-sounding music.

Are Bodily Responses Pre-Musical? Psychophysiological Applications to Music Analysis

David Sears, Mattson Ogg, Mitchel Benovoy, Gil Zilberstein, Stephen McAdams; McGill University, Canada

PA141, Time: 15:00

Two methodological obstacles impede progress in research on emotional response to music: 1) the ability to provide a potentially objective measure for the study of emotions felt by listeners, and 2) an analytical technique that can account for how emotions change over time. We provide solutions to these obstacles by adopting psychophysiological measures reflecting activity of the sympathetic nervous system and by performing continuous analyses of the measures over the entire musical excerpt.

We presented 20 musically trained subjects with 19 Romantic piano excerpts in small ternary form (ABA') lasting 50-90 s. We continuously recorded three psychophysiological measures: galvanic skin response (GSR), heart rate, and facial electromyography. We extracted orienting responses (OR) in the GSR profiles for each subject over the course of each excerpt and then located the temporal windows that elicited a significant number of ORs across all subjects, using the other measures to confirm the OR. We analyzed the formal properties of the music at these windows to determine the potential cause of the ORs. We also extracted expressive performance features (time-varying loudness, tempo variation) from the acoustic stimuli.

Analyses at formal windows suggest listeners orient at the return of formal units (A'), indicating a clear effect of repetition on GSR, and at formal ruptures, in which a failure to provide closure at the end of formal units often elicits expectations for something to follow. Additional analysis between excerpts yielded significant effects of both loudness and tempo on GSR and HR.

The Effect of Pitch Exposure on Sadness Judgments: An Association Between Sadness and Lower Than Normal Pitch

David Huron¹, Gary Yim¹, Parag Chordia²; ¹Ohio State University, USA; ²Georgia Institute of Technology, USA

PA144, Time: 15:30

Participants heard melodies in an experiment consisting of an exposure phase and a test phase. During the exposure phase, pairs of participants heard melodies that used artificial scales: for one participant, certain scale tones were raised; for the other, those same scale tones were lowered. Then, during the test phase, each pair of participants judged the sadness of identical melodies without these alterations. Participants who had heard the exposure melodies with the raised scale tones heard the test melodies as lower, and judged the test melodies to be sadder. The results suggest that the minor mode achieves its sad qualia by contrast with a more familiar mode (major) in which some scale tones are lower than normal. The results also suggest why the minor scale may have no sad connotations for listeners not enculturated to the major scale.

Timbre 1

GOWEN 301, 14:00 - 16:00, Monday 23 Aug 2010

A Statistical Analysis of Timbre Descriptors for Musical Instrument Classification

Song Hui Chon, Stephen McAdams; McGill University, Canada

PA036, Time: 14:00

Timbre is highly informative of the acoustical nature of sound source vibration patterns and the way they are excited. It should therefore be quite useful in the classification of musical instruments. Most automatic classification algorithms use various sound features, including many that model dimensions of timbre. Even though researchers are aware of the fact that including bad features leads to bad classification performance, there has been no large-scale assessment of each descriptor's performance.

This paper presents a statistical analysis of the 70 timbre descriptors collected at IRCAM. The goal is to judge each descriptor's effectiveness in three classification settings: according to musical instrument families, excitation types and the wind instruments' reed types. Eighty-two stimuli from six well-known timbre studies were considered.

Correlation analysis revealed clusters of features that are similar to the nine groups listed in Rioux et al. (2006). A simple k-means clustering on the values from each descriptor yielded a range of moderate classification rates from 33% to 79%. Wind instruments seem to be easier to classify than others. Of the nine descriptor groups, Spectral Centroid group was rather consistent and Attack Time more varied in intra-group performance. For the reed type classification, the Spectral Deviation group is superior to the other groups in terms of mean group performance and intra-group variance. While the classification performance may not be excellent, it showed a promising result with only one classifier and a simple classification algorithm. The performance is expected to improve with combinations of two or more descriptors.

Importance of Spectral Detail in Musical Instrument Timbre

Michael D. Hall¹, James W. Beauchamp², Andrew B. Horner³, Jennifer M. Roche⁴; ¹James Madison University, USA; ²University of Illinois at Urbana-Champaign, USA; ³Hong Kong University of Science & Technology, China; ⁴University of Memphis, USA

PA007, Time: 14:30

Previous research has established that time-varying spectral envelope shape is critical to instrument timbre, with influences of both spectral irregularity and spectral flux (e.g., McAdams, et al.,

1999). This paper describes two studies which attempt to quantify the salience of various spectrotemporal parameters. Using a triadic timbral similarity ranking task, the first study examined the relative contributions of spectrotemporal parameters for centroid- and temporally normalized static and dynamic versions of ten E_4^b instrument tones (i.e., without and with flux). Rotations of MDS solutions indicated relevant spectrotemporal variation, but failed to converge on a particular parameter. For 2-D solutions for static tones, even/odd harmonic ratio correlated best ($R = 0.78-9$), while for 3-D solutions for dynamic tones, only spectral centroid variation yielded consistently high correlations ($R = 0.82-3$). The second study examined how timbre recognition and discrimination for six A_4 instrument tones were impacted by eliminating all but four or seven harmonics while retaining flux. In an MDS task listeners rated the certainty of whether pairs of tones were derived from the same instrument. Impoverished tones were generally recognized as the same instrument, with minimal impact on perceptual distance as long as original resonances were conveyed. Assessment of correlations between perceptual and acoustic dimensions was further aided by MDS coordinates in the absence of stress. These studies affirm the importance of spectral detail in judging timbral similarity while revealing that minimal detail may be sufficient for recognition.

Breath Noise and Timbre Modulation as Two Important Factors for the Synthesis of Wind Instrument Sounds

Michael Oehler¹, Christoph Reuter²; ¹Hanover University of Music & Drama, Germany; ²University of Vienna, Austria

PA164, Time: 15:00

In several experiments it became apparent that vibrato and timbre modulation are important parameters for the perceived naturalness of synthesized wind instrument sounds. However only small effects could be found for the factor breath noise in double reed instruments, where micro-modulations appear to be of particular importance.

It is supposed that generating instrument typical breath noise according to the pulse forming theory will lead to better ratings of the synthesized sounds. Further it is supposed that pulse forming based breath noise particularly improves ratings of instrument sounds that are based on the flow control principle (e.g. the flute).

An ANOVA showed ($p < .01$) that the different types of modulation significantly affect the perceived naturalness of the synthesized sounds. The stimuli with combined pulse width and cycle duration modulation (i.e. timbre modulation) were perceived significantly more natural than all other types of modulation (Tukey HSD, $p < .01$). Whereas there was no difference between the oboe and bassoon sounds in the condition with and without breath noise, a significant difference could be found for the clarinet (t-test, $p < .05$) and the flute sounds (t-test, $p < .01$).

On the one hand the results support earlier findings that source-affected timbre modulation is an important factor for the perceived naturalness of woodwind vibrato sounds, on the other hand it seems that breath noise helps perceiving synthesized woodwind sounds more natural, especially if the instruments are based on the flow control principle.

Audio Signal Analysis of Instrumental and Vocal Excerpts

Bruce Pennycook, Eugenia Costa-Giomi, Tanvi Joshi; University of Texas at Austin, USA

PA068, Time: 15:30

Timbre is a salient acoustical property in the auditory world of infants. Infants can discriminate between tones identical in frequency, amplitude, and duration but that differ in a single partial or in sound decay. They remember timbre characteristics of the music they hear for days, show preferences for specific instrumentations, and discriminate instrumental timbres in a variety of contexts. However, infants do not seem to discriminate the singing voices of unfamiliar women during the first year of life even though they recognize their mother's speaking voice soon after birth.

We analyzed the acoustical properties of instrumental and vocal stimuli used in timbre discrimination studies conducted with 7-, 11-, and 13-month olds. The stimuli consisted of a melody by Bach played with different instrumental samples or sung by different women with the syllable "lah." The purpose of our acoustical analyses was to investigate why infants could discriminate among the instruments but not the voices.

The audio signals were compared on a note-by-note basis and over the entire melody. Initial comparisons were undertaken with the Max/MSP *zsa library for real-time descriptors analysis* (Mikhail Malt and Emmanuel Jourdan, IRCAM) and then with various MATLAB routines for audio descriptor analysis.

Preliminary results show clear differences in the attacks of the various instrumental samples but remarkable similarities in those of the vocal samples. The analyses also reveal the striking acoustical similarities between the voices. Overall, we found that there was more acoustical variability *within* the vocal samples than within the instrumental samples. In other words, the quality of the tone was stable throughout each instrumental rendition of the melody but highly unstable within each vocal rendition. Additionally, we found that the acoustical variability *between* instrumental samples was larger for the instrumental than the vocal samples.

The results of the analyses provide a possible explanation for the findings of previous research about infants' difficulty in discriminating unfamiliar singing voices. When exposed to a vocal sample, infants had to process the high acoustical variability embedded in it, identify it as being produced by a single person, and then discriminate it from another vocal sample which was acoustically similar to the first one but was produced by another singer.

Tonal Perception 2

SMITH 120, 14:00 - 16:00, Monday 23 Aug 2010

Metrics for Pitch Collections

Andrew J. Milne¹, William A. Sethares², Robin Laney¹, David B. Sharp¹; ¹Open University, UK; ²University of Wisconsin-Madison, USA

PA162, Time: 14:00

Models of the perceived distance between pairs of pitch collections are a core component of broader models of the perception of tonality as a whole. Numerous different distance measures have been proposed, including voice-leading, psychoacoustic, and pitch and interval class distances; but, so far, there has been no attempt to bind these different measures into a single mathematical framework, nor to incorporate the uncertain or probabilistic nature of pitch perception (whereby tones with similar frequencies may, or may not, be heard as having the same pitch).

To achieve these aims, we embed pitch collections in novel multi-way expectation arrays, and show how metrics between such arrays can model the perceived dissimilarity of the pitch collections they embed. By modeling the uncertainties of human pitch perception, expectation arrays indicate the expected number of tones, ordered pairs of tones, ordered triples of tones and so forth, that are heard as having any given pitch, dyad of pitches, triad of pitches, and so forth. The pitches can be either absolute or relative (in which case the arrays are invariant with respect to transposition).

We provide a number of examples that show how the metrics accord well with musical intuition, and suggest some ways in which this work may be developed.

The Perceptual Grouping of Musical Sequences: Pitch and Timing as Competing Cues

Kamil Hamaoui, Diana Deutsch; University of California at San Diego, USA

PA122, Time: 14:30

This study investigated the effects of pitch and timing on perceptual grouping, and examined the relative strengths of grouping based on pitch and temporal proximity. Sequences of twelve tones were

constructed in which pitch proximity suggested one type of grouping (e.g., four groups of three tones each) and temporal proximity suggested an opposing type of grouping (in this case, three groups of four tones each). Sequences were presented that varied in the magnitudes of the pitch and temporal cues, and listeners indicated for each sequence whether they heard groupings of three or of four tones. It was found that the larger the pitch distance between groups, the stronger the perceptual grouping based on pitch. However, even in sequences with groups separated by large pitch distances, grouping occurred in accordance with the temporal cue at remarkably small values. It was also found that hierarchical pitch structure had a powerful effect on perceptual grouping, even in sequences where pitch proximity was also present as a cue. The implications of these findings are discussed.

The First Three Seconds: Listener Knowledge Gained from Brief Musical Excerpts

Joseph Plazak, David Huron; Ohio State University, USA

PA148, Time: 15:00

The human auditory system can rapidly process musical information, including: the recognition and identification of sound sources; the deciphering of meter, tempo, mode, and texture; the processing of lyrics and dynamics; the identification of musical style and genre; the perception of performance nuance; the apprehension of emotional character, etc. Two empirical studies are reported that attempt to chronicle when such information is processed. In the first exploratory study, a diverse set of musical excerpts was selected and trimmed to various durations, ranging from 50 ms to 3000 ms. These samples, beginning with the shortest and ending with the longest, were presented to participants, who were then asked to associate freely and talk about any observations that came to mind. Based on these results, a second main study was carried out using a betting paradigm to determine the amount of exposure needed for listeners to feel confident about acquired musical information. The results suggest a rapid unfolding of cognitive processes within a three-second listening span.

Does Musical Syntax Have Parts of Speech?

Ian Quinn; Yale University, USA

PA062, Time: 15:30

Tonality in music is frequently analogized to syntax in language. One might reasonably ask whether the analogy is deep or shallow. Studies of the mental representation of tonal syntax have assumed the analogy is shallow, and have not assumed that the elements of music form structures directly comparable to the structures formed by morphemes and words in language. In this study I test the depth of the analogy by applying to a musical corpus procedures from computational linguistics designed to discover parts of speech in language corpora.

The musical corpus consists of approximately 1000 four-part Lutheran chorales composed in the late sixteenth century (Oslander), the seventeenth century (Praetorius, Hassler, Schein, and Freylinghausen), and the first half of the eighteenth century (Bach and Quantz). Chords are represented not as sets of pitch-classes, but as sets of scale degrees: C-E-G-C in F major is equivalent to G-B-D-G in C major. Chords with different bass notes are considered non-equivalent: F-A-C-F is not equivalent to A-F-C-F, though A-F-C-F is equivalent to A-F-F-C. Importantly, any simultaneity of notes, regardless of consonance or tertian structure, is considered to be a chord.

Results suggest that chords, when represented as described above, can indeed be classified into categories that resemble parts of speech based on their patterns of usage in the corpus and its subcorpora. This finding has important implications for studies on the mental representation of harmonic syntax.

Workshop

KANE HALL - WALKER AMES ROOM
14:00 - 15:00, Monday 23 Aug 2010

The Evolution of Being Through Singing: A Practice of Ontological Transformation

Kay Kleinerman; Institute of Transpersonal Psychology, USA

WKT, Time: 14:00

This qualitative study explores the connection between participation in singing and the development of leadership qualities in women. The theoretical framework upon which this exploration is based is transformative learning, which is a process of making meaning of one's life experiences. My assertion is that singing can be a transformative learning process that enables a shift away from limiting perspectives and toward developing leadership qualities in women via experiential learning, learning within relationship, public performance and the inner journey of reflection and subsequent understanding that leads to individuation.

Women in every generation have fought for the right to be heard, to participate in the leadership of our society, to have voice both metaphorically and literally. Indeed, the word "voice" is often used as a metaphor for leadership, as well as for personal leadership development. Voice is linked to identity for the individual as she knows herself and presents herself in context of her environment, and identity emerges from self-reflection as well as communication with others. It emerges from hearing and being heard. Frequently though, female voices are dismissed or subverted. For women to claim their equitable rights as leaders and meaning makers in this society, they must know themselves, believe in themselves and make themselves heard.

Joyce (1996) addresses this when describing her work using singing as a teaching tool with women. She has found that the path of learning inherent in singing engenders a holistic experience that fosters self-knowledge and mastery, a sense of power, well-being and agency. These very qualities are key components of effective leaders.

Cognitive Skills

KANE 110, 16:30 - 17:30, Monday 23 Aug 2010

Is the Association Between Music Lessons and IQ Mediated by Executive Function?

E. Glenn Schellenberg; University of Toronto Mississauga, Canada

PA107, Time: 16:30

Musically trained and untrained 9- to 12-year-olds were tested on a measure of general intelligence and five measures of executive function, including tests of problem solving and planning (Tower of Hanoi), cognitive flexibility and rule switching (Wisconsin Card Sorting Test), attention and working memory (Digit Span), verbal fluency (Phonological Fluency), and the ability to ignore conflicting information (Sun-Moon Stroop). IQ was correlated positively with performance on each measure of executive function. The musically trained children had significantly higher IQs than their untrained counterparts even when family income, parents' education, parents' first language, and involvement in nonmusical out-of-school activities were held constant. The musically trained and untrained groups did not differ on four of five measures of executive function. The exception was a test of attention and working memory (Digit Span), which is also a subtest of measures of IQ. These results provide no support for the hypothesis that the association between music lessons and psychometric intelligence is mediated by executive function. Rather, the simplest explanation of the findings is that children with higher IQs are more likely than their lower-IQ counterparts (1) to take music lessons, and (2) to perform well on tests of executive function.

The Predictive Relationship Between Length of Musical Training and Cognitive Skills in Children

Kathleen A. Corrigan, Laurel J. Trainor; McMaster University, Canada

PA100, Time: 17:00

Previous research suggests that musical training improves cognitive skills such as spatial-temporal ability (Rauscher et al., 1997), reading (Douglas & Willatts 1994) and general intelligence (Schellenberg, 2004). However, few studies have examined the effect of musical training on a variety of different cognitive skills in the same children, and few have examined whether the length of musical training predicts cognitive skills. We tested 6- to 8-year-olds with a variable degree of musical training on (1) the Wechsler Intelligence Scale for Children (WISC) (2) the Word Identification and Passage Comprehension subtests of the Woodcock Reading Mastery Test — Revised, and (3) two attention tests we developed to measure executive control — the ability to attend to one aspect of a stimulus while ignoring irrelevant aspects — an auditory Stroop task and a visual flanker task. The results of the 24 children tested to date revealed that length of musical training (range 0.1 to 6.2 years) predicted children's reading comprehension scores and overall reading scores, even after accounting for age and the number of hours children spent reading per week. Length of musical training also predicted full scale IQ, and short-term but not working memory scores. Length of musical training did not predict auditory or visual executive control. Thus, we replicated correlations between musical training, IQ and reading scores, but our data suggest that these relations may not be mediated by attentional control.

Emotion 2

GOWEN 201, 16:30 - 17:30, Monday 23 Aug 2010

Music, Emotion, and the Heart: Affective Physiological Responses to Different Modalities of Vocal Expression

Margarita Mazo; Ohio State University, USA

PA084, Time: 16:30

The emotional experience of listening to music has been a subject of much discussion and debate, but less empirical testing. Furthermore, most of the empirical studies that do investigate emotional responses to music, work exclusively with music of the Western art tradition. Ethnomusicologists, meanwhile, propose that responses to music differ across cultures. Following Mazo (1994), this project combines empirical analysis with an ethnomusicological approach to music, focusing on culture-specific and culture-transcendent responses to Russian lament, a traditional form of expressing sadness and grief that could be either spontaneous or ritualized. As a traditional form to express sadness and grief, lament provides unique opportunity for an empirical study because it combines aspects of singing, speaking, and crying. It also shares some sonic properties with laughter, such as voiced exhalations with gasps and certain timbral features. Ethnographic data shows that the local people consider lament to be a highly emotional, disturbing, and, simultaneously, calming experience. This project aims to unravel this duality by contextualizing the physiological markers of emotional involvement. The project investigates respiration, pulse rate, heartbeat, and brain responses of subjects with different cultural backgrounds, listening to vocal expressions of sadness and grief. The present paper reports on one component of the project, a comparative study of heart rate (HR) and heart rate variability (HRV) while listening to Russian lament, speaking and singing.

Emotion and Preferred Timing and Dynamics Expressions in Music

Takayuki Nakata¹, Kana Ohzeki²; ¹Future University Hakodate, Japan; ²Mutoh Co. Ltd., Japan

PA026, Time: 17:00

The present study investigated effects of emotional states on preferred timing and dynamics expressions in music. By combining four levels (absent, small, medium, and large) of timing and dynamics

expressions, sixteen profiles of the first 22 bars of Chopin's Etude in E major were generated in MIDI format using "grand piano" timbre. Twenty-six adults (16 males and 10 females) chose the most desirable levels of timing and dynamics expressions for five imaginary contexts — live performance, high arousal-positive valence (joyful situation), high arousal-negative valence (painful situation), low arousal-positive valence (relaxed situation), and low arousal-negative valence (depressed situation). Results showed that optimal timing and dynamics expressions in Chopin's Etude in E major were associated with listeners' emotional states. Under two high arousal conditions (high arousal-positive and high arousal-negative), participants preferred low levels of modulation in timing parameters. On dynamics parameter, participants preferred higher levels of modulation in high arousal-positive than in high arousal-negative conditions. Under low arousal conditions, there were large individual differences in optimal levels for both timing and dynamics expressions. Findings of this study also suggest that timing expression may be an important parameter to consider when using music for pain reduction.

Timbre 2

GOWEN 301, 16:30 - 17:30, Monday 23 Aug 2010

Perceptual and Acoustical Analyses of Multitimbral Orchestral Chords

Roger A. Kendall¹, Pantelis N. Vassilakis²; ¹University of California at Los Angeles, USA; ²Columbia College Chicago, USA

PA116, Time: 16:30

Many studies have found correlates of both static and time-variant spectral variables to the perception of timbre in single-note and dyadic contexts. We previously conducted a series of perceptual experiments on multitimbral triads derived from common-practice harmony. Consonance and dissonance ratings were correlated with roughness calculations; results indicated chord quality primacy over timbral quality under many conditions. The present research extends psychoacoustical analyses of these multitimbral triads and includes multidimensional scaling of the perceptual similarity of pairs of triad orchestrations within chord type and across generator. Further, four-tone chords were orchestrated according to procedures articulated in orchestration texts: juxtaposition, interlocking, enclosure, and overlapping. Sampled instrument tones (Sibelius) of oboe, flute, and clarinet were used allowing comparison to previous research. In addition, non-traditional combinations including instruments such as saxophone and trumpet were created. Perceptual response tasks included ratings of similarity among pairs and identification tasks of individual instrument constituents within orchestrated structures. Issues of blend/fusion were investigated relative to these perceptual data. Acoustical analyses of spectral distribution and evolution were correlated with perceptual data and compared to previous measures and ratings of roughness, consonance and dissonance, with highly variable results.

Scaling Timbral Combinations: Theorizing Orchestration as a Musical Parameter

Eugene Narmour; University of Pennsylvania, USA

PA181, Time: 17:00

With the rise of opera in the eighteenth century, composers began to exploit timbre (tone quality), developing it into the art of orchestration ("instrumentation" largely referred to technical information). Thus music history converted a fundamental acoustical property into a swift and reliable index of musical style. Yet as an independent musical parameter, the lack of a scientific foundation for timbrally complex combinations has remained woefully under-theorized and distressingly under-analyzed in music theory.

To address these problems, I hypothesize a parametric scale of timbral combinations and then illustrate how ranked combinations might generate timbral structures. These realizations are analogous to the processes, reversals, and returns found in other musical parameters, as developed in the implication-realization model. All research on timbre shows that scaling, whether spectral, temporal,

intervallic, neurological, or perceptual, is fundamental toward its perception. In contrast, the parametric scaling presented here is diagnostic in the analytic-theoretic sense but of potential value in moving the psychological study of timbre to a higher cognitive level.

Of great interest is how orchestration interacts with other parameters. Whether it is employed congruently or noncongruently with respect to other parameters, timbral combinations produce strong affects and unmistakable moods. The parametric scaling hypothesized here thus connects timbral structuration to the explanation of musical emotion. Examples drawn from the classical orchestra repertory and from film music will demonstrate how timbral structures create mood and emotional affect, thereby shaping interparametric functions and thus our aesthetic experiences.

Rhythmic Modeling

SMITH 120, 16:30 - 17:30, Monday 23 Aug 2010

Expressive Timing via Metric Hybrids

Fernando Benadon; American University, USA

PA098, Time: 16:30

Timelines with unequal subdivision counts can have similar onset distributions. Two such timelines form an *analogous* pair. Their resemblance makes it possible for one of the timelines to stand as an expressive transformation of the other. A distance score and an onset displacement vector summarize the pair's expressive properties. Examples are provided in two contexts: compositional and analytical. In the former, gradual transformations result from tracing a path within a network of timelines. In the latter, metric ambiguity results from an analogous groove in Tinariwen's "Mano Dayak."

Implicit Learning of Rhythms Using a Serial Reaction Time Task

Josephine Terry, Barbara Tillmann, Catherine J. Stevens; University of Western Sydney, Australia

PA120, Time: 17:00

Expectations about musical structure may develop when regularities that define particular musical idioms are learned implicitly through mere exposure. Implicit learning (IL) occurs outside awareness and without intention. Consequently, learners have difficulty reporting the structural regularities of the material to which they have been exposed. IL of tone structures and timbre sequences has been reported but IL of rhythm has received less support. This paper reports IL of rhythmic structure using an auditory Serial Reaction Time Task (SRTT). Twenty-four participants identified pseudo-randomly chained syllables (Pa, Ta, Ka) presented during training (Blocks 1-5) according to a repeating pattern of inter-onset intervals (IOIs), giving the sequence a strongly-metrical (SM) rhythmic structure. A new SM structure was introduced in Block 6 (test) with Block 7 returning to the training structure. Participants were not informed of the rhythmic presentation of syllables. It was hypothesized that reaction times (RTs) to syllables would decrease with training and increase at the test block. As expected, RTs decreased across training blocks. An RT increase at the test block was observed only for the shortest IOIs (700 ms). During the final block, when the training structure was reintroduced, RTs to the shortest IOIs were significantly faster relative to the test block, indicating that performance in this final block had benefited from training. Post-tests revealed that most participants (88%) were unaware of the rhythmic presentation of syllables. These findings provide preliminary evidence of IL of rhythmic structure. A follow-up study investigating IL of figural grouping structure will be discussed.

Invited Symposium: Cross-species Studies of Music Cognition

KANE 110, 08:30 - 10:30, Tuesday 24 Aug 2010

Cross-Species Studies of Music Cognition

Aniruddh D. Patel; Neurosciences Institute, USA

SYM010, Introduction

Music is often regarded as a uniquely human phenomenon, yet many components of music cognition may have deep roots in brain functions shared with other animals. Comparisons of humans and other species in terms of music processing can give insight into how and why different components of music cognition evolved. This symposium brings together several researchers who are addressing cross-species studies of music cognition with research on monkeys, great apes, and parrots. The presentations will include empirical results and address a range of theoretical issues in this emerging research area.

The Cognitive Phylogenetics of Musicality: A Comparative Biological Framework for Analyzing Music Cognition

W. Tecumseh Fitch; University of Vienna, Austria

SYM011, Time: 08:30

It has recently become clear that many genes involved in "human-specific" aspects of cognition have clear homologues in both non-primate mammals and more distant vertebrate relatives (e.g. birds), paving the way for a much broader application of the comparative method to all aspects of cognition, an approach termed "cognitive phylogenetics". Examination of a wide variety of species enables us to draw conclusions about whether such mechanisms are homologs (descended from a similar mechanism in a shared common ancestor) or analogs (independently evolved, via convergent evolution). I will illustrate this approach by considering pitch and formant perception, and rhythmic entrainment, concluding that the former represent homologs and the latter analogs. We can use homologous mechanisms in a clade to reconstruct the mechanism in the common ancestor of that clade (remembering that, because all species evolve, no one species will perfectly preserve the ancestral state). Second, we can use analogous mechanisms to test adaptive hypotheses about why a particular mechanism evolved. Further study of convergently evolved traits (such as song in birds, marine mammals, and humans, or beat entrainment in humans and parrots) is particularly important. Another reason to study convergent evolution is the discovery of "deep homology", in which development of convergently-evolved mechanisms is controlled by homologous genes. Perhaps because of a bias towards the study of homology, our comparative dataset on music cognition remains distressingly sparse.

The Effects of Species-Specific Music on the Behavior of Cotton-Top Tamarin Monkeys

David Teie¹, Charles T. Snowdon²; ¹University of Maryland at College Park, USA; ²University of Wisconsin-Madison, USA

SYM012, Time: 09:00

We designed species-specific music to test our theory that music is based on human development, vocalizations, and perceptions. We predicted that by modifying musical characteristics to conform to the corollary aspects of another species we could create music that would elicit appropriate behavioral responses from the other species.

We studied cotton-top tamarins. The monkeys we tested had never been exposed to music and thus had no prior experience. We analyzed the structure of tamarin vocalizations and constructed musical pieces that we predicted would be appropriate for tamarins. We tested tamarins with two examples each of human affiliation-based and threat-based music and two examples each of tamarin affiliation-based and threat-based music.

We found distinctly musical elements in tamarin vocalizations of tamarins that parallel the features hypothesized to convey and influ-

ence emotional states in human music. Tamarins showed increased movement, orientation, and anxious and social behavior to tamarin threat-based music compared to tamarin affiliation-based music. In addition compared with relaxed baseline behavior, tamarins after hearing tamarin affiliation-based music became even more relaxed and increased foraging behavior. The only responses to human music were reductions in movement to human threat-based music and of anxious behavior to human affiliation-based music.

Working with the principles of "Human Music" theory we have shown that music can alter behavior in a nonhuman primate. Music that is characteristic of fear and threat contexts contains complex overtones, dissonant intervals and irregular rhythms. Music expressing order is characteristic of affiliation and contains pure tones, consonant intervals and regular rhythms. When incorporated into music at the pitch range and tempo appropriate for tamarins these features had predicted effects on behavior validating our theory with another species. The emotional contagion of music is effective with another species when compositions reflect an understanding of the acoustic templates of recognition of that species.

Psychometric Comparisons Between Humans and Rhesus Monkeys Across Time Production Tasks

Hugo Merchant, Wilbert Zarco, Luis Prado, Ramón Bartolo; UNAM at Juriquilla, Mexico

SYM013, Time: 09:30

Timed motor behavior is at the essence of higher-level cognition, from planning and collision avoidance to speech. This study aims to provide some evidence for graded continuity of timed motor behavior across primate species. Motor timing performance was compared between twenty human subjects and three Rhesus monkeys during both a synchronization-continuation and a single interval production task. These tasks involved tapping on a push-button to produce the same set of intervals (range: 450 to 1000 ms), but they differed in the number of cyclic repetitions (single vs. multiple) and the modality of the stimuli (auditory vs. visual) used to define the time intervals. The data showed that the variability and accuracy of rhesus monkeys was equivalent to that of human subjects during both the production of single intervals and the tapping synchronization to a metronome. Nevertheless, the monkeys' asynchronies were around 300 ms, suggesting that these animals were not able to synchronize their movement to a sensory metronome as humans do. In addition, human subjects were more accurate than monkeys and showed less timing variability. This was especially true during the self-pacing (continuation) phase of the multiple interval task, a behavior that may be related to complex temporal cognition, such as speech and music execution.

The Social Side of Avian Movement to Music

Aniruddh D. Patel¹, John R. Iversen¹, Irena Schulz²; ¹Neurosciences Institute, USA; ²Bird Lovers Only Rescue Service Inc., USA

SYM014, Time: 10:00

Human movement to music often takes places in social contexts. Some parrot species move rhythmically to music, but does social context play a role in this response, or is this an automatic response to rhythmic sound? We examined this issue via experiments with a sulphur-crested cockatoo named "Snowball". In one experiment, Snowball was presented with novel music with 1) no human in the room, 2) a human present, giving verbal encouragement only, or 3) a human dancing with Snowball. Videos were coded for the percent of each trial during which Snowball danced to the music. A second experiment provided Snowball with a human dance partner who wore closed-ear headphones while dancing. In some trials, Snowball and his partner heard the song at the same tempo, while in other trials, the human heard the song at a different tempo. The human always danced in synchrony with the music that they heard, and hence Snowball was either faced with tempo-congruent or tempo-incongruent dancing by his human partner. Video analysis focused on the effect of these conditions on Snowball's dancing. In both experiments, social context had a notable effect on Snowball's dancing. These findings indicate that social context matters in avian movement to

music. Indeed, it may be that animal movement to music builds an evolutionarily older facility for “social synchrony”, i.e., coordinated movement in the service of social bonding. If this is the case, then social synchrony may provide a necessary (though perhaps not sufficient) evolutionary foundation for rhythmic movement to music.

Personality

GOWEN 201, 08:30 – 10:30, Tuesday 24 Aug 2010

Effects of Personality and Genre on Music-Induced Movement

Geoff Luck, Suvi Saarikallio, Marc R. Thompson, Birgitta Burger, Petri Toiviainen; University of Jyväskylä, Finland

PA105, Time: 08:30

Previous work has identified relationships between the Big Five personality traits — Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism — and characteristics of music-induced movement. Musical genre is also thought to influence characteristics of a listener’s movement. Here, we develop these two strands of research by investigating in detail the effects of personality and musical genre on listeners’ movement. Sixty participants were presented with 30 musical excerpts covering a range of popular music genres — Techno, Pop, Rock, Latin, Funk, and Jazz — and their movements recorded by an optical motion capture system. Fifty-five postural-, kinematic- and kinetic-related movement features were computationally extracted from the movement data, and subsequently reduced to five Principal Components representing Local Movement, Global Movement, Hand Flux, Head Speed, and Hand Distance. A series of MANOVAs revealed that Openness was positively related to amount of local, but negatively related to amount of global, movement, while Conscientiousness was positively related to both. Extraversion, meanwhile, was positively related to amount of local movement, hand flux, and head speed, while Agreeableness was positively related to amount of local and global movement, and hand flux. Finally, Neuroticism was negatively related to amount of local and global movement, and hand flux. As regards genre, local movement was highest for Techno and lowest for Rock, global movement was highest for Latin and lowest for Techno, hand flux was highest for Rock and lowest for Techno, and head speed was highest for Rock and lowest for Latin. Several interactions between personality and genre were also identified.

Narcissism in Music Performance: Singers versus Instrumentalists

Sarah Kettner¹, Richard Parncutt²; ¹University of Music & Performing Arts Graz, Austria; ²University of Graz, Austria

PA153, Time: 09:00

Healthy levels of narcissism are related to self-worth directly influencing motivation (Sellin, 2003). Freud defined narcissism as subject libidinal investment linking it to an individual’s drive to survive. Kohut (1971) introduced the bipolar self-theory based on healthy ambitions and ideals originating from self-object “mirroring” (reflecting an infants evolving grandiosity). Self-directed love saves people from feeling dispensable thus increasing resilience. Many performers believe that healthy narcissism facilitates good stage performance (Hamilton, 1997). Singers differ from instrumentalists in that they embody their instrument. To increase an understanding of this difference, we researched narcissistic disparities comparing them to existing prejudices. The musicians’ narcissism measures were compared to three control groups (technical and psychology students; choristers) using the Narcissistic Personality Inventory (Schröder & Schütz, 2005) and compared with an original performance motivation questionnaire (Kettner, 2007). Participants were 424 students and teachers (273 women and 151 men) from Austrian universities and choirs. No significant difference was found between narcissism in singers and instrumentalists. In narcissistic subscales, singers had significantly higher *physical vanity* and *competence belief* than other groups, and men had higher *leadership*, *superiority* and *ambition* than women. *Frequency of performance* correlated

positively with overall narcissism. Performance majors scored higher on the subscale *ambition* than the music pedagogy majors. The data are consistent with the assumption that healthy levels of narcissism promote music performance quality. Improved understanding of narcissistic drives may help artists and teachers develop strategies to encourage self-esteem through healthy narcissism, and deal appropriately with narcissistic illness.

When and Why Do Musicians Outperform Non-Musicians?

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

PA002, Time: 09:30

Self-identified musicians and non-musicians were given instructions that they would complete a listening task that was diagnostic of musical ability. For Experiment 1, participants completed a relatively easy and straightforward task that involved judging whether pairs of melodies were the same or different. For Experiment 2, participants completed a much harder task that involved learning to classify tones that varied in frequency and duration according to an initially unknown disjunctive rule. In both experiments, participants either gained points for correct answers or lost points for incorrect answers. For the relatively easy task, musicians outperformed non-musicians when they lost points, but showed no differences compared to non-musicians when they gained points. In contrast, for the more difficult task, musicians outperformed non-musicians when they gained points, but showed no differences compared to non-musicians when they lost points. Results are consistent with the hypothesis that musicians adopt different goal orientations than non-musicians and that the tendency to favor one goal orientation over the other is modulated by task difficulty.

Emotion 3

GOWEN 301, 08:30 – 10:30, Tuesday 24 Aug 2010

Recognition is Different from Feeling: Experimental Evidence for Two Different Types of Emotional Processes in Music Using a Between-Subjects Design in a Web Experiment

Hauke Egermann¹, Stephen McAdams²; ¹Hanover University of Music & Drama, Germany; ²McGill University, Canada

PA097, Time: 08:30

According to Gabrielsson (2002), perceived emotions may differ from felt emotions induced by the music. Listeners might recognize an emotional expression in music that is not induced automatically. The first aim of our online study was to determine whether differences between felt and recognized emotions in music are significant in a between-subjects design. Second, we examined which factors modulate the relations between the two types of emotional processes (preference, empathy, and familiarity). 3,164 participants were randomly assigned to 2 groups, listening to 5 musical excerpts randomly selected from a set of 23 (30 sec each). After each excerpt, participants in one group rated recognized emotions whereas participants in the other group rated induced emotions. Data analyses suggest that significant differences exist between ratings of felt and recognized emotion. At the same time, the role of empathy during emotion induction could be described. Thus, the results of this study might facilitate the understanding of the emotion-induction mechanism called “emotional contagion”.

The Facial Feedback Hypothesis and Automatic Mimicry in Perception of Sung Emotion

Lisa Chan, Frank A. Russo; Ryerson University, Canada

PA104, Time: 09:00

An important non-verbal factor in communication of emotions in song is the use of facial expressions. Moreover, emotions may be communicated through mimicry of facial expressions. The current

study examined facial mimicry to neutral and emotional musical stimuli, and compared the effects of perception and imagery. In the perception-only condition, participants were asked to observe the performance, and make subjective ratings of emotion. In the imagery-only condition, participants were asked to imagine reproducing the performance as well as make subjective ratings of emotion. Facial mimicry was found in both conditions, and subjective ratings suggest that a higher degree of mimicry may have been present in the imagery condition. This preliminary evidence suggesting an important role of facial feedback in perception of singing may help understand the process of emotional communication in the context of singing.

The Role of Acoustical Cues in Decoding Emotion from Performance Expression and Compositional Structure

Lena Quinto, William Forde Thompson; Macquarie University, Australia

PA146, Time: 09:30

Emotional meaning can be communicated through performance expression and compositional structure. In this study, we assessed the capacity of musicians to communicate emotions through both these channels separately as well as combined. Three expressive conditions were created: performed only, composed only and performed and composed. To assess the role of performance expression, eight musicians performed emotionally neutral compositions with the intention to express the emotions of anger, fear, happiness, sadness, tenderness and neutral. They then composed melodies with the intention to express the same six emotions, controlling the number of notes. These melodies were put into MIDI format to create stimuli with neutral performance expression where only pitch and rhythm cues were available. Finally, musicians performed their own compositions. Performances were presented to 42 listeners who made forced choice judgements of the emotion conveyed. An acoustic analysis on the musical stimuli was conducted to identify the attributes used by musicians to convey emotion and by listeners to identify emotion. Results indicated that emotional decoding was dependent on emotion and expressive condition. The acoustic analysis confirmed that compositional structure and performance expression access somewhat different emotional cues.

Modeling Psycho-Physiological Measurements of Emotional Responses to Multiple Music Genres

Eduardo Coutinho; University of Sheffield, UK

PA154, Time: 10:00

We sustain that the structure of affect elicited by music is largely dependent on low-level psychoacoustic properties to which humans are particularly sensitive. In support of this claim, we have previously provided evidence that spatiotemporal dynamics in “secondary” music structural parameters resonate with two psychological dimensions of affect underlying judgments of subjective feelings: arousal and valence. In this article we extend those investigations in two aspects. Firstly, whilst previously we focused on western classical music, here we use a repertoire of multiple music genres in order to verify the extent to which the relationships linking sound features and emotion reflect general principles across music genres, or, instead, are genre-specific. The second aspect involves the evaluation of physiological cues as predictors of emotional responses to music. Akin to our previous findings, we will show that a significant part of the listeners’ reported emotions (more than 70% of the variance in arousal and valence) can be predicted from a set of six psychoacoustic features — loudness, tempo, pitch level, melodic pitch, sharpness and texture. The accuracy of those predictions is improved with the inclusion of one physiological variable — skin conductance response. Furthermore, we will demonstrate that the configurations of features with emotional meaning learned from pop, dance or rock music, are applicable to the prediction of emotional responses to classical and film music. This work contributes with new insights to the study of musical emotions, by showing that similar acoustic templates are shared across genres to convey emotional meaning.

Auditory Perception 1

SMITH 120, 08:30 - 10:30, Tuesday 24 Aug 2010

Multiple Fundamental Frequency Estimation Using Machine Learning and Frequency-Scaled Feature Vectors

Daniel Möhlmann, Otthein Herzog; Universität Bremen, Germany

PA160, Time: 08:30

A common problem in music transcription is the accurate identification of notes. Although various methods have been proposed in the past years to detect simultaneous notes in polyphonic music recordings, the results are still not satisfactory when many notes are present. Knowledge about the characteristic spectral patterns of instruments can be integrated to improve the results, e.g. by training an automatic classifier with examples from previously recorded notes and chords.

In this paper, we present a new method of learning note properties from examples, using a support vector machine classifier. Unlike other existing methods, we do not train separate classifiers for each note value, but try to learn a combined model that is independent of the specific fundamental frequencies. We demonstrate that our method is easily implemented and greatly improves the ability of the classifier to recognize previously unobserved note combinations, while maintaining the high accuracy of other existing methods.

Are Musicians Able to More Precisely Hear the Pitch of Their Own Instrument?

Allan Vurma; Estonian Academy of Music & Theatre, Estonia

PA076, Time: 09:00

The decisions about pitch relations can be shifted due to the timbral difference of the tones. The research looks at whether or not the timbre induced pitch shift phenomenon is affected by the high familiarity with the timbre of comparable sounds, or the presence of a few seconds lasting silence interval between them, which both could possibly facilitate the dissociation of pitch from timbre in the perception process. In the perception experiment, two groups of musicians (the violinists and the non-violinists) had to compare the pitch of pair-wise presented violin-tones with different artificially altered timbres (bright and dull). The tones in the pair could be presented either in immediate succession or with a 3.5 s silence interval between them; their F0-s could be equal, or the F0 of the second tone could be up to plus or minus 50 cents different from the F0 of the first tone. As a group average, the violinists and non-violinists were both susceptible to the timbre induced pitch shift in all applied experimental conditions. The lack of silence interval between the comparable tones increases, and the participants belonging to the group of violinists decreases the probable extent of timbre induced pitch shift. The order of presentation of timbres also affected the decisions of violinists but did not affect the decisions of non-violinists. Some “in tune” response distribution graphs showed double peaks, which refer to the possibility of two separate types of pitch perception.

Koechlin’s Volume: Perception of Auditory Size Among Instrument Timbres from Different Families

Frédéric Chiasson¹, Caroline Traube¹, Clément Lagarrigue¹, Bennett Smith², Stephen McAdams²; ¹Université de Montréal, Canada; ²McGill University, Canada

PA004, Time: 09:30

Charles Koechlin’s *Traité de l’orchestration* ascribes different dimensions to timbre than those usually discussed in multidimensional scaling studies: volume or *bigness*, related to auditory size, and intensity, related to loudness. Several studies show that auditory size perception exists for many sound sources, but none proves its

relevance for instruments from different families. For the two experiments of this study, we have developed a method and a graphical interface for testing volume perception. Samples of eight orchestral instruments, equalized in pitch but not in loudness, were used. Task 1 required participants to order eight sets of samples on a size (bigness) scale from “less big” (*moins gros*) to “bigger” (*plus gros*). Task 2 required them to evaluate the sounds’ volume on a ratio scale compared to a reference sample with a value of 100. Preliminary results of both experiments suggest that a common perceptual volume is heard, even by non-musicians, among instrument timbres from different families.

The Perception and Cognition of Basic Textural Structures

Alexander Rozin; West Chester University, USA

PA132, Time: 10:00

Composers, performers, and scholars consider texture to be a critical musical parameter that helps create musical forms and define genres such as fugue. Although many theorists refer to texture in their analyses or in their descriptions of musical style, no consensual definition of texture currently exists. In large part because of this, psychologists have not studied the emotional and structural importance of texture. The Implication-Realization model offers a framework to explain the perception and cognition of any musical parameter including texture.

In this paper, musical texture is defined as two distinct perceptual phenomena:

- the perceived density of a sonority, which derives from more basic parameters such as pitch height, dynamics, dissonance, and timbre; and
- the rate of change of the location of the primary melodic line (i.e., in the soprano, in the bass, etc.), that is, how frequently a listener’s attention moves from one voice to another (accounting for textural types such as “polyphony” and “homophony”).

The present model scales the nonclosural and closural functions of both components of texture. Tracking closure and nonclosure in various examples leads to predictions of experienced tension and resolution and hence facilitates empirical investigations of texture’s role in the creation of musical experience. The paper concludes with suggestions for experiments that could shed light on the functions of texture.

Evolution

KANE 110, 11:00 – 12:30, Tuesday 24 Aug 2010

The Origins of Music: Comparative Evaluation of Competing Theories

Richard Parncutt; University of Graz, Austria

PA155, Time: 11:00

Music evokes strong emotion but is not clearly adaptive: we can survive (or reproduce) without music, but not without food (or sex). Music is universally associated with changed states of awareness and spirituality. A convincing theory of music’s origins must explain such general observations (musical universals). It must be scientific (objective, empirically operationalizable, falsifiable) and convincing across relevant disciplines. No current theory (group survival, mate selection, cognitive skill acquisition, honest communication, territorial marking...) satisfies all criteria.

A promising approach combines empirical evidence from prenatal psychology and the anthropology/sociology of spirituality/ritual. The emergence of reflective awareness during the prehistorical “cultural explosion” enabled early humans to wonder about their origins. Spirituality (virtual agents) provided plausible answers. But why was it universally linked to music in ritual? Ellen Dissanayake has suggested that music emerged from (universal) motherese — suggesting that the origin of the music-spirituality link might be the mother as perceived by the prelinguistic child. The origin of motherese’s emotionally laden sound/movement vocabulary may be associations between prenatally perceived sound/movement patterns and maternal emotion. More generally, motor control, perception,

emotion and cognition have prenatal origins, and technological developments are creating new opportunities for relevant empirical research that can resolve old nature-nurture issues.

Given this background, competing theories of music’s origin will be systematically evaluated according to their underlying assumptions (focus on environment, behavior, physiology or experience?), approaches to hypothesis testing (observation, modeling, convergent interdisciplinary evidence?), and potential to explain specific universal features of music (structure, functions, contexts).

On the Evolutionary Origins of Laughter and Crying

David Huron; Ohio State University, USA

PA083, Time: 11:30

An integrated theory of laughter and crying is presented. It is suggested that both responses are ethological signals that evolved in a social context in response to fear from conspecifics. Following Kottler (1996), it is proposed that weeping is a signal of appeasement or helplessness that solicits empathetic altruistic acts at the cost of lower social status. Following Ramachandran (1998), it is proposed that laughter arises from suppressed fear (false alarm) that, in a social setting, signals the absence of threat. It is proposed that both signals evolved from a common ancestral behavior of punctuating exhaling that can be observed in dogs, spotted hyenas, and great apes. Musical repercussions are discussed.

Diverse Movements in Avian Dancing to Human Music

R. Joanne Jao¹, John R. Iversen², Aniruddh D. Patel², Micah R. Bregman³, Irena Schulz⁴; ¹University of Washington, USA; ²Neurosciences Institute, USA; ³University of California at San Diego, USA; ⁴Bird Lovers Only Rescue Service Inc., USA

PA093, Time: 12:00

Human movement to music is characterized by a rich gesture vocabulary (e.g., the different moves made by a person while dancing to a song). Yet we know very little about the diversity of other species’ gesture vocabulary when moving to human music. In the current study, we aimed to quantify the gesture vocabulary of a Sulphur-crested cockatoo (*Cacatua galerita eleanora*), “Snowball,” that dances to human music. In addition, we aimed to determine whether the proportions of different movement types varied depending on the song being heard. Snowball was videotaped while dancing to two novel songs: “Girls Just Wanna Have Fun” (tempo 120 BPM) and “Another One Bites the Dust” (tempo 110 BPM). No humans were dancing off-camera, thus eliminating immediate imitation as a source of gestural diversity. Rhythmic movements were analyzed frame-by-frame to characterize the number and duration of distinct types of movements and to conduct synchronization analyses. While little synchronization was found in this dataset, fifteen unique dance movements and two composite movements were identified (e.g., downward bobs, head-foot synchrony, side-to-side, etc). Gestures differed in their relative proportions, with seven gestures predominating overall. There were reliable differences between the songs in terms of the relative proportions of different gestures, which indicate that dancing is not a random chaining together of elements from the gesture vocabulary. The current findings demonstrate that a parrot can dance to music using several different types of gestures. These diverse dance gestures suggest a possible way to study creativity and expression by a nonhuman animal.

Music Therapy 2

GOWEN 201, 11:00 – 12:30, Tuesday 24 Aug 2010

Music Perception in Cochlear Implant Users

Ward R. Drennan¹, Grace Liu Nimmons², Robert Kang¹, Jillian Crosson³, Jong Ho Won¹, Jay T. Rubinstein¹;
¹University of Washington, USA; ²University of Iowa, USA; ³Cochlear, USA

PA012, Time: 11:00

The cochlear implant provides a sense of hearing to people with severe hearing loss. The device encodes sounds according to frequency (place), but largely fails deliver the fine spectral and timing information which contributes to good music perception. Engineering efforts are ongoing to improve music perception ability in cochlear implant users. The aim of this study was to develop a validated clinical test of music perception in cochlear implant users. Three tests were conducted to evaluate musical-pitch perception, timbre perception and rhythmless melody perception with 97 cochlear implant users at multiple sites. The pitch perception test used a psychophysical adaptive tracking procedure to measure the smallest semitone increase cochlear implant users can hear. In the timbre and melody tests, listeners identified items from a closed set. The timbre test required listeners to identify recordings of 8 different musical instruments playing the same melody at the same tempo. The melody test involved identification of 12 familiar melodies presented with synthesized piano tones in a repeated eighth-note pattern. This eliminated rhythm cues. Pitch discrimination difference limens averaged 2.64 semitones ranging from < 1 semitone to an octave. Timbre scores averaged 42.9% ranging from chance levels to 83% correct. Melody scores averaged 26.2% correct ranging from chance levels to 94% correct. The test allows clinicians to evaluate a large range of abilities with easy elements (pitch discrimination) and more challenging elements (melody discrimination), and provides a means to evaluate the effect of innovative treatments for severe hearing loss on music perception.

Musical Methods for Little Digital Ears — Musical Learning with Preschool Cochlear Implant Users

B. Petersen¹, R.H. Hansen¹, K. Beyer², M.V. Mortensen¹, Peter Vuust³; ¹Aarhus University Hospital, Denmark; ²Center of Guidance & Special Pedagogy, Denmark; ³Royal Academy of Music, Denmark

PA019, Time: 11:30

Prelingually deaf children who receive cochlear implants (CI) early can successfully develop age-appropriate language skills provided sufficient intervention measures are initiated. However, little is known about the music perception and enjoyment of these children, though the enhanced development in the central auditory system in early-implanted children may benefit music processing. We hypothesized that early-implanted, prelingually deaf children with CI's, who were exposed to group-oriented music learning activities, would increase their music discrimination skills and — as a potential near transfer effect- their linguistic skills too. We also expected to observe music enjoyment and increased musical activity as reported in parental feedback. Ten preschool CI users participated in weekly music sessions for three months, while eleven CI-children acted as controls. Music and speech perception was measured objectively at the beginning and end of the intervention period. For a musical performance reference, test data were collected from a group of normally hearing peers. *Results:* The children in the music group outperformed the controls in all tests. Their musical discrimination abilities improved particularly and approached the normal hearing level in timbre and pitch detection. The feedback from the parents indicated a positive impact on the children's musical interest and activity. *Conclusion:* Music learning activities can be beneficial for the auditory development of child CI users. In sum, the subjects' response, the feedback, and the test results indicate that music offers an enjoyable supplement to standard auditory-oral therapy, with a potential long term impact on the linguistic, cultural, social, and personal development of these children.

Sending Better Music to the Brain via Electrical Stimulation of the Auditory Nerve

Kaibao Nie, Xing Li, Les Atlas, Jay T. Rubinstein;
 University of Washington, USA

PA024, Time: 12:00

Profoundly deaf people can restore speech perception ability with cochlear implants which directly stimulate the auditory nerve by electrical currents. However, music perception with cochlear implants is a significant challenge partially because of the inability of existing sound processing strategies in encoding pitch and timbre cues. We have developed a novel sound coding strategy — Harmonic Single Sideband Encoding or HSSE — that can potentially deliver better musical pitch and timbre through electrical stimulation. Developing the new coding strategy was inspired by the recently-established coherent demodulation theory that transforms a band-limited signal to a low-frequency oscillating signal perceivable to cochlear implant patients. Two cochlear implant patients have been tested acutely with the HSSE strategy and both showed significant performance improvement in recognizing familiar melodies and perceiving musical instrument timbre in our closed-set evaluation experiments. These results suggest that the HSSE strategy holds high potential in restoring music perception with cochlear implants.

Performance 1

GOWEN 301, 11:00 – 12:30, Tuesday 24 Aug 2010

A Comparison of Blocked and Random Practice Orders with University Wind Players

Laura A. Stambaugh; Georgia Southern University, USA

PA176, Time: 11:00

Motor learning research defines a blocked practice order as highly repetitive (AAA BBB CCC) and contrasts it with a random practice order that constantly switch tasks (ABC CAB BCA). The purpose of this study was to examine the effects of these practice orders in a musical context. Thirty-eight university wind students practiced three seven-note tasks in either a blocked or random order during practice sessions on two consecutive days. All participants performed the same number of trials of each task; only the order of trials differed between practice groups. In addition, participants were asked to predict how well they expected to perform the examples on the following day (judgment of learning) by predicting the metronome speed for each task. Retention and transfer testing occurred twenty-four hours and one week after the second practice session. Performances were scored for pitch accuracy, speed, and temporal evenness. Between groups ANCOVAs compared group differences at the end of practice, twenty-four hour retention and one-week retention. Repeated measures ANCOVAs examined within group changes from the end of practice to the two retention sessions. Results of performance analysis will inform recommendations for practice and be examined in relation to previous music-motor research. Judgment of learning predictions were compared with actual performance results. These results will be discussed in the context of self-paced practice and cognitive load while practicing multiple tasks.

The Effect of Instrumental Experience on the Communication of Phrasing and Tension in Music Performance

Bryony Buck, Nick Bailey; University of Glasgow, UK

PA143, Time: 11:30

Movement in time is the very basis of human cognition. Through movement we communicate meaning, understanding our world and those around us. Music performance is seen to comprise groups of movements communicating a performer's structural and emotional interpretation of a score (Davidson, 1993; Vines, 2006; Gabriellson, 2009 for review). The ability to perceive coherent motion, social intent, and affect from point-light displays is applied here to piano performance to further assess structural information communicated through motion.

Three groups (pianists, other musicians, former musicians) are presented with point-light displays of piano performances by highly skilled pianists of two selected Chopin preludes. Each is presented in three modalities; visual-only, audio-only, audiovisual. Participants made continuous judgements of phrasing and tension during each presentation.

Preliminary results found participants could accurately assess phrasing structure, with relative contributions of audio and visual performances supporting previous findings (MacRitchie, Buck, Bailey, 2009). Practising musicians demonstrated slightly greater accuracy and reaction time than former musicians in the audio only condition. Responses reflect melodic and harmonic accents, with the largest perceived change for the A major prelude occurring at the climax in bar 12. Pianists' responses appear more precise than other participants, possibly reflecting empathetic muscle-memory activation.

These findings support and extend previous research, emphasising the level of structural information conveyed during piano performance in the absence of extraneous information. Findings suggest possible role of motor-memory and cognitive mirroring for pianist-audience members over other participants. Results have implications for both performance pedagogy, and understanding cognition and perception of music performance.

The Informal Vocabulary of Professional Musicians for Describing Expression and Interpretation

Erica Bisesi, Richard Parncutt; University of Graz, Austria

PA090, Time: 12:00

We explore and document the vocabulary of professional musicians for describing expression and interpretation. First, we will ask several advanced performance majors (piano and other instruments) from the University of Music and Performing Arts in Graz and several Italian experts in relevant areas (performance, teaching, journalism) to listen critically to commercially available interpretations of a selection of Chopin Preludes and spontaneously describe the interpretations in an interview. We will then analyze their vocabulary by grouping and categorizing terms describing expression and interpretation. Second, advanced piano majors will be asked to perform selected pieces in a fashion corresponding to categories found in stage 1. They will then be asked to explain at the keyboard how they achieved given expressive effects. Their discourse will be analyzed and the vocabulary developed in the first part extended. Finally, they will be asked to listen to selected recorded performances and rate them on scales derived from the categorization in stage 1. A factor analysis will yield a complementary categorization. Participants' statements will be analyzed by grounded theory to develop formulations for the strategies that they use to achieve specified expressive goals. Their vocabulary will be analyzed following methods developed for classifying timbre and wine. This is part of a recently funded project (FWF Lise Meitner Project No. M11 86 - N23) to mathematically model the expressive performance of accents in piano music.

Rhythmic Synchronization

SMITH 120, 11:00 - 12:30, Tuesday 24 Aug 2010

FMRI Investigation of Dynamic Cooperativity: Synchronised Finger Tapping with an Adaptive "Virtual Partner"

Merle T. Fairhurst¹, Petr Janata², Bruno H. Repp³, Johannes Stelzer¹, Peter E. Keller¹; ¹MPI CBS, Germany; ²University of California at Davis, USA; ³Haskins Laboratories, USA

PA006, Time: 11:00

Cooperation is intrinsic to our ability to work together towards a common goal such as music making. The following study presents a novel approach for studying brain activity related to cooperative synchronization between a human and a virtual partner, an adaptively-paced auditory metronome. Using functional MRI (fMRI) and by varying the virtual partner's level of cooperativity, we identify the neural correlates of dynamic, cooperative synchronization. Furthermore,

overlap between cooperativity and sensorimotor synchronization (SMS) is explored, and therefore a bridge between social cognition and simpler goal-directed action. This adaptively-paced tapping task provides a model with which to study the dynamic, cooperative relationship experienced when playing music in a group. Results presented both replicate previous findings and expand our understanding of the brain networks underlying SMS and cooperativity. These include shared fronto-parietal areas, implicated in executive function and simulation, and variable activation of medial and lateral subdivisions depending on levels of cooperativity.

Synchronizing with Metrically Ambiguous Music

Dirk Moelants; Ghent University, Belgium

PA011, Time: 11:30

A large majority of studies on tempo perception assumes that music has a clearly defined, unique metric structure. However, quite some music can be interpreted following different metric subdivisions. Typically a metric level that follows a ternary subdivision could also be interpreted as binary, leading to binary-ternary ambiguity, with tempi in a 3:2 ratio. To investigate both personal preferences in the interpretation of the meter and the musical structures affecting the ambiguity, a set of 120 musical excerpts, from a broad range of musical styles and in a wide range of tempi, was collected. Each of the excerpts contained a metric level that would normally be considered ternary by music theorists. 50 subjects tapped along with the perceived tempo of the excerpts. In a majority of the pieces, the responses show both ternary and binary interpretations, although the amount of ambiguity varies. We see a distinction between subjects that mostly prefer a binary interpretation and those who stick to a ternary interpretation. The ambiguity globally increases with tempo, but there is a remarkable 'dip' in the ambiguity around 180 bpm, where we see that the ternary interpretation is very dominant. This confirms findings that there is an optimal grouping interval of about one second (60 bpm) and corresponds to the typical tempo of a (Viennese) waltz. It also shows that simple embodied reactions to music can reveal interpretational differences between individual listeners.

Do Musicians Synchronize Better with a Prototypical Conductor?

Clemens Wöllner¹, Frederik J.A. Deconinck², Jim Parkinson³, Michael J. Hove³, Peter E. Keller³; ¹Royal Northern College of Music, UK; ²Manchester Metropolitan University, UK; ³MPI CBS, Germany

PA129, Time: 12:00

This study compares point-light representations of 12 individual conductors with morphs of their movements. Conducting as a musical profession is characterized by high degrees of individual differences. Orchestra musicians, on the other hand, adapt to new conductors swiftly and may therefore access mental representations of prototypical conducting movements, which they compare internally with the perceived movements of the current conductor. Previous research provides evidence that observers prefer prototypical (quantitatively averaged) over individual human faces, and rate the aesthetic quality of average musical interpretations higher than individual performances. We hypothesize that quantitatively averaged (morphed) movement patterns are perceived as prototypes and preferred over individual patterns in behavioral tasks and rating responses. Twelve conductors of different expertise levels were recorded with a Vicon motion capture system. Conductors produced typical beat patterns in two movement styles (legato and marcato). Point-light representations of the conducting movements were morphed across two different expertise groups and across all conductors (grand average). Participants watched videos of the point-light displays and synchronized with the prototypical and individual conducting movements. In addition, they rated the perceived clarity of the beat, the general quality and conventionality. Analyses focus on synchronization accuracy in the tapping responses, and relationships between behavioral and self-report measures. Findings shed light on differences between conductors in relation to prototypical conducting movements.

Invited Symposium: How The Hypothesis Lost its Spots

KANE 110, 14:00 - 16:00, Tuesday 24 Aug 2010

How the Hypothesis Lost Its Spots: Some Considerations When Formulating Arguments About the Evolutionary Origin and Function of Music

Ellen Dissanayake; University of Washington, USA

SYM020, Introduction

Although non-evolutionary suggestions about music's origin and function have existed from Antiquity, it is only within the past decade that scientifically-informed hypotheses about music (unlike those for language) have appeared. As we propose, refine, and evaluate hypotheses, let's try to avoid Kipling-esque Just-So Stories (while also realizing, as David Barash reminds us, that even good science often begins with a tentative, speculative answer to a question, which can lead to clarification of one's thinking). In proposing plausible music evolution hypotheses, some basic considerations are required. First, what feature in music is adaptive: the ability to entrain to an external pulse, recognize melodic contours, perform (drum, dance, sing), blend tones, feel musical emotion, or some other feature? What adaptive function(s) does that feature (or features) serve? Fields relevant to these questions include paleoarchaeology, human anatomy and neurobiology, the evolution of language, music-like communication in other animals, developmental psychology of musical and linguistic behavior in infants and young children, ethnomusicology, the art and practice of music itself and, of course, evolutionary theory and human evolution. With regard to the evolution of human behavior, Niko Tinbergen's "Four Whys" outline crucial considerations for those who wish to propose or evaluate evolutionary hypotheses about music. Speakers in this symposium will implicitly or explicitly have considered these subjects in their presentations and the final speaker will provide a forum for further discussion.

Did Neanderthals and Other Early Humans Sing? Seeking the Biological Roots of Music in the Territorial Advertisements of Primates, Lions, Hyenas, and Wolves

Edward H. Hagen¹, Peter Hammerstein²; ¹Washington State University, USA; ²Humboldt University, Germany

SYM021, Time: 14:00

Sexual selection, though probably responsible for the evolution of some aspects of human music, cannot easily explain several of music's most important characteristics. Music is often performed in circumstances, such as funerals, that have little directly to do with mating; it is frequently directed towards infants, children, and adult members of the same sex, whereas mating signals should almost always be directed towards adolescent and adult members of the opposite sex; and it is, in most cases, the cooperative product of a group, something not easily explained by individual competition for mates.

If music and dance were instead rooted in the territorial advertisements of coalitions, all of these would have straightforward explanations. Group defence of territories is found in many gregarious mammalian carnivores, including lions, canids, and hyenas. In these taxa, group members often mark territory boundaries and direct aggressive behaviour towards alien conspecifics found within the territory. Middle Pleistocene hominids, such as Neanderthals, occupied an ecological niche similar to such large carnivores, and so could be expected to share with them a suite of behavioural traits. Complex, coordinated vocalizations that function, at least in part, to advertise the group defence of a territory is a behavioural trait exhibited by several social carnivores, as well as many other gregarious animals, including primates. The evolution of human music and dance could be rooted in such coordinated auditory and visual territorial advertisements. Human proto-music, in essence, might have been functionally analogous to the howling of wolves.

Neo-Hedonism and the Plural Pleasures of Music

David Huron; Ohio State University, USA

SYM023, Time: 14:30

Art has no predefined function, which means that it can be harnessed to serve any number of purposes, including no purpose at all. Sometimes art is successful because it educates us, inspires us, challenges us, disturbs us, or even insults us. But if art didn't appeal to some people at least some of the time, it would cease to play much role in human affairs. Music commands a prominent place in personal experience, economic life, and collective culture. Music could not have achieved or sustained such prominence without tapping into some of the many pleasures afforded by biology. This paper offers a modern defense of the pleasure principle (neo-hedonism) and suggests that aesthetic philosophers have underestimated the complexity, richness, pervasiveness, and importance of pleasure. I suggest that even if music evolved in antiquity to promote a specific behavior (such as social bonding, or sexual selection) in its modern forms, music is structured to appeal to many forms of pleasure concurrently. Most complex behaviors (such as dinner parties or vacation travel) involve the activation of multiple pleasure channels simultaneously. Watching a sporting event with friends at a sports bar can combine gastronomic pleasures (glucose) with stimulant pleasures (nicotine), with depressant pleasures (alcohol) with social pleasures (oxytocin), with feelings of social (team) superiority (serotonin). Like the sports bar, music listening typically addresses a plurality of pleasures rather than a single unidimensional "aesthetic" pleasure.

Basic Considerations When Proposing Hypotheses About the Evolutionary Origin and Function of Music

Ellen Dissanayake; University of Washington, USA

SYM024, Time: 15:00

Although non-evolutionary suggestions about music's origin and function have existed from Antiquity, it is only within the past decade that scientifically-informed hypotheses about music (unlike those for language) have appeared. In proposing plausible music evolution hypotheses, some basic considerations are required. First, what feature in music is adaptive: the ability to entrain to an external pulse, recognize melodic contours, perform (drum, dance, sing), blend tones, feel musical emotion, or some other feature? What adaptive function(s) does that feature (or features) serve? Fields relevant to these questions include paleoarchaeology, human anatomy and neurobiology, the evolution of language, music-like communication in other animals, developmental psychology of musical and linguistic behavior in infants and young children, ethnomusicology, the art and practice of music itself and, of course, evolutionary theory and human evolution. With regard to the evolution of human behavior, Niko Tinbergen's "Four Whys" outline crucial considerations for those who wish to propose or evaluate evolutionary hypotheses about music. After description of these and other questions relevant to the subject, the speakers and audience are invited to engage in further discussion.

Music Therapy 3

GOWEN 201, 14:00 - 16:00, Tuesday 24 Aug 2010

Regaining Your Voice: Modified Melodic Intonation Therapy in Acute Care

Dwyer Conklyn; The Music Settlement, USA

PA040, Time: 14:00

Melodic Intonation Therapy (MIT) is a speech therapy technique developed for the treatment of stroke patients demonstrating expressive aphasia. Recent studies have demonstrated that through the use of MIT Broca's area becomes active and there is an increase in right brain cortical fibers connecting the homologous regions of Wernicke's area and Broca's area. This study seeks to determine the efficacy of a modified version of MIT in early stroke rehabilitation using a randomized controlled single blind pre/post test repeated measures design. Currently 24 of 40 subjects have been enrolled. Preliminary results indicate positive increases both within each session and between each session for the treatment group, while the

control group shows positive scores only within the second session and show an overall downward trend between sessions. In all but one condition the treatment group outperformed the control group. These early trends support the use of Modified Melodic Intonation Therapy as an early intervention for stroke patients with expressive aphasia.

Effects of Regular Involvement in Amateur Group Singing for People with Disordered Eating

Metaxia Pavlakou; Tufts University, USA

PA059, Time: 14:30

The research presented here examines the benefits of participation in amateur group singing for people suffering from eating disorders, in a non-clinical setting. Results of an initial investigation indicated that participation in a short community-based group singing workshop resulted in positive emotional, social, cognitive and behavioural outcomes relevant to the particular needs of the group members. A follow-up study, which involved the creation of a longer group singing workshop, investigates in more depth the impact of regular involvement in the group singing activity for this population. This qualitative study used a semi-structured interview as the main research instrument. The study highlights participants' process of familiarization and subsequent connection to each other, and the process of overcoming their inhibitions and learning to express freely through singing. It also identifies some negative aspects of the group singing experience, namely participants' initial discomfort, their difficulty to express themselves and relate to others that reflect some of the underlying issues that surround people with eating disorders, and demonstrates how these can be addressed by regular participation in group singing. Moreover, the study illustrates some of the unique elements of the group singing experience that can be of particular help to this population, such as the facilitation of emotional awareness, the safe identification and experience of feelings and the use of the voice as a medium of self-expression in the presence of other people. The findings provide a preliminary basis for the development of a model of the therapeutic role of participation in amateur group singing for this population.

An Autistic Boy's Spontaneous Singing and Related Emotional States

Stefanie Stadler Elmer, Salome Bachmann; University of Zurich, Switzerland

PA165, Time: 15:00

Particularly for autistic children, music offers an engaging means of self-expression, emotional communication and social interaction. In therapeutic settings, music has been shown to reduce clinical symptoms, structure and create predictable routines, enhance motivation, and create joint attention. This study aimed at understanding regularities in a 10-year-old autistic boy's emotion self-regulation and spontaneous singing. Since early childhood, he has been highly interested in music. Clinically diagnosed for severe autism, he has daily therapeutic treatment (Applied Behavior Analysis) where listening to music is used as the main reward. Two therapeutic sessions were video-taped and micro-analyzed. Three emotional states were distinguished and coded: expressions of joy (typically, anticipating music as a reward), of frustration (typically, after reward), and of neutral emotional states. The boy's positive and negative emotional states are clearly identified by increased body movements, facial and vocal expressions. His spontaneous singing was analyzed with respect to quantity and quality (themes, musical parameters). Results show a high and almost equal incidence of spontaneous singing during both, negative and positive emotional states, and less during neutral emotional states. During joyful feelings, singing varies widely with respect to themes and musical parameters, e.g. loudness, and it is adapted to the context, whereas during negative emotions, he uses a narrow repertoire, higher volume, and adapts less to the situation. He uses spontaneous singing to express positive and also negative arousal. Singing seems to help him coping with strong emotional states. It may work as an intrinsic self-regulative mechanism to express and structure high arousals.

The Effects of Participation in a Music Therapy Voice Protocol (MTVP) Group on the Mood of Individuals with Parkinson's Disease and Their Caregivers

Olivia Swedberg; Florida State University, USA

PA138, Time: 15:30

This study investigated whether participation in a Music Therapy Voice Protocol (MTVP) group affected the mood of individuals with Parkinson's disease ($n = 13$) and their caregivers ($n = 10$). All participants completed a pre- and post-test in which they rated their mood on four dimensions (*happy*, *energetic*, *tired*, and *sad*) of an adapted Visual Analog Mood Scale. Participants with Parkinson's disease were also asked during the pre-test to rate the current effectiveness of their medication and the severity of their symptoms on a 5-point scale. Participants then took part in a 50-minute MTVP group, which included opening and closing conversation, physical, facial, and breathing warm-ups, and vocal and singing exercises. Ratings of happiness and energy were highly correlated and were combined for subsequent analyses. Because a series of Mann Whitney U tests revealed no significant differences between individuals with Parkinson's disease and their caregivers on pre-tests or post-tests for any of the dimensions of mood, all participants were considered to be one group. A Wilcoxon Signed-Ranks test revealed a significant increase in happiness/energy, $W = -522$, $n = 41$, $p < .01$, from the pre-test to the post-test. While ratings of tiredness and sadness decreased, this decrease was not significant ($p > .05$). A Spearman Rank Order comparison showed that higher scores of functioning with regard to symptoms were correlated with happiness/energy scores, $r_s = 0.70$, $p < .01$. These findings suggest that participation in group MTVP may improve the mood of individuals with Parkinson's disease and caregivers.

Emotion 4

GOWEN 301, 14:00 - 16:00, Tuesday 24 Aug 2010

The Influence of Cognition and Emotion in Pianistic Performance

Marcia Kazue Kodama Higuchi¹, José Eduardo Fornari Novo Júnior², João Pereira Leite¹; ¹University of São Paulo, Brazil; ²University of Campinas, Brazil

PA158, Time: 14:00

Studies on musical learning have demonstrated a strong correlation between musicians' cognitive and affective attentions with variations of musical aspects of their performance. However, it is still unclear how these two types of attentions are expressed in musical features of pianistic performance. The present study aims to verify if cognitive or affective pianistic performances can be differentiated by acoustic descriptors. Recordings of nine pianists playing the same piece of music focusing only on cognitive aspects of musical structure, or paying attention solely on affective aspects, were analyzed by two musical descriptors. They are computational models that retrieve the musical features of Pulse Clarity (PC) and Articulation (AR). Results showed that all affective performances had less AR (more *legatos*, less *staccatos*) and less PC (less metric precision or more agogics) when compared to the cognitive performances. For affective and cognitive performances, AR mean values respectively are: 1006.1 and 1522.7, and PC mean values are: 2.2224 and 2.8296. Both p value were < 0.001 . Previous studies indicate that *legatos* and agogics (i.e. lack of pulsation) are important features related to expressiveness, indicating that affective performances have more expressive features than cognitive ones. Therefore, our findings suggest that it is possible to use a computational model built with descriptors, such as AR and PC, to aid the automatic classification of affective and cognitive performances.

Effects of Repetition and Phrase Structure on Emotional Arousal

Steven R. Livingstone¹, Emery Schubert², Janeen Loehr¹, Caroline Palmer¹; ¹McGill University, Canada; ²University of New South Wales, Australia

PA159, Time: 14:30

How do listeners' emotional responses to a musical work reflect musical repetition and phrase structure? We examine listeners' emotional responses to musical repetition and their correspondence with compositional structure. Based on the results, we develop a model for the automatic detection of phrase boundaries. Two musical works were examined: One highly similar in timing and loudness across sections, and a second that was less similar. Sixty-seven participants with varied musical training responded to orchestral recordings of the Pizzicato Polka (Strauss) and the Slavonic Dance (Dvorak); we focus first on the Polka, which contains the phrase structure (A1 B1 A'1, A2 B2 A'2). Arousal responses were correlated across musical sections to determine the correspondence for repeated, melodically related, and melodically unrelated musical phrases. Phrase boundaries were then detected automatically by incrementally correlating listeners' arousal responses for repeated musical sections. Participants' arousal ratings indicated a statistically high correlation between repeated musical phrases (A1 to A'1), a moderately high correlation for related phrases (A1 to A2), and a negative correlation for contrasting phrases (A1 to B1). The algorithm correctly detected 7 of the 8 phrase boundaries, with a low rate of false alarms. Similar results were found for the Slavonic Dance (Dvorak). Listeners' emotional arousal responses corresponded with musical repetition and with the phrase structure in two orchestral works. These findings suggest that listeners' emotional arousal corresponds to the larger-scale structure of the music and that they can be used as a tool for algorithmic detection of phrase structure.

Same or Different? Individual Differences in Differentiation of Self-Perceived Emotional Responses to Music

Joanna Kantor-Martynuska¹, Joanna Horabik²; ¹Warsaw School of Social Sciences & Humanities, Poland; ²Polish Academy of Sciences, Poland

PA161, Time: 15:00

This paper presents the results of a study concerning the role of attention and experience in the conceptual differentiation of emotional responses to music (ERM). The main purpose of the study was to test whether the ability to differentiate between emotional responses to music is associated with music-driven attention (MDA), formal musical expertise, and informal music experience (particularly, responsiveness to music). MDA was defined as the tendency to have one's attention unintentionally allocated on musical stimuli in a range of everyday contexts, mostly when music is irrelevant to the cognitive task at hand. To measure the differentiation of self-perceived ERM, 73 musicians and non-musicians listened individually to 190 pairs of 20 musical excerpts matched each-for-each. While listening, they were asked to make similarity decisions ("same" or "different") for their emotional responses to each pair of musical excerpts. In another session, participants filled out the *Music-Driven Attention Scale* (MDAS; a self-report measure of individual differences in MDA), and a musical experience questionnaire. Data were analyzed with reference to graph theory. MDA was independent of formal musical expertise and positively associated with musical experience. Differentiation of emotional responses to music was positively associated with MDA, formal musical expertise, and musical experience. These results suggest that the differentiation or granularity of self-perceived ERM is positively associated with 1) systematic musical training, 2) the importance of music for an individual manifested e.g., in his/her involvement in listening to music, and 3) a music-driven attention in a range of everyday contexts.

Domain-Specific or Not? The Applicability of Different Emotion Models in the Assessment of Music-Induced Emotions

Jonna K. Vuoskoski, Tuomas Eerola; University of Jyväskylä, Finland

PA064, Time: 15:30

The aim of this study was to compare the applicability of music-specific and general emotion models — namely the Geneva Emotional Music Scale (GEMS), and discrete and dimensional models — in the assessment of musically induced emotions. 102 participants listened to 16 film music excerpts, and rated the emotional responses evoked by the music excerpts. Intraclass correlations and Cronbach alphas revealed that the overall consistency of ratings was the highest in the case of the dimensional model. However, the GEMS model possessed both the weakest and some of the strongest items among all three models. The dimensional models also outperformed the other two models in the discrimination of music excerpts, and principal component analysis revealed that 89.9% of the variance in the mean ratings of all the scales (in all three models) was accounted for by two principal components that could be labeled as valence (inverted) and arousal. It can be concluded that there is further need to develop music-specific emotion models, as well as to test the existing models in a systematic manner.

Memory 1

SMITH 120, 14:00 - 16:00, Tuesday 24 Aug 2010

Plink: Thin Slices of Music

Carol Lynne Krumhansl; Cornell University, USA

PA169, Time: 14:00

Short clips (300 and 400 ms), taken from popular songs from the 1960's through the 2000s, were presented to participants in two experiments to study the detail and contents of musical memory. For 400 ms clips, participants identified both artist and title on more than 25% of the trials. Very accurate confidence ratings showed that this knowledge was recalled consciously. Performance was somewhat higher if the clip contained a word or part-word from the title. Even when a clip was not identified, it conveyed information about emotional content, style and, to some extent, decade of release. Performance on song identification was markedly lower for 300 ms clips, although participants still gave consistent emotion and style judgments, and fairly accurate judgments of decade of release. The decade of release had no effect on identification, emotion consistency, or style consistency. However, older songs were preferred suggesting the availability of recorded music has altered the pattern of preferences previously assumed to be established during adolescence and early adulthood. Taken together, the results point to extraordinary abilities to identify music based on highly reduced information.

Neural Correlates of Music Learning: An EEG Study of Musical Memory

Kat Agres¹, Jason Zevin²; ¹Cornell University, USA; ²Weill Cornell Medical College, USA

PA180, Time: 14:30

Most electroencephalography (EEG) research examining music perception has focused on observing differences in the auditory evoked response (AER) to novel or familiar music. Components of the AER, such as the ERAN (early right anterior negativity), have been shown to reflect knowledge of musical structure. Relatively few studies, however, have investigated the neural responses underlying learning as music becomes more familiar over time (with repeated exposure), and how brain responses change accordingly with the increasingly detailed musical representation that is formed in memory. The present study used Irish folk tunes to explore the role of familiarity on the amplitude of obligatory components of AERs, such as the N1. It was hypothesized that amplitude would gradually decline because fewer neural resources would need to be recruited as familiarity increased. Over the course of learning a novel tune, the listener develops a predictive model that becomes progressively more detailed

and accurate. Once the tune becomes familiar, bottom-up responses become weaker because the listener is predicting the forthcoming music. To determine how musical structure affects predictability and neural efficiency, randomizations of the tunes (which lacked tonal and metrical structure) were also repeatedly presented to listeners. Preliminary results show that increasing familiarity with structured tunes results in decreased obligatory sensory responses, whereas no such effect is observed for repeated random 'tunes', for which it is unlikely that a predictive model would be learned from brief exposure.

The Influence of Music on Memory for Images

Sherilene M. Carr, Nikki S. Rickard; Monash University, Australia

PA051, Time: 15:00

Enhanced cognitive performance after listening to music is believed to be mediated by enjoyment-related arousal, which is consistent with arousal mediation of performance in terms of an inverted U shaped relationship. In non-music research, emotionally salient events elicit an adrenal arousal response, detectable by heart rate and skin conductance changes, that modulates the consolidation of memory. It is possible then that enhanced cognitive performance in response to music is mediated by emotional arousal. However, as physiological changes in music-cognitive performance research have typically not been recorded, this relationship can only be speculated. Music is capable of eliciting physiological changes consistent with emotion, as such, this study was designed to explicitly test whether arousing music could enhance memory. In a repeated measures design, 15 males and 22 females (18–49 years) listened to two self-selected enjoyed music tracks and two tracks to which they were indifferent. Physiological changes were measured continuously. A radio science show excerpt was used as a no-music control. After each condition, participants viewed a collage of 24 international affective picture system (IAPS) images. Memory for details within all 5 collages was tested after a 30 minute delay. Results clearly support the arousal hypothesis. Images presented after music that induced high arousal were better remembered, irrespective of enjoyment or picture valence. The effect was further moderated by motivational type, with memory enhanced only for participants high on the BAS Reward Motivation scale. Findings are discussed in terms of emotional arousal in response to rewarding cues.

The Effect of Music-Induced Emotion on Long-Term Word List Retention

Sarah Judde, Nikki S. Rickard; Monash University, Australia

PA156, Time: 15:30

Learned information is consolidated over time, allowing recently formed memories to be strengthened or weakened (modulated) for some time after acquisition. Although post-learning arousal treatments have been found to modulate memory consolidation, examination of the temporal parameters of these effects in humans has been limited. Further, whether emotionally arousing music can modulate memory in this way is not yet known. In the current study, 127 participants learned a neutral word list and were exposed to either a positively or negatively arousing musical piece following delays of 0, 20 or 45 minutes after learning. One-week later, participants completed a long-term memory recognition test, followed by Carver and White's (1994) approach/avoidance personality scales. Retention was significantly enhanced, regardless of valence, when the arousal manipulation occurred at 20 minutes, but not immediately or 45 minutes, post-learning. Further, the effect was moderated by BAS 'drive' approach sensitivity, with memory modulated only in participants high on this scale. The selective facilitatory conditions of music identified in the current study (timing and personality) offer valuable insights.

Amusia

KANE 110, 16:30–17:30, Tuesday 24 Aug 2010

Intonational Identification-Imitation Dissociation in Congenital Amusia

Fang Liu¹, Aniruddh D. Patel², Adrian Fourcin³, Lauren Stewart¹; ¹Goldsmiths University of London, UK; ²Neurosciences Institute, USA; ³University College London, UK

PA121, Time: 16:30

Congenital amusia is a neuro-developmental disorder of musical perception. A recent study reported that amusics were able to imitate the correct direction of a heard pitch interval, despite their inability to identify its direction (Loui et al., 2008). This study examines whether a similar dissociation holds in identification and imitation of intonational pitch contours, and considers the relationships between speech production, intonational contour identification/imitation, and sensitivity to changes in pitch. Sixteen British amusics and sixteen matched controls completed a set of speech production, statement-question identification/imitation and pitch threshold tasks. The speech production tasks involved reading a story and producing three sustained vowels. The statement-question identification/imitation task required participants to identify/imitate statements and questions that differed primarily in pitch direction of the final word. The pitch threshold tasks assessed participants' thresholds for detection of pitch change and discrimination of pitch direction. Despite having normal speech production and laryngeal control, amusics showed significantly worse performance than controls on both identification and imitation of statements and questions. While both groups (particularly the amusic group) showed facilitation for imitation versus identification, a few participants imitated the goal rather than the form of a small proportion of questions. Finally, a negative association was found between amusics' pitch-direction discrimination thresholds and their performance on statement-question imitation. In summary, compared with controls, a strong dissociation between statement-question identification and imitation was found for amusics. The findings support previous evidence that pitch processing in language and music involves shared mechanisms.

Memory for Pitch in Congenital Amusia: Beyond a Fine-Grained Pitch Discrimination Problem

Victoria J. Williamson, Lauren Stewart; Goldsmiths University of London, UK

PA177, Time: 17:00

Congenital amusia is a developmental disorder that affects the perception and production of music. Since the introduction of a standardised diagnostic tool in the form of the Montreal Battery for the Evaluation of Amusia (MBEA; Peretz, Champod & Hyde, 2003) congenital amusia has been largely associated with deficits in the detection of pitch change and discrimination of pitch direction (Foxton et al. 2004; Hyde & Peretz, 2004). However, recent reports have suggested that pitch memory deficits may also play an ancillary role in the disorder (Gosselin, Jolicoeur & Peretz, 2009; Tillmann, Schulze & Foxton, 2009; Williamson et al., 2010). The present study aimed to measure memory capacity (span) for pitch sequences in individuals with amusia and matched controls. We also tested the capacities of verbal short-term memory (digit sequences) and working memory, in order to determine whether the pitch memory impairments seen in amusia reflect a pitch-specific short-term memory deficit or a more general memory problem. Analogous adaptive-tracking procedures were used to generate tone and digit spans using stimuli that exceeded psychophysically measured pitch perception thresholds, and an automated operation span task was used to measure working memory. Individuals with amusia had significantly smaller tone spans, whereas their digits spans were of equivalent size to those of controls. Working memory deficits were seen in only a small subgroup of individuals with congenital amusia. These findings support the existence of a pitch-specific component within short-term memory that is selectively compromised in congenital amusia.

Music Therapy 4

GOWEN 201, 16:30 - 17:30, Tuesday 24 Aug 2010

Finding the Words for It: How Alexithymia Can Account for Apparent Deficits in the Ability of an ASD Group to Describe Their Emotional Responses to Music

Rory Allen; Goldsmiths University of London, UK

PA014, Time: 16:30

It is common practice, when studying musically evoked emotions in listeners, to use a self-report format to measure their responses. This paper points out that the outcome of such studies will be affected by individual variability in participants' ability to verbalize their emotions (type-II alexithymia). It presents results from new research, comparing a sample of high-functioning adults with ASD to a matched control group on their emotional responses to a set of musical items. The study, which included both self-report and physiological measures of emotional responsiveness to music, as well as a separate measure of type-II alexithymia, demonstrates that an apparent reduction in emotional responsiveness to music in the ASD group can be accounted for by the higher mean level of alexithymia in that group. The implication of this, that the ASD group is essentially unimpaired in emotional responsiveness, is confirmed by the lack of group difference in the physiological responses to music. These findings suggest that future studies of musical emotions using self-report measures to compare groups whose mean alexithymia scores may differ, should not be interpreted as proving the existence of group differences in emotional responsiveness unless the alexithymia factor has also been taken into consideration.

Music Therapy with Children with ADHD: Attention and Hyperactivity Regulation Through Music Therapy

Suvi Saarikallio, Pirkko A. Paananen, Jaakko Erkkilä; University of Jyväskylä, Finland

PA163, Time: 17:00

Music has been shown to affect attention and activity levels, and music therapy methods are relatively often used in the treatment of people with ADHD. However, the therapeutic interventions and the musical activities that may underlie the positive effects are clearly under-researched. The current study aimed at identifying elements and practices of music therapy that are most successful with children with ADHD. Five children, aged 10-12 years, participated in twelve music therapy sessions, 45 minutes each. The sessions were video recorded and both qualitative and quantitative methods were used in analyzing the episodes consisting of various music therapy activities and interventions. The aim of the analysis was first to assort the most successful as well as the most unsuccessful episodes within the sessions, and then to find out the determinants and causes for them. The effect of music therapy activities and interventions were investigated in relation both to group behaviour and individual responses. We found out that clearly structured, rhythm-based activities and singing were most often successful, in particular within a setting where therapists and children were in close physical proximity to each other (in circle, for instance). On the other hand, unstructured activities such as free improvising with loud band instruments and with more physical distance to each other easily led to chaotic behaviour. Furthermore, complex verbal instructions easily caused restlessness and most often did not lead to understanding of a task, whereas activities based on short instruction and modelling of an activity were more successful.

Improvisation

GOWEN 301, 16:30 - 17:30, Tuesday 24 Aug 2010

Segmentation in Improvisation: Computational, Perceptual and Physiological Analyses

Freya Bailes, Jon Drummond, Roger T. Dean; University of Western Sydney, Australia

PA044, Time: 16:30

Musicological analyses of both acoustic and electroacoustic improvisations reveal structures of segmentation and transition, and a feature found to facilitate segmentation is sound intensity. But it is important to determine what segments performers and listeners perceive. The current project aimed to determine computationally and perceptually what musicians and listeners generate and access in the sound structure of improvised music.

Expert keyboard improvisers performed a series of ten short improvisations using a MIDI grand piano. The first and last improvisations in the series were free, while the intermediate improvisations were supposed to include particular referent features such as dynamic contrast. Improvisations were recorded audio-visually and as MIDI output. Skin conductance was monitored throughout the performance at sites on the performer's left foot. Subsequently, performers were asked to listen back to extracts of their own improvisations over headphones, and to indicate when they heard a change in sound by moving a mouse for the duration and magnitude of the change. It was hypothesized that listeners' perceptions of sonic structure would coincide with musicological and computational segmentation of the improvisations.

Results show the successful computational segmentation of performances with respect to the improvisational referent. Analyses of skin conductance levels and perceptual ratings of change in sound will be presented to illustrate their alignment with this segmentation. Finally, the lag structures of physiological and perceptual responses will be informative as to the planning and salience of different musical parameters in real-time, and this will be modeled in detail using multivariate time series analysis.

The Search for Common Time: Temporal Negotiations Between Jazz Musicians

Rebecca J. Evans; Paris Ouest Nanterre La Defense University, France

PA118, Time: 17:00

Temporal negotiation in a jazz context implies not only the coordination of rhythmic motifs, but also of the intrinsic, malleable and shared pulse, manipulated both in the present moment, and in relation to the musical whole. In jazz, even as the tempo remains 'constant', fine-scale rhythmic delivery becomes just as important as tone, pitch or loudness. Indeed jazz musicians possess an incredibly heightened sensitivity to and control of such musical timing for both expressive and communicative purposes. Musicians' roles, responsibilities and style, musical culture, improvisational rules and etiquette, and phenomena revealed through studies of synchronous tapping such as negative first-order correlation and drift all contribute to the process of musical creation in time. To complicate matters further, music, to be personally involving and socially valuable, must be "out of time". For these reasons, audio recordings were obtained of a Parisian group's studio rehearsals of four versions of a contemporary jazz composition, chosen because an argument arose between the bassist and the drummer in relation to their timing. Drum and double bass tracks, corresponding to the argument's two authors, were used to investigate musical interaction, through analysis of musical song structure, tempo and inter-musician asynchrony, or participatory discrepancies. Results are discussed in relation to research on musical grounding techniques and communicative musicality, in the search for a deeper understanding of common time — what it means to play 'good time' and groove together in interactive musical performance.

Memory 2

SMITH 120, 16:30 - 17:30, Tuesday 24 Aug 2010

Liking and Memory for Music: Effects of Effortful Encoding

Stephanie M. Stalinski, E. Glenn Schellenberg; University of Toronto Mississauga, Canada

PA115, Time: 16:30

Previous research has found that more-liked music excerpts are remembered better than excerpts that are disliked or responded to neutrally. One possible explanation for this effect is that excerpts that are more-liked may be either spontaneously or effortfully processed in a deeper manner, leading to stronger memory traces and better subsequent recognition. We investigated this possibility in two experiments. Participants in both experiments initially heard 24 music excerpts and rated how much they liked each excerpt on a scale from 1 (dislike a lot) to 7 (like a lot). Subsequently, they heard the same 24 excerpts as well as 24 previously unheard excerpts and made recognition and confidence judgments. Participants received no specific study instructions in Experiment 1. In Experiment 2, participants were told that their memory for the excerpts would be tested later and that in order to remember the excerpts, they should visualize a detailed and unique place where they would be likely to hear that kind of music. Participants in the visualization experiment had better recognition memory than participants without such instructions. In both experiments, excerpts that were rated as more liked (ratings of 6 or 7) were remembered better than excerpts that were disliked (ratings of 1 or 2) or neither liked nor disliked (ratings of 3-5), and the effect of liking on memory for music was not influenced by task instructions at time of encoding. Because the liking effect was not eliminated when deep processing was encouraged for all items, music preferences appear to affect memory processes at a more unconscious level.

Working Memory and the Perception of Hierarchical Tonal Structures

Morwared Farbood; New York University, USA

PA117, Time: 17:00

This paper examines how the limitations of working memory affect the perception of hierarchical tonal structures. Within this context, it proposes some modifications to Lerdahl's tonal tension model in order to better explain certain experimental data. Data from a study on the perception of musical tension were analyzed using regression analysis that took into account various parameters including harmonic tension, melodic contour, and onset frequency. Descriptions of how these features change over different time spans ranging from 0.25 to 20 seconds were used in an attempt to identify the best predictors of the general tension curve. The results indicate that change in harmony best fit the tension data when the time differential was between 10-12s, while other features best fit the data at a time differential of around 3s. This suggests that the memory of tonal regions is retained for a considerably longer period of time than is the case for other musical structures such as rhythm and melodic contour.

Audio Visual

KANE 110, 08:30 – 10:30, Wednesday 25 Aug 2010

Convergent Methods in the Study of Visual and Musical Components in Film

John Hajda; University of California at Santa Barbara, USA

PA037, Time: 08:30

The purpose of this research is to utilize convergent methods to study the roles of musical and visual elements in the perception of genre, mood and plot expectation in opening credits. 64 stimuli were generated from opening credit segments of Hollywood feature films. There were 8 original clips — two from each of the following genres: adventure, comedy, horror and romance — and 56 “fake” clips, in which the visual elements from one film were combined with the musical underscoring from a different film. Each stimulus contained visual scenes, matted credits and musical underscoring. In an overt, quantitative design, subjects rated (1) the degree to which each stimulus “belonged” to one of the four canonical genres or (2) mood of each stimulus and effectiveness of audio/visual combinations. In a covert, qualitative design, each subject was presented with four stimuli, with no repeats of visual scene or musical underscoring. Also, the subject was not informed a priori that the clips may be fakes. After each stimulus presentation, the subject wrote the genre to which the film likely belonged and wrote a story (plot continuation) about what might happen immediately following the presented clip. Analyses showed that, in almost all instances, both the quantitative genre and mood data and qualitative plot expectations differentiated stimuli based on the musical underscoring, regardless of the visual components. The converse was not true. These findings suggest that, in many films, one’s first impression of genre, mood and narrative is based on the musical, not visual, domain.

Perception of Emotion Portrayal in Cartoons by Aurally and Visually Oriented People

PerMagnus Lindborg; Nanyang Technological University, Singapore

PA066, Time: 09:00

This article reports results from a study of perceived emotion portrayal in cartoons by different groups of subjects. A set of audiovisual stimuli was selected through a procedure in two steps. First, 6 ‘judges’ evaluated a large number of random snippets from all Mickey Mouse cartoons released between 1928 and -35. Analysis singled out the five films ranking highest in portraying respectively anger, sadness, fear, joy and love/tenderness. Subsequently, 4 judges made a continuous evaluation of emotion portrayal in these films, and six maximally unambiguous sequences were identified in each. The stimuli were presented to two groups (N=33), one in which the subjects were expected to be visually oriented, and one where they would tend to be more aurally oriented, in three different ways: bimodally (original) and unimodally, i.e as an isolated sound or video track. We investigated how group and modus conditions influenced the subjects’ perception of the relative intensity of the five emotions, as well as the sense of realism portrayed in the cartoon clips, and how amusing they were found to be. Finally, we developed an estimate for *visual-aural orientation* as a linear combination of select self-reported variables, and tested it as a predictor for the perception of medium dominance.

The Influence of a Visual Performance Component on Preference Ratings in Response to Complex Musical Sound

Scott D. Lipscomb, Guerino Mazzola, Erkki Huovinen; University of Minnesota, USA

PA058, Time: 09:30

The purpose of the present study was to determine whether the presence of a visual performance component enhances to a significant degree the music listening experience of the listener-viewer

in response to examples varying in the level of complexity, genre (jazz and art music), and stimulus presentation condition (audio only, audio with algorithmic visualization, or audio with visual performance). Results of two previous studies revealed outcomes contradicting initial hypotheses. In Lipscomb & Mazzola (2007), participant responses assessing listener experience and preference revealed no significant influence of the visual component. Lipscomb & Mazzola (2008) revealed a significant main effect for audio-visual condition, but post-hoc analysis showed that the only difference was between the conditions including the visual performance and visualization. Surprisingly, the visual performance data resulted in *lower* preference ratings than the visualization. Important methodological modifications were made to enhance the ability to address effectively the present research questions. A block design was utilized so that every participant experienced excerpts not only of each musical genre (jazz and art music), but stimuli representing each of the three A-V conditions (audio only, audio with algorithmic visualization, or audio with visual performance). The number of verbal response scales was reduced, so that a series of items could be added that directly addressed respondent evaluation of influence related to the visual component. Results of this revised research design will be presented, along with relevant implications for introducing music in the classroom that falls outside the “comfort zone” of students enrolled.

Cross-Cultural

GOWEN 201, 08:30 – 10:30, Wednesday 25 Aug 2010

Cross-Cultural Similarities in Polyphonic Timbre Perception

Vinoo Alluri, Petri Toiviainen; University of Jyväskylä, Finland

PA048, Time: 08:30

Polyphonic timbre has been demonstrated to be an important element for computational categorization according to genre, style, mood, and emotions. In the present study, we investigated the perception of polyphonic timbre in a cross-cultural setting. Indian and Western non-musicians rated Indian and Western popular music excerpts (1.5 sec, n=200) on 8 scales namely ‘Colorful-Colorless’, ‘Warm-Cold’, ‘Dark-Bright’, ‘Empty-Full’, ‘Soft-Hard’, ‘Strong-Weak’, ‘High Energy-Low Energy’ and ‘Acoustic-Synthetic’. Acoustic features were computationally extracted from the stimuli and were used to predict the perceptual data. The solutions from factor analyses were found to be highly similar for both the Indian and Western participants. Moreover, the acoustic features that predict the perceptual dimensions were similar across the two participant groups. Furthermore, both the perceptual dimensions and their acoustic correlates matched closely with the results of a previous study performed using Western musicians as participants. The present findings imply that there might exist universals in polyphonic timbre perception.

Phonetic Perception of Instrumental Sounds: Example of Church Bell

Rytis Ambrazevičius¹, Žanna Pärtlas²; ¹Kaunas University of Technology, Lithuania; ²Estonian Academy of Music & Theatre, Estonia

PA042, Time: 09:00

Phonetic analogies of instrumental timbres have previously been the subject of some discussion. Our recent studies concentrated on the phonetic perception of bell sounds. The data for the statistical generalization was based on traditional Lithuanian vocal imitations of bells (the layer of folklore) and the results of the imitation experiment where participants were asked to write down the phonetic associations (nonsense syllables) evoked by the bell strokes presented. The present paper is an extension of the above-mentioned studies into the cross-cultural perspective; it concentrates purely on the imitation experiments.

For this purpose, the listening experiment described was conducted with three groups of subjects: Lithuanian, Estonian, and mixed

Slavonic. Generally, statistical analysis of the experimental data resulted in similar conclusions for all ethnic groups. For instance, larger/smaller bells are associated predominantly with low/high vowels: the correspondence (absolute or relative) with the F2s (or “effective” F2s) of the bell strokes can be envisaged. The occurrence of diphthongs was high in the imitating syllables, especially those with falling F2s (*au*,...) or ending with nasals (*in*, *am*,...): the same tendencies can be observed in decaying bell strokes, including the relatively “nasal” spectrum with pronounced dips (“antiformants”).

As for the initial consonants of the syllables, plosives prevailed. This is in accord with the short attacks of bell strokes. However, statistics for these plosives differed more noticeably than those for vowels between the ethnic groups. This is probably due to the essential difference in the consonant systems (in terms of voiced/voiceless qualities) in Lithuanian/Slavonic and Estonian.

Universal and Culture-Specific Factors in the Recognition and Performance of Musical Emotions

*Petri Laukka*¹, *Tuomas Eerola*², *Nutankumar S. Thingujam*³, *Teruo Yamasaki*⁴, *Grégory Beller*⁵;

¹Stockholm University, Sweden; ²University of Jyväskylä, Finland; ³University of Pune, India; ⁴Osaka Shoin Women's University, Japan; ⁵IRCAM, France

PA171, Time: 09:30

The question of the universality of musical emotions is the source of much discussion but empirical evidence remains scarce. This study aimed to (a) explore what emotions/affects may be reliably communicated through music within and across cultures, and (b) to explore how this communication is achieved by means of universal and culture-specific performance strategies. Three professional bowed-string musicians from each of 4 different musical cultures (Western classical, Swedish folk, Hindustani classical, and Japanese traditional music) were instructed to express 11 different emotions/affects (affection, anger, fear, happiness, humor, longing, peacefulness, sadness, solemnity, spirituality, and neutral) by performing short pieces of music. All musical stimuli were judged by 3 groups of listeners from Sweden, India, and Japan ($N = 30/\text{culture}$). All stimuli were further analyzed with regard to a wide variety of acoustic (*e.g.*, register, tempo, dynamics and timbre) and musical (*e.g.*, rhythm and tonality) cues using the MIR toolbox. Results showed that anger, fear, happiness, and sadness received the highest recognition rates and were generally recognized across cultures, whereas affects like longing and spirituality were not well recognized. Also, listeners were somewhat more successful when judging stimuli from familiar, compared to less familiar, musical cultures. The acoustic analyses revealed many similarities, and some differences, across cultures with regard to the patterns of cues used to communicate the various emotions/affects. Discussion will focus on the ways in which emotional expression in music, and speech, depends on a combination of universal and culture-specific factors.

An Experimental Investigation of the Perception of Linear Frequency Scales Found in Central Australian Aboriginal Vocal Music

David Brennan; University of Western Sydney, Australia

PA092, Time: 10:00

Ellis, in a paper that analysed pre-instrumental scales in Central Australian Aboriginal vocal music proposed the hypothesis that those scales are best understood if one assumes a linear frequency progression between the notes of the scale. During the 1990s, Will conducted a further analysis of Ellis's recordings and proposed an expansion on the linear scale structure first proposed by Ellis. Will concluded that the music contained components of both linear and exponential scale systems with the fundamental units of those scales standing in a linear relationship. This interpretation distinguishes the Central Australian scales from overtone scales found in other parts of the world. This paper reports two experiments that investigate the perception of linear scale systems of the type proposed by Will and Ellis. In Experiment 1 a comparison is made between participants' ability to judge interval size using both linear and

exponential scales. In Experiment 2 participants are asked to indicate preference between Ellis's original recordings of Central Australian Aboriginal vocal music and those same recordings digitally manipulated to comply with conventional exponential scales. Interestingly, the experiments do not reveal a preference for exponential scale based music or greater accuracy when performing a perceptual task based on the more familiar exponential scales. These findings are of particular interest for those working in the fields of music therapy and microtonal tuning systems.

Cognitive Modeling

GOWEN 301, 08:30 – 10:30, Wednesday 25 Aug 2010

Information Content in Melodic and Non-Melodic Lines

Ben Duane; Northwestern University, USA

PA108, Time: 08:30

Although melodies seem to be focal points for attention — figures to the grounds created by other musical lines — little is known about why this is so. This paper tests the hypothesis that melodies mark themselves for attention partly by being less predictable than the lines that accompany them. As in several previous studies, predictability is quantified using various types of information entropy. These entropies are computed for melodic and non-melodic lines extracted from two musical corpora — one containing rock songs, the other containing Baroque keyboard minuets. Results show that the various entropies not only are significantly higher in melodies than in non-melodies, but can be used to classify lines as melodic or non-melodic with above-chance accuracy.

Narmour's Principles Affect Implicit Learning of Melody

Martin Rohrmeier, *Ian Cross*; University of Cambridge, UK

PA152, Time: 09:00

Implicit learning constitutes a central process in musical enculturation (Tillmann, 2005). Whereas several studies investigated implicit learning of melody, little work has been done exploring the constraints that affect the learning process. This study focussed on the extent to which Narmour's melodic principles have an impact on implicit learning of melodic structure by combining experimental and computational modelling approaches.

Based on previous results of melodic learning under an artificial grammar learning paradigm (Rohrmeier et al., accepted), the present experiment employed the identical underlying grammar and manipulated the terminals so that generated melodies systematically violated Narmour's principles. Participants performed worse in this Narmour-violating condition compared with the baseline suggesting that Narmour inconsistent materials impede the ease of learning or processing.

Computational simulations compared a simple recurrent network (Elman, 1990), the Competitive Chunking model (Servan-Schreiber & Anderson, 1990) and an n-gram model (Pearce & Wiggins, 2004) based on a parameter grid technique. Each simulation modelled the same procedure as the behavioural experiments. In a second set of simulations, the models were evaluated after an initial pretraining on a set of 942 melodies from the Essen folksong collection. The first set of simulations revealed no difference between both conditions. When models were pretrained, there was a significantly worse performance for simple recurrent network and n-gram models. However, characteristic model performance patterns with respect to different stimulus types did not match human patterns well.

A Hierarchical Hidden Markov Model of Melodic Mode in Western and Non-Western Musical Idioms

Panayotis Mavromatis; New York University, USA

PA028, Time: 09:30

Melodic mode is central to non-Western and early Western musical idioms, and is defined using static features (scale construction,

tuning, scale-step functions) and dynamic ones (motives, formulas, phrase types). Unlike their static counterparts, the dynamic aspects of mode have proven resistant to systematic formulation. Accounts of dynamic modal behavior are typically descriptive rather than explanatory, often consisting of simple inventories of melodic patterns. Such approaches fall short of defining precisely to what extent a dynamic entity, such as a melodic formula, can vary while maintaining its identity; moreover, they do not specify the causes and conditions underlying this variation. This paper develops a framework that allows precise characterization of a melodic mode's dynamic features using the formalism of Hidden Markov Models (HMMs). We illustrate our formalism by applying it to several modal environments drawn from Gregorian as well as modern Greek church chant. For each such environment, a two-layer hierarchical HMM trained on a corpus of modal melodies is used to identify (a) the prototypical phrase schemata employed by each mode; (b) the rules of syntax that determine how these schemata follow one another to produce a complete chant; (c) how each phrase schema's concrete realization deploys a well-defined vocabulary of melodic formulas. This analysis shows that, even though each melodic idiom employs its own pitch system and melodic vocabulary, all these idioms display similarities in both structure and deployment of their melodic formulas, suggesting a mental representation of melodic mode involving general mechanisms underlying sequence production.

A Corpus Analysis of Rock Harmony

David Temperley, Trevor de Clercq; University of Rochester, USA

PA050, Time: 10:00

In this study we report a corpus analysis of rock harmony. As a corpus, we used Rolling Stone Magazine's list of the "500 Greatest Songs of All Time"; we took the 20 top-ranked songs from each decade (the 1950s through the 1990s), creating a set of 100 songs. Both authors analyzed all 100 songs by hand, using conventional Roman numeral symbols. Agreement between the two sets of analyses was over 90%. The analyses were encoded using a recursive notation, similar to a context-free grammar, allowing repeating sections to be encoded succinctly. The aggregate data was then subjected to a variety of statistical analyses. We examined the frequency of different chords and chord transitions. The results showed that IV is the most common chord after I, and is especially common preceding the tonic. Other results concern the frequency of different root motions and three-chord patterns, patterns of co-occurrence between chords (do certain harmonies tend to occur together in the same songs?), and changes in harmonic practice across time.

Social Psychology 2

SMITH 120, 08:30 - 10:30, Wednesday 25 Aug 2010

Assessing Musical Self-Esteem: Development of an Analytic Measure

David J. Hargreaves, Victoria C. Rowe; Roehampton University, UK

PA173, Time: 08:30

In his *Principles of Psychology* (1890), William James suggested that our self-esteem 'is determined by the ratio of our actualities to our supposed potentialities... thus, Self-esteem = Success / Pretensions'. We apply James' original approach to the development and piloting of a new measure of musical self-esteem which investigates participants' 'ideal' and 'actual' self-ratings on one general scale ('musician') and 5 specific ones ('performer', 'composer', 'teacher', 'listener' and 'fan'). 99 university music students completed the 'Musical self-images questionnaire', on which they rated their ideal (I) and actual (A) selves on 6 10-point scales, as above. We found that James' quotient measure (Actual/Ideal) was more useful than the more conventional discrepancy measures [A-I]; that self-esteem was generally lower for 'composer' than for all the other scales; that the 'composer' and 'fan' scales showed generally low correlations with the other 4 scales; and that two main factors described these intercorrelations, which distinguished 'active music-making' from 'listening/teaching'. We

conclude that an analytic approach to the elements of self-esteem in different musical activities is far more illuminating than the use of generalised psychometric scales, such that our prototype scale deserves further development.

Children's Singing Development, Self-Concept and Social Inclusion

G.F. Welch, Evangelos Himonides, J. Saunders, I. Papageorgi, T. Rinta, M. Vranka, C. Stephens Himonides; IOE University of London, UK

PA038, Time: 09:00

The UK Government initiated a National Singing Programme 'Sing Up' in the autumn of 2007 with the intention of fostering weekly positive singing experiences for all children of Primary (elementary) school age in England by 2011. As part of the evaluation of this programme, a research team from the Institute of Education, University of London were appointed in 2007 to conduct an independent evaluation of the initiative's impact.

Children (n=8,162, aged 7+ to 11+) were drawn from one hundred and fifty-five schools located across England. Children's individual singing behaviour and development was assessed on two well-known songs using a specially designed protocol that combined two established rating scales. Attitudes to singing, self-concept and social inclusion were assessed by a specially designed questionnaire embracing six themes. Social background was assessed in relation to the Government's Index of Multiple Deprivation.

There were significant age, gender, ethnicity and school type differences in the emergent findings. Within these group variables, older children, girls and national programme experienced participants tended to have more advanced singing development. Black and white children were likely to be more highly rated in their singing competency than their Asian peers. There was no evidence that more competent singers came from socially advantageous settings. Age and longitudinal data indicated that children's singing competency tended to improve with age, and particularly so in a stimulating musical environment. In addition, there was a strong positive correlation between children's singing development and their self-concept and sense of social inclusion.

The Music USE (MUSE) Questionnaire: An Instrument to Measure Engagement in Music

Tan Chyuan Chin, Nikki S. Rickard; Monash University, Australia

PA131, Time: 09:30

It has been proposed that active engagement with music has positive impacts on human cognition, emotion and social interaction. However, research on the psychological benefits of music has been largely limited to comparisons between musicians and non-musicians, with this distinction being further limited to years of 'formal music training'. Moreover, the enormous variation across studies in musicianship and non-musicianship criteria makes it difficult to draw meaningful interpretations of findings across studies. We argue here that active music engagement should go beyond years of formal music training, to include performing (instrumental playing) and non-performing (listening) music activities, to provide a more meaningful interpretation and application of music research findings. We introduce the MUSE (Music USE) questionnaire, an online self-report measure of active music engagement, with three dimensions of musicality. The first two dimensions (music training and instrumental use indices) relate to traditional musicianship, but aim to capture this construct via a broader range of measures than years of formal music training. The final dimension relates to other forms of music engagement independent of traditional musicianship. This dimension was assessed via a 124-items questionnaire, which includes questions relating to the frequency and value of a range of music activities. Analyses of an initial sample of 210 individuals (mean age = 37.55 years, *SD* = 11.31) recruited via convenience sampling showed acceptable alpha coefficients on eight factors (Personal Inspiration; Engaged Production; Dance; Physical exercise/health; Social listening; Reminiscence; Active music listening and Cognitive

and emotional regulation) of this measure. Factor analysis of the data established a 50-item scale for the MUSE. In addition, relationships between the indices of musicality and factors of music engagement were explored, and gender differences in music engagement were examined.

The Effect of Background Music on the Evaluation of an Ad for an Internet Site Allowing Copying College Essays

Naomi Ziv¹, Moran Hoftman², Mor Geyer²; ¹Max Stern Academic College of Emek Yizre'el, Israel; ²Tel-Aviv Yafo Academic College, Israel

PA142, Time: 10:00

The study aimed to examine the effect of background music and presentation context on the reception of an ad promoting unethical behavior, and the relationship between attitudes towards cheating and evaluation of the ad. In a 2×2 design, 4 groups of 30 participants each listened to a fictive radio ad for an internet site allowing copying college essays with or without positive background music, before or after completing an attitudes-towards-cheating questionnaire. Participants who heard the ad with background music remembered less information than participants who heard the ad without background music. They also evaluated the ad more positively. Participants who first completed the attitudes-towards-cheating questionnaire evaluated the ad more negatively than participants who heard the ad first. Participants who first heard the ad with background music evaluated the ad most positively, whereas participants who first filled out the questionnaire and then heard the ad without background music evaluated it most negatively. Finally, general attitudes towards cheating did not affect evaluation of the ad. Results suggest that music distracted listeners from focusing and processing the information presented in the ad, and through its effect on mood, lead them to accept its unethical content.

Symposium: Scalable Analytical Approaches and Performative Affordance

KANE 110, 11:00 – 12:30, Wednesday 25 Aug 2010

Scalable Analytical Approaches and Performative Affordance

Fernando Gualda¹, Atte Tenkanen², Vanessa Hawes³, Tânia Lisboa⁴; ¹Queen's University Belfast, UK; ²University of Turku, Finland; ³University of East Anglia, UK; ⁴Royal College of Music, UK

SYM080, Introduction

Music Analysis, be it thorough or immediate, intentional or unconscious, is an important step in interpreting and understanding a musical work. Systematic approaches to music analysis have greatly profited from computational paradigms. Within studies of music performance and interpretation, however, computers can be obtrusive. Thus, it is essential to design interactive interfaces within an ecological research paradigm in order to study musical interpretation.

This symposium combines three complementary approaches to computational music analysis. All approaches focus on particular analytical problems arising from the ambiguous nature of music cognition and Gestalt principles. It follows that this ambiguity, rather than being detrimental, allows distinct interpretations and understandings of a musical score.

The first approach offers an adaptable perspective to motivic analysis, conciliating multiple analytical interpretations of a given piece. The second approach allows the exploration of distinct rhythmic, tonal, and textural contexts in which motives appear. The final approach investigates the quality of musical information contained in a sequence of motives in a specific order.

The symposium consists of three spoken paper presentations, live performance, and discussion. During the live performance all analyses will either be concurrently projected or available as a handout.

Motivic Dissimilarity and Musical Interpretation — An Interactive, Computational Approach

Fernando Gualda; Queen's University Belfast, UK

SYM081, Time: 11:00

Identification of motives is frequently one of the initial steps in music analysis, interpretation, and performance. Even though motivic analysis is a standard approach, the very term 'motif' lacks a unanimous definition. This allows distinct analytical perspectives to coexist. In this paper, rather than attempting to unify the concept of musical motif, its definition is left as a parameter for the analyst. By selecting motives, a motivic space is automatically generated. Thus, distinct motivic analyses of the same musical work can be compared, so that the performative affordance of each analysis can be assessed.

The overall motivic space depends on either the initial selection of motives or a theoretical definition of motif, both of which can be done by the analyst. Once defined, motives are automatically searched and compared to each other, thus forming a motivic space within which distances between motives can be calculated. Mathematically, the definition of equivalence relations along with dissimilarity measures is sufficient to create a motivic space. The concept of Pitch-Class Category allows equivalence of motives under tonal transpositions and chromatic transformations.

Distances of distinct selections of motives from J. S. Bach's BWN 1030b are presented. Since each selection of motives is slightly different, its motivic space will represent the entire collection differently. The performative affordance of each motivic space is discussed. The live performance of the piece will illustrate the author's view on the application of the analytical methods in musical interpretation.

Comparison Structure Analysis for Musical Understanding

Atte Tenkanen; University of Turku, Finland

SYM082, Time: 11:30

Similarity measures are used in many research areas, since defining the similarity of objects is crucial in data analysis and decision-making processes. In this study, I utilize a computer-aided analytical method called Comparison Structure Analysis (CSA), which can be applied to different dimensions of music. CSA depends on an abstract systematic segmentation that allows a statistical or mathematical survey of the data. The segmentation produces vectors or unordered sets of the same length that are compared with the same type of comparison set utilizing a similarity measure. The aim of CSA is first and foremost practical: to produce dynamic and understandable representations of musical properties by evaluating the prevalence of a chosen musical feature within a musical piece. In the present study, CSA and some of its derivative applications are used for detecting invertible counterpoints, short-term modulations and tonal extremes in BWV 1030b.

Information Representation for Analysis and Interpretation of Motivic Order

Vanessa Hawes; University of East Anglia, UK

SYM083, Time: 12:00

The theoretical basis for the system of computational analysis explored here is a dynamic probability model of musical perception first proposed by Coons and Kraehenbuehl in 1958. The method draws on a listener's experience of a sequence of events, as he adapts his expectations in the light of what has happened in the sequence up to that point. The output of the system is a series of percentages representing relative information for each event in a sequence.

The original method is outlined and problems specific to its application to real music, such as the absence of the effect of long-term memory in the model, are addressed with recourse to ecological approaches to musical perception.

The system is used for an examination of Bach's BWV 1030b, where various structural groupings defined by the analyst are interpreted into information profiles. Particular attention is paid to differences in information profiles for sequences where identifiable motives are ordered differently. The event sequences within those motives are

then examined and characteristic information profiles for each motif are produced.

These results are presented as examples of performative affordance, and the future development of tools for practical music making based on the analysis described is suggested.

Education 1

GOWEN 201, 11:00 - 12:30, Wednesday 25 Aug 2010

Advancing Interdisciplinary Research in Singing (AIRS): Part 1 Development

Annabel J. Cohen¹, Frank A. Russo², Laurel J. Trainor³, Sandra E. Trehub⁴, Christine D. Tsang⁵; ¹University of Prince Edward Island, Canada; ²Ryerson University, Canada; ³McMaster University, Canada; ⁴University of Toronto Mississauga, Canada; ⁵Huron University College at Western, Canada

PA182, Time: 11:00

A major international collaborative research initiative entitled "Advancing Interdisciplinary Research in Singing (AIRS)" takes a comprehensive approach to the natural ability of singing. With the objective of understanding individual, cultural, and universal influences on singing and the influences of singing on individuals and societies, AIRS researchers are focusing on three themes: (1) the development of singing ability (2) singing and learning, and (3) singing and well-being. The AIRS digital library and virtual research environment (VRE) support the collaboration. A three-dimensional approach is being taken to outline a model of how singing develops in every individual, with perspectives ranging from neuroscience to linguistics, rigorous techniques for determining children's discriminative and motor capabilities associated with singing, and sampling the broad range of skills of singing, some of which have language analogues.

Laurel Trainor and Christine Tsang are leading a basic inquiry into the relation between perception and production of singing and an investigation of the sensory and motor constraints on production accuracy. A number of factors will be considered such as formal training, type of language (e.g., tonal vs non-tonal), environments (home, school, community), and cross-cultural differences. In addition to behavioral measures, this sub-theme will eventually incorporate brain measurements (using EEG and fMRI) to form the basis of a cognitive neuro-social scientific model of singing development.

Sandra Trehub and Frank Russo are spearheading research on multimodality aiming to document the mirroring of facial and body movement between parent and infant through audiovisual capture, electromyographic capture, and analysis of eye-movements as well as exploring lawful facial and body movement that occur during singing and the ways in which these movements change as a function of age and culture.

Annabel Cohen and her team are initiating cross-cultural and longitudinal designs for trials with an AIRS Global Test Battery of Singing Skills that take advantage of both the seven-year time-span and the global reach of the project. The battery tests voice range, singing the "easy" minor third interval and other musical elements (scale, major triad), vocal creativity, singing back a familiar song, and learning an unfamiliar song. Storage in the AIRS digital library increases data access.

Supported by the Social Sciences and Humanities Research Council of Canada (SSHRC)

Advancing Interdisciplinary Research in Singing (AIRS): Part II Beyond Development — Education and Well-Being

Patricia S. Campbell¹, Rachel Heydon², Jennifer Nicol³, Mary Gick⁴, Andrea Rose⁵, Godfrey Baldacchino⁶; ¹University of Washington, USA; ²University of Western Ontario, Canada; ³University of Saskatchewan, Canada; ⁴Carleton University, Canada; ⁵Memorial University of Newfoundland, Canada; ⁶University of Prince Edward Island, Canada

PA183, Time: 11:30

Prime considerations in educational research on singing are in knowing what singers sing — their repertoire, along with how singers acquire the songs and their singing style, both formally and informally, from infancy onward, and across the world's cultures. This presentation examines the multiple (and not-so-simple) dimensions of learning, teaching (and training), and transmitting songs and singing styles informally and formally as well as raises an awareness of the function of song as a vehicle for the transport of knowledge beyond music itself. 'Seattle singing scholars' (P. S. Campbell, E. Chessin, M. Perdue) are focusing on topics of (a) the informal singing, learning, and transmission of songs by children; and (b) the vocalizations inherent (but often unconsciously rendered) within the formal lessons offered by musicians of selected instrumental art traditions of the world's cultures. Darryl Edwards is leading research in performance education at the tertiary level, including (a) singers' perceptions of their own performances when compared with the perceptions of their audiences, and (b) frequency and utilization of mimicry in teacher-student instruction. Singing is effectively used in a wide spectrum of educational settings, as a natural conduit for knowing the world beyond music. A team led by Andrea Rose conducts research on the role of singing in teaching of other curricula such as linguistic (phonetic, semantic, syntactic), musical, or social studies.

Researchers are also studying the contribution of singing to well-being, broadly defined to include social relations (cross-cultural and intergenerational understanding) and subjective (life satisfaction) and objective (physical health status) measures. A multi-site international endeavor guided by Lily Chen-Hafteck, entails developing new curricula to teach the songs of the culture and the cultural context, and the aim is to track both short- and long-term attitudes to cultures. Applying her work on intergenerational (IG) art, Rachel Heydon is exploring social and content learning, interactions, and the process of creating learning opportunities (curriculum development) in a pilot study of a shared-site (both young and elderly) IG singing program. Jennifer Nicol leads the study of direct benefits (as well as contraindications) of singing for psychological and physical health across the lifespan. Projects include partnering with other health professionals to investigate the relative advantage of active versus passive singing in hospital settings and homes for seniors; exploring singing's role in facilitating youth engagement and ultimately positively impacting high school retention, and the benefits of singing lessons in later life.

Supported by the Social Sciences and Humanities Research Council of Canada (SSHRC)

Practice Space: Real-Time Visual Feedback for Music Education

Makiko Sadakata¹, Alex Brandmeyer¹, Renee Timmers², Peter Desain¹; ¹Radboud University Nijmegen, The Netherlands; ²University of Sheffield, UK

PA094, Time: 12:00

Despite much advance in our understanding of human music performance, musical expression is still difficult to learn. Musicians must undergo intensive training for long time in order to obtain the skill to freely control expression. It would be of great interest to music teachers and learners if this learning process could be enhanced. In the Practice Space project, we developed and evaluated five real-time visual feedback systems, each of them aims at highlighting different

aspects of learning involved in musical performance: loudness and timing imitation of simple rhythmic patterns, longitudinal study on learning timing patterns, learning expressive drum patterns, learning to fluently play the piano trills, and exploration practice of the grace note timing. Comparison of evaluation of these systems revealed following findings. First, trainees could learn to use novel visual representations rather quickly in general, even in the case where the relation between visual parameters and performance parameters are not known. Thus learning is highly adaptive and can be implicit. Second, not only speeding up the learning process, but providing information of musical performance which are difficult to be picked up by the learners otherwise (e.g., subtle performance timing), can bring up trainee's performance to a higher level that cannot be achieved without VFB. Third, qualitative evaluation confirmed that majority of participants (in all experiments) rated the system positively. These all point to the fact that VFB can be beneficial in music educations. Benefits and limitations of these systems will be discussed.

Gesture

GOWEN 301, 11:00 - 12:30, Wednesday 25 Aug 2010

Perceiving Spatial Gestures

Jason W. Solomon; Western Carolina University, USA

PA087, Time: 11:00

This paper describes the perception of *spatial gestures* as they occur during musical performance. Within an acoustic ensemble, a spatial gesture emerges from the consecutive musical activity of discretely positioned ensemble members. Gestures are differentiated by particular orderings, in time, of sonic events occurring at separate points in the ensemble space. While auditory localization enables the listener to distinguish the varying locations of musical sound sources, the grouping principles of Gestalt theory explain the processes by which discrete object- or event-parts may be grouped together in perception to form a continuous whole. Bregman (1990) describes the manner in which temporally successive sounds are perceptually joined into coherent "streams" on the bases of qualitative similarity (timbre, loudness, and/or duration) and frequency proximity (i.e., nearness in pitch space). A complex auditory scene might comprise multiple streams that are segregated from one another owing to the unique qualities and locatedness of the sounds constituting each stream. This paper extends Bregman's theory to suggest that an auditory stream might consist of qualitatively similar or dissimilar sounds occurring successively at different points in space. The grouping of a stream's spatiotemporally distinct sound-events results in the formation of a spatial gesture. The phi phenomenon is applied to audition to account for the perception of virtual motion often engendered by a spatial gesture. During the performance of a musical work, recurrent and related spatial gestures may function as unifying motives, and both the specific directionality and the kinetic shape of a gesture are rich in interpretive potential.

Expression of Piano Timbre: Gestural Control, Perception and Verbalization

Michel Bernays, Caroline Traube; Université de Montréal, Canada

PA166, Time: 11:30

Timbre is a key to musical expressivity in virtuosic pianistic performance, discussed amongst professionals through an extensive, yet very abstract and emotional, vocabulary. This study first aims to determine the degree of consensus of this vocabulary among pianists. Furthermore, timbre's quantitative and functional characteristics are yet to be explored. We thus intend to identify timbre correlates in a performer's gesture on the keyboard. A professional pianist was asked to play three short pieces, with eight different timbres as successive instructions to colour the performances. The audio recordings were used as stimuli for a timbre identification task, in which 17 other pianists had to label the timbre with the descriptor they deemed most fitting. The results, more than three times above chance, were significantly improved by taking into account the semantic proximity ratings between descriptors. This is thus indicative

of a semantic consistency in the perception and description of piano timbre. Then, from key position and hammer velocity data collected in the performances through the computer-controlled recording grand piano Bösendorfer CEUS, we computed numerous gesture features as cues of dynamics, articulation, synchronism, key touch and attack and pedal use, among which several were significantly correlated with the timbre performed. This is a step towards a comprehensive gestural mapping of piano timbre that could yield significant improvements in piano pedagogy and software modelization.

Perception and Recognition of Expression in Pianists' Gestures: A Continuous Response Study

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

PA137, Time: 12:00

Body movements are highly integrated into musical performances as conveyers of musicians' expressive intentionality and projections of the music's temporal organization. Observers use musical gestures to empathize with the performer's expressive and emotional intentionality. Previously, we used a continuous response paradigm to examine which kinematic features of conductors' movements might govern an observer's perception of expression. It was found that high levels of perceived expressivity were characterized by increased amplitude, greater variance and higher speed of movements. This study adopts a similar approach to pianists' gestures but implements performances with varying levels of expressive intensity to the stimuli. Our main questions are: 1) as the performer's expressive intensity is increased, does the observer obtain a clearer recognition of expression and 2) what movement features do observers use to identify expressive playing in piano performances? To this end, 32 individuals provided continuous ratings of perceived expression, valence, activity and power; while observing 9 animations of piano performances rendered from motion capture data. Thirty-two movement features relating to kinematic and postural characteristics of the piano performers were extracted. Principle component analysis was used to reduce the dimensionality of features to 10 variables. These newly derived variables were used as predictors of perceived expression, valence, activity and power in a series of linear regressions pooling the movement variables in different combinations. In general, upper body movements were chief indicators of expressivity. This implies that intended expressivity is best conveyed through the parts of the body furthest from the keyboard and that contain the highest degrees of freedom.

Social Psychology 3

SMITH 120, 11:00 - 12:30, Wednesday 25 Aug 2010

Strong Experiences of Music: The Importance of Popular Music Festivals in Adults' Lives

Alexandra Lamont¹, Alinka Greasley², Rebecca Hale¹;

¹Keele University, UK; ²University of Leeds, UK

PA130, Time: 11:00

Music listening is increasingly common in everyday life and has a range of emotional effects. However, focused music listening situations are relatively rare, yet these have been shown to have positive therapeutic implications (Gabrielsson & Lindström, 1995). Music festivals have been identified as a context which frequently evokes strong experiences of music in young adults (Lamont, 2010), and research has explored the nature of classical, folk and jazz festivals (e.g. Pitts, 2005; Karlsen, 2007) in terms of place, identity, and emotions. However no research has yet explored popular music festivals from this perspective or considered why people might choose to attend such events.

The current study focused on a summer electronic dance music festival in England in 2009, and began with observational ethnographic methods to describe the character of festival life. From 1000 flyers distributed at the festival and messages placed on relevant online discussion boards, 83 participants completed at least a third of an online follow-up survey and 59 completed it fully; to date 10

participants have taken part in later follow-up telephone interviews. The festival is relatively small (10,000 attendees) and centred around various types of electronic music. Most attendees were affected either by drink or drugs or both, but the atmosphere was very relaxed and there was very little violence or aggression. A clear sense of social cohesion and camaraderie was observable. This was confirmed by questionnaire responses which revealed that friendship and music combined were the major motivators for attending this festival; that many festival-goers were regular attendees at this and other smaller festivals; and that the chance to escape from reality was the main emphasis of the event. The 'total experience' was emphasised by many. Interviews similarly confirmed themes of friendship, music, narcotics, atmosphere, predictability, and escaping from reality.

These findings show that for a residential event, attendees are more likely to engage in the 'total experience' found by Bowen & Daniels (2005) in the context of a one-day festival rather than the purely social or musical reasons they also uncovered. Our findings shed light on how a musical experience can be meaningful and long-lasting in terms of personal narratives. While participants are generally not able to give reflective comments at the event itself, their reflections in the months afterwards show an ability to recall and make sense of the experience in the context of their everyday life.

Social Comparison by Young Musicians Who Participate in a Community of Musical Practice

Margit Painsi, Thade Buchborn; University of Music & Performing Arts Vienna, Austria

PA033, Time: 11:30

Learning a musical instrument in a community of musical practice provides a variety of opportunities for social comparison. This comparison is an important influence on children's motivation and their self-beliefs during skill acquisition (Schunk, 1984). Children form ideas about their own ability by comparing themselves with their peers and when they hear teachers make public evaluations (Rosenholtz & Simpson, 1984). Our research aims to investigate pupil's motives for social comparison and the way they gain information about others' and their own musical abilities in various learning situations. In addition, we are interested in the function of social comparisons for their musical development with special regard to motivation and self-beliefs. The sample comprised forty 11 to 12-year-olds from a secondary school which participated in an extended music programme. Data was collected by video observation and semi-structured interviews. Results show that children's self-evaluations of their musical abilities are based mostly upon social comparison with their peers. The pupils were very well informed about their own and their peers' strengths and weaknesses and strongly referred to their peers as an external frame of reference when talking about their own musical achievement. From the video it became apparent that pupils took different roles when interacting in informal learning situations which might provide different perspectives for social comparison. Without doubt this social comparison enables the children to compare their musical competences based on different perspectives whereby they might assumingly more or less consciously or unconsciously evoke the information they need for their current development.

Influences of Choir Singing on Cognitive and Emotional Processing in 5th-Grade Children

Wibke Gütay, Gunter Kreutz; Carl von Ossietzky University of Oldenburg, Germany

PA070, Time: 12:00

Previous research has shown that music training can positively influence cognitive functions like verbal memory. However, it is unclear, whether vocal training may have similar effects as tuition on musical instruments. Furthermore, questions arise as to whether music training has any effects on emotional processing including stress regulation. The present investigation addresses longitudinal effects of a choral singing program on verbal memory and stress regulation.

Forty-four 5th-graders (29 female) participated. Group A children (n = 28) received weekly choir rehearsals and vocal training in small

groups. Group B children (n = 16) received regular music tuition only. Cognitive (verbal memory test) and emotional (stress questionnaire) assessments were conducted at the beginning and end of one school year.

Children of both groups were found similar in relation to their socio-economic status, overall academic achievement and extracurricular music activities. Repeated measures ANOVAs with group and sex as between-subject factors and time as within-subject factor were performed separately for each dependent variable. Group A children showed an improvement in verbal learning efficiency which could not be seen in group B, although the effect reached significance only by disregarding children who played musical instruments. Three-way interactions were observed in relation to stress regulation. Girls benefited from choral singing in seeking social support, whereas group A boys showed decreases of anger-related stress-symptoms.

This study suggests that training in choral singing may support cognitive and emotional processing in terms of verbal memory and coping strategies. Influences of gender were noted that should require more detailed investigation.

Young Researcher Award

KANE 130, 12:30 - 13:00, Wednesday 25 Aug 2010

The Role of Temporal Prediction Abilities in Interpersonal Sensorimotor Synchronization

Nadine Pecenka, Peter E. Keller; MPI CBS, Germany

PA010, Time: 12:30

Musical ensemble performance requires precise action coordination. To play in synchrony, musicians presumably anticipate their co-performers' upcoming sounds. Our previous studies revealed that about two-thirds of individuals predicted upcoming tempo changes during on-beat finger-tapping, whereas the remaining individuals tracked the changes. The current study examined the stability of individual differences in prediction/tracking (P/T) tendencies and their role for dyadic synchronization. Forty individuals with either strong prediction or tracking tendencies were invited to participate in 2 experimental sessions. In both sessions, participants were asked 1) to tap alone with a tempo-changing pacing signal and 2) to tap in dyads comprised of individuals with similar or different P/T tendencies. Results indicated that P/T tendencies were highly stable over several months and played an important role for dyadic synchronization performance. Specifically, dyadic synchronization performance was better explained by the P/T tendencies of the co-performers than by their individual synchronization abilities.

Symposium: Music Health and Wellbeing: Therapy, Education and Communication

KANE 110, 08:30 - 10:30, Thursday 26 Aug 2010

What Is Music Health and Wellbeing and Why Is It Important?

Raymond MacDonald¹, Laura A. Mitchell¹, Gunter Kreutz²; ¹Glasgow Caledonian University, UK; ²Carl von Ossietzky University of Oldenburg, Germany

SYM051, Time: 08:30

This paper reviews a number of different perspectives investigating the relationship between music and health. Possible reasons relating to why music may have beneficial effects on health are explored; these include a discussion of social, cultural neurological, medical, developmental and education issues. The contrasting but related contributions of music therapy, community music and music education will be discussed and research examples will highlight various ways in which music and health can be studied. Different types of methodologies will be presented and here the emphasis will be on comparing and contrasting the ways in which we utilise quantitative and qualitative methodologies both separately and together. For example, the paper will present studies that utilise focus group approaches (music education) and semi structured interview approaches (music and mental health). These will be compared with research that involves questionnaire designs (eg patterns of music listening and health). Studies that adopt an experimental (both clinical and laboratory) approach will also be presented. While there is still much to learn about the processes and outcomes of music interventions aimed at improving health, there is now growing evidence that music can have a significant positive effects. These effects can be physiological and/or psychological and can manifest themselves in various ways. There are many routes to understanding the process and outcomes of music interventions focused on positive health outcomes and it is important to utilise pluralistic models of music psychology research in order to fully understand these benefits.

Music and Rehabilitation: Neurological Approaches

A. Blythe LaGasse, Michael H. Thaut; Colorado State University, USA

SYM052, Time: 09:00

Throughout history, music has been considered a creative and beautiful artistic language of human expression. However, recent scientific and clinical research has demonstrated the power of musical stimuli goes beyond that of expression, demonstrating that musical stimuli can promote neuroplasticity in the brain and functional changes in neurological rehabilitation. The therapeutic application of musical stimuli has been shown effective in treating cognitive, sensory, and motor dysfunctions due to neurologic disease of the human nervous system. Research in the field of neuroscience and music lead to the development of Neurologic Music Therapy, a research-based system of standardized clinical techniques that promote neurological changes. This presentation will focus on prominent research in music and rehabilitation and will illustrate how this art form as a language of the brain can promote neurological changes.

Music Instruction and Children's Intellectual Development: The Educational Context of Music Participation

Eugenia Costa-Giomi; University of Texas at Austin, USA

SYM053, Time: 09:30

Music has been part of the education of children for centuries. Although researchers have studied the benefits of music instruction for almost a hundred years, much of the research on its contribution to children's cognitive development has been completed during the last 15 years. I will provide an overview of research efforts in understanding the relationship between music and intelligence as well as music and academic achievement and recent applications of this

research for the education of children. In order to assess the value of music instruction in educational context, I will review data on the characteristics of children who choose to study music, persevere in music studies, and dropout of music lessons and the characteristics of music programs in public schools in the United States. Evidence suggesting that the selectivity of those who start music instruction in terms of demographic and personal characteristics increases over the years raises questions about the long-term intellectual benefits of music instruction.

Embodied Musical Communication: Evidence from Singing, Dancing and Musical Instrument Playing

Jane Davidson; University of Western Australia, Australia

SYM054, Time: 10:00

The strong coupling between motor programming demands for sensori-motor accomplishment as well as the use of the body to shape and reflect socio-musical communication has already been well-examined by the current author (see Davidson, 2005, for a review), and these elements have been shown to occupy a central role in musical sharing. But, there is much scope for further investigation to deepen understanding. There is a need to consider the interaction between bodily action and musical engagement across a range of musical arts activities from singing and dancing through to musical instrument playing in order to explore fully the nature of embodied musical communication.

This paper aims to investigate examples of musical arts engagement (singing and dancing) with the intention of generating a detailed understanding of socio-musical production and perception of embodied communication.

The investigation draws on both quantitative (frequencies of behaviours) and qualitative methods (semi-structured interviews, participant observation reports) in line with those described elsewhere by the author (see Davidson, 2004). With funding from the Australian Research Council, a project has been designed in which participants are drawn from three contexts: a rural Balinese community where people engage in the learning of music through both dance and singing; a rural South African context where the Venda engage in their musical learning in a completely integrated dancing and singing manner; and finally, in Western Australian high schools where young people learn their music, singing, and dancing as separate elements.

The data show that the context in which the musical arts activities take place shape profoundly their focus and the degree to which participants relate the forms of musical arts practices one with the other. In Venda, the separation between the skills of singing and dancing are few, with embodied musical, personal and overall social communication being highly apparent. For the Australian learners, the relative lack of opportunity to learn to dance out rhythms and feel melodies in their bodies, with instrumentalists depending more on the fine grained motor control of acquiring skill to control musical instruments, results in a more stressful and less socially communicative learning experience.

Engaging with Blacking's concept of human musicality (Blacking, 1973) and Malloch and Trevarthen's (2008) concept of communicative musicality, the author draws together a theoretical account of musical arts practices and their central role in human communication.

Education 2

GOWEN 201, 08:30 - 10:30, Thursday 26 Aug 2010

Level of Musical Training in a University Sample: Implications for Current Methodologies

Kathryn Schenk, Karen Sullivan, Doug Mahar; Queensland University of Technology, Australia

PA089, Time: 08:30

A growing body of literature is seeking to determine whether musical education impacts on non-musical abilities. Typically this question is investigated using a between-groups research design, comparing musicians with non-musicians. A limitation of this approach arises from the variation with which musicianship is defined and conceptually

ally such definitions are problematic if they result in an artificial or inappropriate dichotomy. This study aimed to examine the musical training experiences of a combined musician/non-musician sample. This data was used to test the validity of previous dichotomous definitions of musical training, by examining the types of musical training for evidence of bi-modal distributions. The Musical Training Survey (MTS) was designed to gain information about the various types of musical education to which most university students have previously been exposed, according to three categories; classroom-music lessons, school-based-instrumental lessons, and outside-of-school-music lessons. Participants ($N = 115$) had an average of 7.65 years of classroom and 3.87 years of school-based instrumental lessons. Furthermore, a quarter of the participants had more than eight years of private musical tuition. No significant differences were found between participants based on their university course for the number of years spent in classroom or school-based-instrumental lessons, or the age at which outside-of-school-music lessons were commenced. This study highlights the need for a clear and standardized definition of musical training, due to the differences that may exist between types of training. Future research should more clearly measure and describe the musical training experiences of participants.

Extending the RAN Task to Pitches in the Prediction of Musical Sight-Reading Performance

*Anna K. Tirovolas, Ron W. Stringer, Daniel J. Levitin;
McGill University, Canada*

PA077, Time: 09:00

The rapid automatized naming (RAN) task has become a standard instrument in the assessment of text reading fluency. In this study, we sought to create an equivalent task aimed at assessing music reading fluency. Here, we report on the creation of a new musical rapid automatized naming task for pitches. We hypothesized that performance on the music RAN would be associated with performance on standard RAN tasks, including letters, digits, objects, and colours. A second hypothesis was that musical training would correlate specifically with music RAN performance. RAN performance, measured by the interonset intervals of vocal naming responses, was used to predict fluency in a sight-reading performance of piano music. Participants were 34 pianists, aged 18 to 36. Analyses revealed numerous inter-correlations among RAN tasks, including correlations between music and standard RAN performance; no significant associations were found between musical training and RAN performance, although correlations were highest for the pitch and colour RAN. Findings show that the music RAN is more related to timing than pitch accuracy in a musical sight-reading performance, consistent with the domain of language, where RAN predicts text reading fluency, rather than phonemic decoding skills. Further research is needed to address the potential application of this new RAN task in its use in the assessment of music reading dis/ability.

Musical Training Facilitates Brain Plasticity: Short-Term Training Effects on Sensorimotor Integration

C. Carolyn Wu, Vanessa K. Lim, Jeffrey P. Hamm, Ian J. Kirk; University of Auckland, New Zealand

PA078, Time: 09:30

Efficient sensorimotor integration is essential for music performance. Musicians undergo extensive training which enhances established neural links between auditory and motor areas of the brain. Long-term training develops, strengthens and enables flexibility in these connections allowing proficiency in performance. Previous research has indicated that passive listening of trained music can result in the recruitment of premotor areas, even after short-term training. This suggests that such mappings can be specific, and can rapidly become automatic. It has been argued that these mappings rely on activity in mirror neuron systems (involved generally in imitating and learning actions), and has also been suggested that these systems are heavily dependent on actual sensorimotor experience. However, others propose that sensorimotor experience is not required to activate this system, as listening to any rhythms may be enough to demonstrate involuntary motor coactivation. Action-observation studies in this

field using electroencephalography (EEG) have associated changes in mu-rhythm activity with the mirror neuron system. We utilized this method in our action-listening study in order to detect involuntary motor coactivation during passive listening to melodies and rhythms. We investigate whether motor coactivation during passive listening occurs specifically for newly acquired sound-action mappings after training. Subjects participated in a short-term training scheme in which they were trained to accurately play back randomly generated basic piano melodies. Preliminary results show changes in the mu-rhythm activity in post-training EEG recordings. These initial findings support the hypothesis that sensorimotor experience is important for the mirror neuron system.

The Effect of Background Variables on the Competency Dimension of "Perceiving and Contextualising Music"

Anne-Katrin Jordan¹, Andreas C. Lehmann², Jens Knigge¹; ¹Universität Bremen, Germany; ²University of Music Würzburg, Germany

PA179, Time: 10:00

With the introduction of educational standards and competency orientation in German schools for core subjects, it is desirable to develop a corresponding model for music. This study is part of a broader attempt to model musical competencies (Niessen et al., 2008). Here, we focused on a first competency facet ("Perceiving and contextualising music") which is characterized by aspects of aural skills, music history, musical literacy, and application of basic music theory. Our goal was to identify whether the competency model is unidimensional (all items tapping into the same construct) or multidimensional and to assess the influences of various background variables (e. g., socioeconomic background, out-of-school music experience) on item quality and model validity. For this, a large number of items with high curricular validity were developed, piloted with sixth grade students in schools, and refined after item analyses. A final set of items was administered to 508 students in a computer-based test. The analyses at item and model level were conducted with methods of item response theory (IRT). After model validation and through model comparisons, a multidimensional model with four dimensions emerged. The following dimensions were used for describing students' abilities: (1) elemental music perception and perception combined with either (2) terminology, (3) or notation (4) or historical/cultural context. Although the test was easier for students with out-of-school music experience, only few items showed actual DIF (> 0.3). Hence, it is possible to construct music items that fit the Rasch model but do not favor students with out-of-school musical experience.

Performance 2

GOWEN 301, 08:30 - 10:30, Thursday 26 Aug 2010

Motor Expertise Influences Perceptual Accuracy in String Musicians

Clemens Wöllner¹, Rouwen Cañal-Bruland²; ¹Royal Northern College of Music, UK; ²VU University Amsterdam, The Netherlands

PA071, Time: 08:30

Ensemble performance requires high levels of motor and audiovisual coordination. Research still needs to scrutinize the relationship between these skills. In line with common coding theory, we hypothesize that motor expertise should map onto perceptual consistency in music-specific tasks. Ten string musicians (motor experts), ten non-string musicians (visual experts), and ten non-musicians were invited to watch progressively occluded video recordings of a first violinist indicating entries to fellow members of a string quartet. Participants synchronized with the perceived timing of the musical entries. Compared to visual experts and non-musicians, string players not only responded more accurately, but also with less timing variability. These findings provide evidence that motor experts' consistency in movement execution — a key characteristic of expert

motor performance — is mirrored in lower variability in perceptual judgments, indicating close links between action competence and perception.

Historically Informed Practice: Musical Decision-Making in Baroque Violin Music

Daniel Bangert, Emery Schubert, Dorottya Fabian;
University of New South Wales, Australia

PA079, Time: 09:00

The interpretation of a notated musical score through performance involves a complex process of decision-making. Some musical decisions are made rapidly and without conscious awareness while others are the product of detailed analysis and deliberation. This paper explores the musical decision-making processes of Baroque violinists.

This study involved three professional Baroque violinists who sight-read, practiced and performed a short piece of solo Baroque violin music. Verbal reports were collected after the sight-read and performance and the performers were asked to 'think aloud' during the practice session. The participants made decisions about tempo, dynamics, bowing, phrasing, ornamentation, articulation, note duration and chord playing. By comparing performance decisions that were marked or commented on during practice with those that were not, this paper aims to identify and describe analytical and intuitive methods of musical decision-making. One-quarter of all performance decisions were made as the result of explicit, conscious processes while the remaining three-quarters were unplanned or not reported by the performers.

Exploring the Relationship Between Voice Leading, Harmony, and Intonation in a Cappella SATB Vocal Ensembles

Johanna Devaney, Jonathan Wild, Peter Schubert, Ichiro Fujinaga;
McGill University, Canada

PA061, Time: 09:30

Intonation in vocal ensembles is a complex phenomenon. Unlike fixed-intonation instruments (such as the piano), singers are able to adjust the tuning of each note dynamically. The question motivating this study is whether the intonation practices of SATB ensembles are influenced more strongly by local musical activity, namely voice leading and harmony, than an idealized tuning system, such as Just Intonation. We are working with a group of professional singers who are configured in different combinations into SATB ensembles. The repertoire is a set of exercises, which were designed to highlight how particular configurations of musical materials influence intonation. Specifically, the exercises explore the points of opposition between vertical and melodic intonation tendencies as well as whether organizations of musical materials encourage pitch drift. The intonation is analyzed both in terms of perceived pitch, the mean of the fundamental frequency (F0) estimates for each note, and the evolution F0 over the duration of each note. In order to compare the evolution of F0 between notes of different lengths, we use the discrete cosine transform (DCT). The first DCT coefficient provides us with information about whether the singers are gliding up or down and the subsequent coefficients indicates the amount that F0 deviate from a steady slope over the course of the note.

The Effect of Transient Perturbation of Auditory Feedback on the Control of Keystroke Movements During Playing the Piano

Shinichi Furuya, John F. Soechting;
University of Minnesota, USA

PA127, Time: 10:00

The present study was aimed to elucidate the role of auditory feedback derived from one keystroke in the control of successive keystrokes during piano playing. We examined the effects of transient auditory perturbations with respect to the pitch, loudness, and timing of one tone on subsequent keystrokes while six pianists played short excerpts from three simple musical pieces having different inter-keystroke interval. The results demonstrated that the

inter-keystroke interval became shorter immediately after a delay in tone production. This compensatory action depended on the tempo, indicating that temporal information provided by auditory feedback is utilized to regulate the timing of movement elements produced in a sequence. We also found that the keystroke velocity changed after the timing, pitch, or loudness of a tone was altered, although the response differed depending on the type of perturbation. While delaying the timing or altering the pitch temporarily led to stronger keystrokes, altering the loudness changed the keystroke velocity in an inconsistent manner. Furthermore, perturbing a tone elicited by the right hand also affected the rhythmicity and velocity of keystrokes with the left hand, indicating that auditory feedback from one hand was taken into consideration for the control of the contra-lateral hand so as to maintain bimanual coordination of tone production. Finally, altering the pitch sometimes resulted in striking an incorrect key mostly in the slow piece, emphasizing the importance of pitch information on one tone for accurate planning and execution of sequential piano keystrokes.

Auditory Perception 2

SMITH 120, 08:30 - 10:30, Thursday 26 Aug 2010

Modeling Human Brain Activity Associated with Chronologically Dynamic Melodic Expectations

Richard Randall, Gustavo Sudre;
Carnegie Mellon University, USA

PA099, Time: 08:30

Neuroimaging studies often rely on averages of multiple trials to represent their findings. Such averaging is necessary in order to control for unwanted artefacts and noise. Averaging across an entire set of trials, however, has the effect of transforming a diachronic experience (listening to a stimulus multiple times) into an artificial single-listening experience. Music scholars frequently discuss the impact of multiple hearing on the perception and understanding of music. In general, however, neuroimaging studies musical expectation do not account for such "rehearings." This study attempts to address the issue of rehearsals in neuroimaging studies by employing a novel method of data analysis called an *rw-average*. The *rw-average* defines a variable-sized moving window (*w*) that is incremented across the set of all trials at various spacings (*r*). Using MEG to record response data, this procedure capitalizes on diachronic listening and describes how the neural responses to stimuli change over time.

A Computational Model of Pitch Streaming and Dissonance

Neil McLachlan;
University of Melbourne, Australia

PA168, Time: 09:00

The roughness model of sensory dissonance first proposed by Helmholtz in the 19th century, and then refined by Plomp and Levelt in 1965, has dominated music literature. This model proposes that dissonance is due to co-modulation of excitation within critical bands, and so would be associated with processing in the brain stem. However over the last decade evidence has emerged that suggests that dissonance is associated with cortical mechanisms, and may be due to difficulty in streaming component sources. The recent Object-Attribute model of auditory perception by McLachlan and Wilson proposed that recognition mechanisms are integral to streaming and the formation of auditory gestalt by priming population codes for auditory features such as pitch. In a computational model of pitch processing McLachlan proposed that pitch priming is based on the location and pattern of excitation across critical band filters in relation to templates stored in long-term memory for common sound types such as pure tones and harmonic complexes. This paper outlines a neurobiologically detailed computational model of the recognition and pitch priming mechanisms proposed in these earlier models. The accuracy of matching a single pitch component of chords may be used as a measure of pitch streaming. The model predictions of the strength of pitch priming compared well to behavioral data in the literature for pitch matching accuracy for the

components of 2-pitch chords of harmonic complexes. The strength of pitch priming was limited by the resolution of critical band filters and interactions between pitch priming mechanisms associated with memory templates for particular chords. Furthermore, reductions in the strength of pitch priming were correlated to both poorer pitch streaming and to increased dissonance ratings for various chord tunings.

Brainstem Encoding of Consonant and Dissonant Intervals

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

PA063, Time: 09:30

This study seeks to understand how musical intervals are encoded in early (subcortical) stages of auditory processing. In our previous study, we found that brainstem structures faithfully represent the fundamental frequencies (f0s) and harmonics of the two tones composing a musical interval. As a consequence of nonlinear processes in the nervous system, combination tones were also evident in the human auditory brainstem response (ABR).

To examine how combination tones contribute to the sensory consonance and dissonance of musical intervals, this study measured ABRs to musical intervals with varying degrees of consonance and dissonance. Results show that, for the consonant intervals, the combination tones with the largest amplitudes reflect notes that are musically well harmonized with the f0s of the interval. In contrast, the combination tones in the ABR for the dissonant intervals form non-harmonic chords when combined with the stimulus f0s. This suggests that the consonance or dissonance of an interval is maximized by nonlinear processes in the auditory system. These processes give rise to distortion products (combination tones) that effectively make a consonant interval sound more consonant or a dissonant interval sound more dissonant.

Compared to the dissonant intervals, the spectra of the consonant intervals also included fewer and more widely spaced spectral components. This is because most combination tones of consonant intervals coincided with the f0s, harmonics or other combination tones. Helmholtz (1877) proposed that the perception of dissonance results from beats caused by the interference of partials and combination tones of close frequencies. By demonstrating that consonant intervals produce overlapping frequency components in the ABR, this study provides the first neural evidence supporting Helmholtz's theory.

Repetition Detection Across Multiple Exposures

Elizabeth Hellmuth Margulis; University of Arkansas, USA

PA043, Time: 10:00

It has often been observed that music is a hyper-repetitive stimulus. Zuckerkandl (1956) marvels that "music can never have enough of saying over again what has already been said, not once or twice, but dozens of times." Bruno Nettl calls repetition "a musical universal" (1983) and W. Tecumseh Fitch refers to it as "a design feature of music" (2006). Yet we know remarkably little about the cognitive mechanisms underlying the aesthetic processing of musical recurrence.

This study addresses a preliminary question in the larger enterprise of understanding the perceptual function of musical repetition: what things do listeners hear as repetitions, and when? How does repetition detection change across multiple exposures of a particular work?

Participants with minimal formal musical training heard short excerpts from commercial recordings of four contrasting pieces. While they listened, they were asked to press a button each time they identified a repetition of any element, whether long or short. They heard each excerpt four times in a row, performing the task again each time.

Task success was indicative of the level of attending employed by a listener — repetitions that occurred at a sub-tactus level were more difficult to detect, as were repetitions that extended too far beyond it. The effect of exposure on repetition detection varied according to the type of repetition — exposure facilitated repetition detection

for long units, but hindered repetition detection for short units, suggesting that across rehearsals, attention shifts away from small- and toward larger-scale levels of organization.

Social Psychology 4

KANE 110, 11:00 – 12:30, Thursday 26 Aug 2010

Musical Group Interaction in Children Can Promote Empathy Through Shared Cognitive Mechanisms

Tal-Chen Rabinowitch, Ian Cross, Pamela Burnard; University of Cambridge, UK

PA174, Time: 11:00

Various cognitive mechanisms are involved in the perception of music and its production. Several of these very same mechanisms may also be important for empathy. Underpinning this relation between music and empathy is a theoretical model describing the process of emotional perception of music and how music, especially in a group context, may create joint intentionality, leading, under certain conditions to an experience of intersubjectivity amongst players. Repeated, music-induced, experience of intersubjectivity could help develop skills that may also be beneficial for an everyday capacity for empathy. We therefore set to explore the extent to which the experience and skills acquired in music can be transferred to empathy in real life situations. We conducted a year-long study that consisted of a special musical program intended for children (including several control groups), especially tailored to emphasise and encourage a set of putative musical features (or cognitive mechanisms, e.g. entrainment, imitation, etc.) that are predicted to positively influence empathy. Empathy was evaluated at the beginning and end of the study. We found a significant improvement in empathy scores in children participating in music but not in control groups, in support of our hypothesis. Moreover, children who took part in the musical program showed a differential emotional reaction to a sad stimulus, depending on the level of entrainment in a preceding part of the test. No such selective emotional response was observed in children from control groups, implicating more directly the links between music and entrainment, and between entrainment and empathy.

Drumming Together Increases Activity in the Caudate and Prosocial Behavior — If Drumming Comes Easy

I. Kokal¹, A. Engel¹, Sebastian Kirschner², C. Keysers¹; ¹University of Groningen, The Netherlands; ²MPI EVA, Germany

PA032, Time: 11:30

Why does chanting, drumming or dancing together make people feel united? Here we investigate the neural mechanisms underlying interpersonal synchrony and its subsequent affiliative effects among synchronized individuals. We hypothesized that reward areas will be active when individuals synchronize their actions during drumming, and these reward signals will facilitate prosocial commitment among drum partners. 18 non-musicians were scanned with functional magnetic resonance imaging while they drummed a rhythm, in alternating blocks, with two experimenters: one drumming in- and the other one out-of-synchrony relative to the participants. During the last (manipulation) run, one experimenter drummed continuously with half of the participants in- and with the other half out-of-synchrony. After scanning, this experimenter 'accidentally' dropped eight pencils, and the number of pencils collected by the participant was used as a measure of prosocial commitment. Our results revealed that participants, who mastered the rhythm easily before scanning, showed increased activity during synchronous drumming in an area (caudate) we showed to also respond to monetary rewards in the same participants. The activity in the caudate also predicted the number of pencils the participants later collected to help the experimenter. In addition, participants collected more pencils to help the experimenter when she was drumming synchronously than when she was drumming asynchronously. By showing an overlap between activity during synchronized drumming and monetary reward, our findings suggest that interpersonal synchrony is culturally universal because it increases affiliation by triggering the basic reward system.

Synchrony, Compliance, and Destructive Obedience

Scott S. Wiltermuth; University of Southern California, USA

PA157, Time: 12:00

Two experiments demonstrated that practices involving synchrony can enable people to bind other people to them, making those others more likely to comply with their requests and engage in destructive obedience. In the first experiment, participants who acted in synchrony with a confederate were more likely than those in the asynchronous condition to comply with the confederate's request to lie about their performance in a subsequent joint task. In a second experiment, participants instructed to follow a leader while walking in-step with him felt closer to him and were more willing to kill sow bugs at the leader's request in an ostensibly different experiment than were participants in other conditions. The studies thus showed that synchronous activity can be used to spur anti-social behavior.

Development

GOWEN 201, 11:00 - 12:30, Thursday 26 Aug 2010

Young Children's Song-Making: An Analysis of Patterns of Use and Development

Margaret S. Barrett; University of Queensland, Australia

PA178, Time: 11:00

This paper reports the findings of a three-year longitudinal study of young children's (aged 18 to 54 months approximately) song-making (invented and canonic song) and music engagement that sought to identify the nature, extent, and purpose of young children's engagement in song-making and music engagement, and the characteristic features of the musical 'products' they developed. 18 parent-child dyads were recruited from two settings, a *Kindermusik* programme (12 dyads) and a day-long child-care centre (6 dyads). Data sources included parent-maintained video and paper diaries of song-making and music engagement, interviews with parents and other care-givers, and researcher observations of children in musical activity. These data were coded and categorized to identify the nature, use, and characteristic features (musical, emotional, expressive, linguistic, and affective) of children's engagement as singers, listeners, song-makers, and music-makers. Findings indicate that young children use song-making in varied contexts in their daily lives and for a range of purposes. Their song-making reflects both a capacity to adopt and adapt the musical features of their musical environment in their music-making, and, early indications of an individual "style". Song-making provides a means by which young children practise and elaborate on the musical forms of their cultural setting. Such work builds a rich repertoire of musical thought and action that underpins their musical development. Children's song-making (invented) also functions as a means by which they monitor and regulate their interactions with the emotional, social and material features of their world, and, in this process, undertake crucial identity work.

Analysis of Timing in Children's Music Reading Performances

Helga Rut Gudmundsdottir; University of Iceland, Iceland

PA096, Time: 11:30

Previous research has demonstrated that the measurement of timing is highly challenging in children's music reading performances. In this study, music reading performances of 6-13 year-old piano students with two-year piano training were analyzed. The performances were digitally recorded as the students read three short musical pieces with simple rhythms of quarter notes and eighth notes. The data included information on the frequency and duration of pauses, length of performances and individual pitches.

The results confirm previous findings regarding highly erroneous timing in children's music reading performances. The timing data was thoroughly examined and analyzed in order to search for age related characteristics and patterns in the children's performances. On average, the older children completed their performances faster than the younger children by 1.7 seconds and made fewer and shorter

pauses than the younger children. However the standard deviations were higher in the older group than in the younger group.

The method used to estimate rhythmic accuracy was to calculate the ratio between the quarter notes and the eighth notes in the score. The ratio would be close to the value 1.0 in rhythmically non-varied performance but close to the value 2.0 if the rhythmic values were observed. The younger children produced more values of 1.0 than the older children and vice versa, indicating that the older children observed the rhythm more accurately than the younger children. The implications of the results are both in terms of music reading and research methodology.

Investigating Age Related Differences in Timbre Representation and Discrimination

Leen De Bruyn, Dirk Moelants, Marc Leman; Ghent University, Belgium

PA139, Time: 12:00

For the development of age appropriate music education applications for the evaluation and training of timbre perception and discrimination, good insight in the development of timbre perception and age specific timbre mapping is necessary. However, research on the development of timbre discrimination and representation is very scarce.

The present study aims at gaining a deeper insight in the development of timbre perception skills and the results will contribute to the development of an age appropriate training application for timbre perception skills in children. We looked both at age related differences in timbre mapping based on similarity judgements by adults and primary school children, and age related differences in timbre identification and representation skills. In total 179 children of three different age categories and 36 adults were asked to fill out a questionnaire investigating timbre representation and timbre discrimination skills.

Results show that timbre representation and timbre discrimination skills are age specific and interrelated. Up to 9 years old, children have difficulties with representing or describing abstract musical sounds, directly impacting their ability to judge similarities between musical timbres correctly.

Music & Language 1

GOWEN 301, 11:00 - 12:30, Thursday 26 Aug 2010

Modular Processing? Phonetic Information Facilitates Speech and Song Imitation

James T. Mantell, Peter Q. Pfordresher; University at Buffalo, USA

PA081, Time: 11:00

The modular account of musical processing holds that some aspects of song processing are domain-specific; song and speech processing might occur along relatively distinct, independent pathways. In the current work, five experiments utilized an intentional imitation paradigm to investigate the accuracy with which normal individuals imitate the pitch-time trajectories of short speech and song sequences. Participants imitated sentence and melody targets that were presented in their original, worded form and as phonetically neutral, wordless sequences (syllables were synthesized to a 'hum'). Melodies were created based on the pitch-time contour of sentences but were diatonic and isochronous. Experiments 1 and 2 investigated whether or not phonetic information assists or disrupts imitative performance; in Experiment 1, the original targets were imitated as heard but in Experiment 2, participants imitated all sequences using the neutral syllable "ah." Experiments 3, 4, and 5 manipulated temporal structure so that speech and song duration were equated (Experiment 3), target syllable timing was speech-like (Experiment 4), or isochronous, like melodies (Experiment 5). Global pitch imitation accuracy was analyzed by comparing pairs of matched target-imitation pitch-time trajectories after adjusting for differences in production rate; these adjustments were used to measure the imitation of overall sequence rate. The results showed that throughout all timing manipulations, speech and song imitation was superior

when phonetic information was presented in the target and produced in the imitation. The results also revealed a melodic advantage for absolute pitch matching. The robust phonetic advantage does not strongly favor a modular account of song processing.

A Cross-Domain Model? Grouping of Phonemes into Syllables by a Model of Melodic Segmentation

Geraint A. Wiggins; Goldsmiths University of London, UK

PA145, Time: 11:30

I present an exploratory study into the application of the IDyOM model of musical melody learning, prediction and segmentation to learning of linguistic sequences. In this study, I report on the segmentation of phonemes, represented in a symbolic format, into syllables. Using metadata from the TIMIT corpus, I demonstrate that the IDyOM model of musical melody expectation is capable of predicting segmentation boundaries in linguistic phoneme streams. The model predicts syllable boundaries in this data with $k=0.48$, characterised by Landis and Koch as "moderate agreement"; precision is .71, recall is .63, F1 is .67. These results show that the IDyOM model, though designed for the simulation of human melodic expectation in music is capable, with a very simple extension, of predicting segmentation in language. This adds support to the system as a model not just of melodic expectation, but of generalised perceptual sequence learning. It also provides a candidate explanatory model of a common process which would unify these aspects of the perception of language and music.

An Investigation of the Acoustic Vowel Space of Singing

Evan D. Bradley; University of Delaware, USA

PA069, Time: 12:00

Speaking and singing use the same vocal apparatus, but to very different effect. While the articulatory and acoustic properties on speech require the speaker to balance perceptibility and articulatory effort concerns, these pressures are moderated in singing by additional concerns for consistent resonance, expression, and style. This study aims to determine whether acoustic changes caused by singing which affect vowels have a systematic effect upon the acoustic vowel space which could have consequences for the linguistic content of sung lyrics.

One major difference between speech and singing is larynx height, which tends to be lower during singing. Larynx height varies during speech, and is associated with vowel identity. The effect of larynx lowering causes the first and second formant frequencies of most vowels to be lowered, generating predictions for changes in vowel space between the two registers.

In order to compare the vowel spaces used during singing and speech, singers were recorded singing and speaking the lyrics of a song, and the formant frequencies of each vowel were analyzed. Analysis of spoken and sung vowel spaces indicates that the vowel space undergoes systematic changes during singing. Some of these changes are consistent with larynx lowering, but other articulation changes occur, and articulation strategies may be employed differently by male and female singers.

Auditory Perception 3

SMITH 120, 11:00 - 12:30, Thursday 26 Aug 2010

A Cognitive Test of Interactive Music Listening

Grace Leslie¹, Olivier Warusfel²; ¹University of California at San Diego, USA; ²IRCAM, France

PA147, Time: 11:00

Recent efforts at designing interactive sound environments at Ircam, in particular the installation Grainstick by Pierre Jodlowski, have shown the enthusiasm that ensues when an audience is able to take an active role in music production.

The test described here employs the full musical version of the installation, in which various synthesis methods were coupled to motion

tracking systems, in an effort to discern the effect that interactivity may have on music listening. Two controllable sound types and one uncontrollable ambient sound were included in these methods. Each sound type had one associated sound effect (movement, modulation, or placement in space).

Participants were divided into active and passive groups, in which they were exposed either to a listening exposure or interactive exposure of the installation. During the test, a mixture of previously presented or not presented sounds, with or without their associated effect, were presented to the participants, who in turn performed a forced-choice recognition task.

The effect of mode of presentation, that is, whether the subject was active or passive, was not statistically significant. However, sounds with controllable effects were better recognized than their uncontrolled counterparts. These preliminary results support the importance of spatial and modulation effects for sound recognition in interactive musical settings. Current and future research examining the role of physical interaction in the music listening process will also be discussed.

The Role of Familiarity in the Perception of Dissonance for Musical Chords

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

PA047, Time: 11:30

Sensory dissonance is assumed to be created by the beating of closely tuned tones that give rise to perceptual roughness. Previous studies challenge this view with patient cases of cortical lesions showing selective loss of sensory dissonance. Furthermore, EEG correlates of dissonance have shown to be similar to those for pitch streaming, and neurobiological models of pitch perception have linked this to increases in stimulus familiarity. We investigated the contribution of roughness, familiarity, and pitch streaming to sensory dissonance in musicians of varying ability. Seventy-eight individuals were questioned about their musical habits and asked to listen to a series of musical chords with varying harmonic overtones. Pitch streaming ability was measured by asking participants to match nominated pitches with a sine tone. Each musical chord was also subjectively rated for familiarity and dissonance. Results showed that high pitch streaming ability was strongly dependent on active instrumental practice and not on passive listening. We found no evidence that dissonance increased with the number of harmonics as predicted if roughness caused dissonance. Furthermore, familiarity with particular musical chords reduced perceived dissonance for participants with high pitch streaming ability. These findings provide strong evidence that musical practice reduces the experience of dissonance.

Accuracy Gains in Relative Pitch Perception Conferred by Presentation of Congruent Non-Auditory Information

Frank A. Russo, Michael Maksimowski; Ryerson University, Canada

PA172, Time: 12:00

In live music, auditory information tends to be accompanied by congruent visual information as well as congruent vibrotactile information. The current study was designed to examine the potential gains conferred by such non-auditory information. In Experiment 1, participants were asked to make interval size judgments for sung melodic intervals in each of three unimodal conditions. Auditory stimuli were presented via headphones; visual stimuli were presented via LCD (visual recording of singer); and vibrotactile stimuli were presented using a pair of tactaid skin stimulators held in the palm (driven by the auditory signal). Following brief exposure to sample intervals, participants were asked to make interval size judgments (in semitones) for all chromatic intervals spanning 1 to 11 semitones in each unimodal condition. Accuracy of the interval size judgments was better than chance across all conditions with auditory yielding the best accuracy followed by visual and then vibrotactile. In Experiment 2, participants made interval size judgments in unimodal as well as cross-modal conditions. Accuracy of interval size judgments was

best in the audio-visual condition and comparable in the audio-alone and audio-tactile conditions. In Experiment 3, participants were trained with vibrotactile stimuli over a series of five 90-minute sessions. Accuracy of interval size judgments in audio-tactile conditions steadily improved as training progressed and ultimately exceeded accuracy levels obtained with audio and audio-visual conditions. The results are discussed in light of differences in the extent of exposure to visual and vibrotactile information in music.

Symposium: Music Health and Wellbeing: Clinical and Applied Contexts

KANE 110, 14:00 – 16:00, Thursday 26 Aug 2010

Investigating the Effects of Music on Experimentally-Induced Pain

Laura A. Mitchell, Raymond MacDonald; Glasgow Caledonian University, UK

SYM061, Time: 14:00

The efficacy of psychological pain management strategies is frequently tested using methods of experimentally-induced pain, allowing greater control in comparisons of what is a complex and highly individual experience. This presentation provides an overview of the contribution made by such studies to the evidence base for music listening for pain relief and management; discussing theoretical and methodological issues, strength of the evidence to date and our developing understanding of the mechanisms underpinning the effects.

Psychoneuroendocrine Effects of Musical Behaviour on Health and Wellbeing — An Overview of Research

Gunter Kreutz¹, Cynthia Quiroga Murcia², Stephan Bongard²; ¹Carl von Ossietzky University of Oldenburg, Germany; ²Frankfurt University, Germany

SYM063, Time: 14:30

The focus of his paper rests on psychoneuroendocrinological effects of musical behaviour in non-clinical and clinical contexts. Both historical and evolutionary perspectives offer views on musical participation to significantly influence neurohumoral processes in the brain that may have profound consequences on individual health and wellbeing. Empirical approaches over the last two decades have begun to address such assumptions using markers including cortisol, oxytocin, testosterone, endorphine, immunoglobulin A, and others. The goal of this review is to evaluate the existing literature at different levels including methodologies, results, and interpretations of findings. A further goal is to highlight emerging themes for future research, particularly with respect to the developing field of music and health. Significant effects of various musical activities on psychobiological markers have been observed in some, but not all studies. However, the development of this research appears compromised by paucity of publications, in general, and methodological issues, in particular. Importantly, the specificity of musical influences at neurohumoral levels has not been convincingly demonstrated. We argue that psychophysiological effects of music at neurohumoral levels suggested in the literature are inconclusive and subject to continued discussion. In particular, systematic reviews as well as meta-analytic studies will be needed which require a far greater amount of highly controlled studies than are available today. Investigating psychoneuroendocrine processes thus remains one of the most promising and fascinating areas of research on consequences of musical behaviours for health and wellbeing.

Researching the Relationship Between Health Psychology and Community Music in Diverse Settings

Alexandra Lamont, Michael Murray; Keele University, UK

SYM064, Time: 15:00

Previous research on music in community settings has largely been descriptive. There is a need for greater attention to potential theoretical concepts that can help develop our understanding of the varying

impact of music in these settings. This paper brings together two different psychological perspectives to explore community music. Firstly, a community psychology approach considers the processes involved in engaging people in social action coupled with Freire's work on critical literacy which emphasises the importance of connecting local social action with broader social change. Secondly, principles of positive psychology are drawn on, namely the components Seligman identifies as being necessary for well-being: hedonism, engagement and meaning. Bringing these two perspectives together helps understand both the community and the individual within it.

The paper presents evidence from two different community settings exploring how music can provide a focus for creating and enhancing community confidence and cohesion and for supporting wellbeing. One of these is a choir which was prompted by participants within a relatively affluent close-knit village community, while the other is a choir set up by local organizers in an inner-city area of social deprivation. Participants and organizers from both settings have been interviewed, focusing on motivations to engage and sustain the activity and placing this in participants' own musical biographies. The key themes emerging from the analysis are similar across settings, drawing out a group narrative, highlighting various social and community issues, and emphasizing participants' enjoyment in singing alongside health problems and organizational challenges.

Community music is one type of project which has great potential in enhancing community confidence and well-being. The current results provide important insights into the challenges involved in generating a musical community and in providing interventions which are sustainable and long-lasting. In addition to empirical findings, the presentation will also review the theoretical and practical issues involved in linking community music with health psychology.

Music: A Non-Pharmacological Intervention in Clinical Pain Patients

Guenther Bernatzky¹, Michaela Presch¹, Werner Kullich²; ¹University of Salzburg, Austria; ²Ludwig Boltzmann Institute for Rehabilitation of Internal Diseases, Austria

SYM062, Time: 15:30

The specific aim of this paper is to evaluate the effects of music on acute and chronic pain in clinical pain patients with and without surgery. Our goals are two-fold, namely first to present an overview of research, and second to address issues surrounding the implementation of music in pain therapy for clinical patients. Whereas the efficacy of systemic and regional analgesia techniques is well proved, the efficacy of music as a non pharmacological intervention for the treatment of pain has not been established well enough. Music alleviates pain, stress and feelings of depression in patients suffering from acute and chronic pain. Music can also relieve some cognitions such as helplessness and hopelessness.

Infant Development 1

GOWEN 201, 14:00 – 16:00, Thursday 26 Aug 2010

“Watch and Listen to the Singer:” Perception of Face-Voice-Song Associations by Infants and Adults

Eugenia Costa-Giomi; University of Texas at Austin, USA

PA009, Time: 14:00

We would be surprised to hear Pavarotti sing Michael Jackson's "Beat It" or watch Kathleen Battle sing Verdi with the voice of Dolly Parton. This is because we have learned to associate these musicians with certain songs and musical styles and have also learned to associate their voices with their faces. We investigated infants' and adults ability to associate a singer with a specific voice and melody.

We presented infants and adults with videos of two women each singing a different song. After familiarizing them with the two combinations of face-voice-melody (Face A-voice A-melody 1 and face B-voice B-melody 2) we presented them with two novel combinations (Ab1, and Aa2) and a familiar one (Aa1).

Infants attended significantly longer to the novel combination in which the face-voice association was violated than to the familiar combination in which all associations were preserved indicating that they had learned the correspondence between the voices and faces of the singers. Supporting previous research, the results showed that infants did not attend longer to the combination that violated the voice-melody association. On the other hand, adults detected the violation of voice-melody association but not the violation of voice-face association. In other words, infants were more sensitive to the association between the voices and faces of the singers whereas adults were more sensitive to the association between the faces of the singers and the melodies they sang.

Participation in Active Infant Music Classes Accelerates Acquisition of Scale Structure Knowledge

David Gerry, Laurel J. Trainor, Andrea Unrau; McMaster University, Canada

PA016, Time: 14:30

Given that music is important for mother-infant interaction and that the brain is most open to change early in development, infant music classes with active participation have potential for wide-ranging benefits. Past research has shown that under normal circumstances Western infants have not yet acquired knowledge of what notes belong in the Western major scale. In the present study, part of a larger project, infants ($n=30$) were randomly assigned to either Suzuki philosophy music classes or passive music listening control classes. After 6 months of classes, infants controlled how long they listened to either a tonal or atonal version of a short melody in a head-turn preference paradigm. An ANOVA revealed an interaction between type of music class and preference for the tonal versus atonal version. Suzuki class infants looked significantly longer at the tonal, compared to the atonal version of the melody; there were no significant effects in the passive listening group. Furthermore, listening times decreased significantly over the preference test session for infants in the Suzuki class, but not for infants in the control class, suggesting more efficient encoding in the former group. These results suggest that the Suzuki classes accelerated acquisition of musical key structure. We conclude that active musical participation affects musical acquisition and that infants can engage in meaningful musical training when appropriate pedagogical approaches are used.

Challenging Infants' Apparent Bias for Speech

Mariève Corbeil¹, Sandra E. Trehub², Isabelle Peretz¹; ¹Université de Montréal, Canada; ²University of Toronto Mississauga, Canada

PA039, Time: 15:00

A number of scholars have argued that infants prefer speech to non-speech signals and "happy talk" to neutral talk. The goal of the present study was to determine whether infants prefer happy talk to vocal but non-verbal music, specifically, humming. Infants 4-6 months of age and 7-11 months of age were exposed to infant-directed speech syllables and hummed lullabies in a head-turn preference procedure. Speech stimuli differed from hummed lullabies not only in the presence of consonants and vowels but also in greater variations of pitch, loudness, timbre (voice quality), and timing. Although both types of stimuli were highly engaging to infants, no preference was evident at younger or older age levels. The findings raise questions about claims of inherent biases for speech in general or for happy talk in particular. Future comparisons should include happy talk versus hummed play songs and soothing talk versus hummed lullabies.

Can Prospective Parents Differentiate Between an Infant's Musical and Linguistic Babblings?

Mayumi Adachi; Hokkaido University, Japan

PA151, Time: 15:30

The infant's vocalization diverges into linguistic and musical babblings (Moog, 1968/1976). Musical babblings tend to occur in musical contexts (Tafuri & Villa, 2002). In Adachi and Ando (2010), the acoustical features of a Japanese toddler's babblings did not

differ as a function of context. However, Japanese mothers tended to interpret the babblings originated from infant-directed speech (IDSp) as "speech-like" and those originated from infant-directed songs (IDSn) as "song-like" even though the original context of each babbling was not perceptible. These results suggest that "musical" babblings are a human, rather than an acoustical, phenomenon. The next question is whether the differentiation of speech- and song-like babblings is a "maternal" or a general phenomenon. In the present study, I investigated whether young adults — prospective parents — would differentiate between the toddler's musical and linguistic babblings. I also explored possible auditory cues that would determine their interpretations. If the phenomenon derived from a maternal instinct, only female adults would be able to differentiate babblings. Japanese young adults (22 women, 22 men) without any child listened to 50 vocal stimuli (0.5-6s) extracted from spontaneous exchanges between a 19-month-old Japanese toddler and his parents at home. All the stimuli contained only the infant's voice that was not crying, nagging, laughing, or clearly discernable words. The participants evaluated how each stimulus sounded on a 4-point scale from "1 = clearly speaking" to "4 = clearly singing." Results and their implications will be presented.

Music & Language 2

GOWEN 301, 14:00 - 16:00, Thursday 26 Aug 2010

The Speech-to-Song-Illusion: Empirical Findings

Simone Falk¹, Tamara Rathcke²;

¹Ludwig-Maximilians-Universität München, Germany;

²University of Glasgow, UK

PA041, Time: 14:00

We investigate a musical illusion first described by Diana Deutsch. In this "speech-to-song illusion", a spoken phrase shifts to be heard as sung without changing any acoustic characteristics of the signal. The perceptual change is achieved by repeating the phrase several times in exactly the same way. So far, the effect has been found only with a single phrase as piece of evidence and shown only for English. We assume that the acoustic shape of a spoken phrase will either support or suppress the perception shift from speech to song depending on tonal and/or rhythmic factors. We hypothesize that the shift will occur more often and earlier, i.e. after fewer repetitions, when the following acoustic characteristics are present in the signal: (1) regularity of accentual structure (as opposed to non-regularity), and intervocalic segmental grouping (as opposed to syllable-based grouping); (2) level-like f_0 -trajectories (as opposed to contour-like f_0 -trajectories), and presence of prominent musical intervals (as opposed to non-scalar tonal relationships). The rhythmic (1) and tonal (2) hypotheses were tested with 62 German listeners using prosodically manipulated speech. Results show that the acoustics of the signal did influence the perception of the illusion, and especially the overall frequency of occurrence. The tonal hypothesis was mainly supported since target stability significantly facilitated occurrence of the illusion. Results concerning the rhythmic hypothesis were less clear and await further exploration in an ongoing experiment. Furthermore, we could demonstrate that the speech-to-song illusion is robustly perceived by German listeners and that it is not a language-specific phenomenon.

Further Factors Affecting Word Intelligibility in Sung Phrases

Randolph Johnson¹, David Huron¹, Lauren Collister²;

¹Ohio State University, USA; ²University of Pittsburgh, USA

PA102, Time: 14:30

Research on word recognition has a long-standing tradition. However, comparatively little research has investigated factors that contribute to the recognition of sung lyrics in music. A previous study by Collister and Huron (2008) found a seventy-five percent drop in word-recognition frequency of sung English words compared with spoken counterparts.

Following our previous findings, the present study focused on eight factors that were thought to be important influences on word intelligibility in musical phrases: 1) archaic/vernacular words; 2) presence of diphthongs; 3) melismatic text setting; 4) alignment of music/word stress; 5) word repetition; 6) a syllabic setting priming an ensuing melismatic setting; 7) rhyme; and 8) singer voice type (operatic or musical theater).

First, we recorded six vocalists in a concert hall. Each vocalist sang solo melodies whose lyrics consisted of a standard carrier phrase that ended with a "target" English word. During the experimental phase of the study, participants listened to these sung passages, while attempting to identify the target word. After hearing each passage, participants typed their response on a computer keyboard.

The results indicated that the intelligibility of lyrics was degraded in four conditions: 1) archaic language; 2) melismatic setting; 3) music/word stress mismatch; 4) rhyming, successive target words. Intelligibility of lyrics was facilitated in three conditions: 1) words containing diphthongs rather than monophthongs; 2) target word repetition in a successive passage; 3) melismatic setting preceding a syllabic setting of the same target word. Musical theater and operatic voice types did not exhibit a significant difference in intelligibility.

Where Weird Is Wonderful: Incongruities and Aesthetics Across Music and Language

Cara R. Featherstone, Catriona M. Morrison, Mitch G. Waterman, Lucy J. MacGregor; University of Leeds, UK

PA091, Time: 15:00

Theories regarding expectations, incongruities and aesthetics present a striking similarity across music and language domains. Traditional explanations and more recent theoretical accounts suggest a model in which an element incongruous with expectations contributes to a heightened aesthetic experience. However, to date there has been no systematic comparison of the processing of aesthetic incongruities across music and language.

The present study aimed to assess the plausibility of a unified model, through the analysis of Event-Related Potential (ERP) and behavioural data. The auditory stimuli were short sentences and musical pieces that included specific incongruities (harmonic, rhythmic, semantic or syntactic) used for effect by authors and composers. The stimuli were experimentally manipulated to produce three conditions: no incongruity (*normal*), an incongruity which was resolved (*unexpected-resolved*) or an unresolved incongruity (*unexpected-unresolved*; Featherstone et al., in preparation). Twenty-four musicians and 24 non-musicians used seven identical scales to rate these stimuli for tension, oddity, cognitive engagement and aesthetics while EEGs were recorded.

Oddity ratings increased significantly between conditions (*normal* < *unexpected-resolved* < *unexpected-unresolved*) in both participant groups, but a typical oddity-related ERP effect was significant only in musicians for the harmonic stimuli and only in non-musicians for the semantic stimuli. The *unexpected-resolved* stimuli were rated as significantly more aesthetically pleasing than *normal* stimuli in the harmonic and semantic sets by the group who did not show the typical oddity-related ERP effect. The implications of these findings are discussed with respect to interpretations of the observed ERP effects and music and language aesthetics.

Musical Modality in Spontaneous and Acted Speech

Dicky Gilbers¹, Laura van Eerten²; ¹University of Groningen, The Netherlands; ²Institute for Dutch Lexicology, The Netherlands

PA030, Time: 15:30

Speech resembles music in many aspects. One of the common features is the expression of emotion. This raises the question whether intonation patterns in emotional speech resemble major and minor modalities in music. We report on several studies which show that major modality is indeed found in read out happy speech, whereas it is less present in spontaneous happy speech. In this study we investigate major modality in spontaneous speech and acted realizations of the spontaneous speech fragments.

Spontaneous emotional intonation was obtained in interviews in which participants were asked to talk about hilarious passages from a movie or a book. In order to elicit comparable acted speech, the most cheerful fragments were repeated by actors in a performance task. Frequency analyses of most spontaneous cheerful speech fragments show one frequency peak. In acted speech, however, we find significantly more often modes in the sense of more than one peak in the distribution.

Listeners are well capable of distinguishing acted from spontaneous speech. The difference has been characterized by position of pauses, speech rate and precision of articulation. In this study we introduce modes as an extra acoustic discriminating parameter. Musical modality provides a template for emotional speech, which emerges in particular in acted speech. However, these idealized realizations are set aside in spontaneous speech due to lenition influences on the articulation of speakers. We conclude that especially acted emotional prosody is very similar to musical modality.

Rhythm & Timing 1

SMITH 120, 14:00 - 16:00, Thursday 26 Aug 2010

A Detuned Simple-Ratio Attractor in Production of Cyclic Two-Interval Rhythms

Bruno H. Repp¹, Justin London², Peter E. Keller³; ¹Haskins Laboratories, USA; ²Carleton College, USA; ³MPI CBS, Germany

PA123, Time: 14:00

Early research on the cyclic production of rhythms consisting of two unequal intervals has shown that the simplest interval ratio (1:2) tends to be produced most accurately, while other ratios are distorted in the direction of 1:2, which thus functions as an attractor. Recently, however, we have found that the 1:2 ratio itself is reliably distorted (increased) in musicians' tapping, suggesting a complex attractor ratio in the vicinity of 4:7. This result was obtained in a synchronization task, and it could have been due to a range of interval ratios that was not symmetric around 1:2. Experiment 1 used a synchronization-continuation task with two overlapping ranges of ratios, both including 1:2. At the faster of two tempi, the "upward detuning" of the 1:2 attractor ratio was replicated in both synchronization and continuation tapping, and range had no effect. At the slower tempo, the effect was obtained reliably only in synchronization, and only in the higher range. Experiment 2 showed that the effect is reduced but not eliminated when auditory feedback is provided during continuation tapping. Experiment 3 investigated whether the detuning arises in rhythm perception or production. The results point to production: The detuning persisted in production of a two-interval rhythm paced by a three-interval rhythm, but it disappeared in production of a three-interval rhythm paced by a two-interval rhythm. The cause of the detuning, however, is still not known.

The Role of Attention in Simultaneous Intrapersonal and Inter-Agent Coordination

Peter E. Keller, Tim Schröder; MPI CBS, Germany

PA082, Time: 14:30

Musical ensemble performance often requires simultaneous *intrapersonal* coordination between an individual's own body parts (e.g., two hands) and *inter-agent* coordination between one's own actions and externally controlled events (e.g., another's sounds). The current study investigated the attentional demands of such multilevel coordination by requiring musicians to solve easy or difficult mental arithmetic tasks while performing an antiphase sensorimotor synchronization task with or without feedback tones. Participants (12 percussionists, six with task-relevant gamelan experience) produced finger taps with alternating left and right hands on a MIDI percussion pad in antiphase with isochronous pacing sequences. These sequences were composed of medium pitched piano tones and taps did or did not trigger piano tones (which were either the same as, or different from, the pacing pitch). Participants concurrently solved an easy arithmetic task in one experimental session and a relatively

difficult arithmetic task in a second session. Results indicated that tap timing was most precise when feedback tones were provided. This general benefit of auditory feedback was more pronounced with difficult arithmetic than with easy arithmetic only in non-gamelan percussionists. Thus, temporal precision during simultaneous intrapersonal and inter-agent coordination is facilitated when one's own actions and external events can be readily integrated into a single sequence. Experts at multilevel coordination (e.g., gamelan musicians) engage in such integration independently of concurrent attentional demands, while individuals with less expertise benefit most from integration when attentional resources are scarce.

Temporal Coordination in Duet Performance

Janeen Loehr, Caroline Palmer; McGill University, Canada

PA029, Time: 15:00

Little research has examined how musicians achieve the precise temporal coordination that is required for ensemble music performance. The current study investigated piano duet performance to determine whether representations of a pianist's actions are activated in a duet partner with whom they must synchronize their performances, how individual differences in solo performance influence performers' ability to synchronize with their partners, and whether synchronizing with a partner influences partners' subsequent solo performances. Pairs of pianists performed right-hand melodies simultaneously with left-hand melodies produced by themselves (bimanual condition) or by their partner (duet condition). Each pianist also performed the right-hand melody without accompaniment, both before and after the experimental conditions (unimanual conditions). The complexity of the left-hand accompaniment influenced the timing of the right-hand melody in the same way whether it was performed by the self or by the duet partner, supporting the hypothesis that representations of partners' actions are activated during duet performance. A priori differences between partners' solo performance rates influenced how well-synchronized their duet performances were; the larger the difference between partners' solo rates, the larger their asynchronies during duet performance. Synchronizing with a partner also influenced individuals' subsequent solo performance rates; duet partners with larger a priori differences in solo rate converged in performance rate from before to after the duet performances, whereas pairs with smaller a priori differences diverged. These findings shed light on the mental representations that may underlie ensemble music performance and document the influence of individual differences on the dynamics of interpersonal coordination.

Tapping Doesn't Help: A Dissociation Between Motor Behavior and Tempo Judgment

Justin London; Carleton College, USA

PA008, Time: 15:30

Three experiments explored the relationships between beat rate, tapping, and tempo perception. All involved a rhythmic standard followed by a comparison; experimental task was a 3AFC of "slower, same, or faster." Stimulus patterns had component periodicities of 2400/1200/600/300 versus 2000/1000/500/250ms, respectively, using all combinations of the longest periodicity with all other components. In experiment 1 participants simply judged relative speed, in Experiment 2 focused on the beat level, and in Experiment 3 tapped along as they made their judgments. In all three experiments judgments were highly accurate (89–97% correct) when the standard-comparison involved the same pattern/same tempo, and were good for the same pattern at different tempos (80–83% correct). Performance degraded significantly in other contexts, especially different patterns at the same tempo (Exp 1 40%, Exp2 52%, Exp3 48%; Exp 3 vs. Exp 2 the difference is n.s.). A main effect for pattern and a pattern x tempo interaction were observed in all three; a main effect for tempo occurred only in experiment 1. Analysis of a subset of the experimental conditions indicated that surface activity was of greater salience than that of beat level. Tapping along (Experiment 3) did not improve overall performance, and a possible bias effect of tapping rate on tempo judgment was observed. Thus there is an apparent dissociation between tapping behavior and tempo judgments. This suggests that our judgments of tempo emerge from

our perception of periodicities in the music, awareness of our own rhythmic behavior(s), and the interaction between the two.

Performance 3

KANE 110, 16:30 - 17:30, Thursday 26 Aug 2010

IF — A 5-Year-Old Drummer Prodigy

Simone Dalla Bella, Jakub Sowiński; WSFiZ in Warsaw, Poland

PA035, Time: 16:30

A growing body of studies has targeted the development of time perception (e.g., beat sensitivity), and time production (e.g., in sensorimotor synchronization) in infants and children. For example, it was found that infants respond to violations of repetitive timing patterns (i.e., meter; Hannon & Trehub, 2005), and can code meter in auditory patterns via body movement (Phillips-Silver & Trainor, 2005). Moreover, around 2.5 years children start adjusting their movement to the beat of an auditory stimulus, in particular in a social setting (Kirschner & Tomasello, 2009). However, only after 12 years children's ability to synchronize is comparable to that of adults (Drake et al., 2000). Much less, however, is known about time production and perception in individuals exhibiting outstanding musical abilities, and their development with age. In this study we described the case of IF, a 5-year-old drummer exhibiting very precocious and outstanding musical abilities. At 4 years of age, IF already mastered the skills which allowed him to play in a band. At that time he started to be noticed internationally as a musical prodigy, and received the attention of world-class percussion teachers. IF and two comparison groups (5 age-matched controls, and 20 university students without musical training) performed sensorimotor synchronization (SMS) tasks and anisochrony detection tasks. In SMS tasks participants played on a drum pad in correspondence with isochronously presented sounds (with various IOIs), with the musical beat of familiar and unfamiliar musical excerpts, and with the main metrical stress of familiar spoken segments. In the anisochrony detection task, participants detected an anisochrony in 5-tone sequences. Performance in SMS tasks was analyzed using circular statistics. The results revealed that IF was more accurate and less variable in SMS tasks than both comparison groups for most of the presented stimuli. IF's performance in the anisochrony detection task, albeit higher than that of age-matched controls, was still comparable to that of adult non-musicians. In sum, IF, in spite of his young age, entrains to regular temporal patterns (e.g., musical beat) more accurately than adult nonmusicians do. IF's performance in synchronization tasks cannot be fully explained by his ability to detect deviations from isochrony (which is comparable to adult performance). These results shed new light on the relations between skilled performance in drumming and the ability to synchronize with regular temporal patterns during development.

A Phonotactics of Drum Patterns

Richard Ashley; Northwestern University, USA

PA170, Time: 17:00

Studies of speech production deal with both physical dimensions of vocal tract movements and with probabilistic frequency distributions of sound patterns. This study investigates similar factors in drum patterns. It aims to understand how drumming patterns are constructed, looking at both frequency of sequences of timbres and how these patterns are produced by motion sequences across the drumset. I focus on "linear drumming," where only one instrument is struck at a time, a technique with many parallels to speech. A corpus of drum parts in the linear manner was assembled, using both published texts and MIDI recordings. From these, grammars were produced using first- and second-order transition probabilities of timbre sequences. The drumming equivalents of "tongue twisters" were constructed, with sequences of notes which were not attested in the corpus but which would be either easy to produce, or not, in motor terms. Skilled drummers were given the patterns to replicate and the results were recorded. Results to date indicate that production of drum patterns is based on ease of production, but also on a cognitive or acoustic attribute of contrastiveness. Patterns which are difficult to produce

in terms of their movements are characterized by irregular timing, but so are patterns which lack acoustic contrastiveness. Drum patterns are built not only on abstract aspects of metric structure, but also on the ways in which the body interacts with the geometry of the drumset, and with acoustic demands of timbral contrast. Thus, linear drumming has many parallels with speech production.

Infant Development 2

GOWEN 201, 16:30 - 17:30, Thursday 26 Aug 2010

Hearing Two Objects at Once: Segregation of Simultaneous Auditory Objects by Harmonic Mistuning in Infants

Nicole A. Folland¹, Blake E. Butler¹, Nicholas A. Smith², Laurel J. Trainor¹; ¹McMaster University, Canada; ²Boys Town National Research Hospital, USA

PA049, Time: 16:30

Separating complex sound waves into the simultaneously-sounding objects that gave rise to them is crucial for the perception of polyphonic music and harmony. Until now, little research has addressed how well infants are able to separate complex sound waves containing information from two auditory objects. For adults, a mistuned harmonic in a complex tone segregates from the rest of the tone and is perceived as a separate higher-pitched auditory object. Experiment 1 used a conditioned head-turn procedure to examine whether 6-month-old infants are able to discriminate a complex tone with one harmonic mistuned from a complex tone with all harmonics in tune. Infants were able to discriminate mistunings of 8, 6, & 4% [mean d 's = 1.42 (SD=0.31); 1.29 (0.68); 1.17 (0.25)], but not 2% [0.23 (1.10)]. In a second experiment we used EEG to measure the 'object-related negativity' that correlates with the perception of two simultaneous auditory objects in adults. We found an object-related response in the case when one harmonic was mistuned but not when all harmonics of the complex tone were shifted in frequency. This research shows that by 4 months of age infants have the ability to use harmonic relations in order to determine whether there are one or two simultaneously-sounding objects, an ability that is necessary for musical development.

Differentiating People by Their Voices: Infants' Perception of Voices from Their Own Culture, a Foreign Culture and a Foreign Species

Rayna H. Friendly¹, Drew Rendall², Laurel J. Trainor¹; ¹McMaster University, Canada; ²University of Lethbridge, Canada

PA022, Time: 17:00

The ability to discriminate and identify people by voice is important for social interaction in humans. It is also important in musical contexts, where we can identify singers by their voice qualities. In the present study, we are investigating the role that experience plays in the development of voice discrimination. Learning to discriminate a number of musically-relevant stimuli has been shown to follow a common pattern of experientially-driven perceptual narrowing. For example, 6-month-old North American (NA) infants can detect mistunings equally well in both native Western scales and foreign Javanese scales. However, NA adults are much better at detecting the mistunings in native than Javanese scales. The aim of the current study is to investigate whether a similar narrowing pattern occurs for the processing of different vocal timbres. We tested English-speaking adults', 6-month-olds' and 12-month-olds' abilities to discriminate either native-language (English), foreign-language (Mandarin) or foreign-species (primate) vocalizations. Six-month-olds discriminated voices equally well for the primate and English voices. However, their performance was significantly better for English than Mandarin voices. In contrast, adults perform best-to-worst for the English, Mandarin, and primate vocalizations, respectively. Twelve-month-olds are currently being tested to see when perceptual narrowing occurs. Results suggest that the ability to discriminate individuals by voice becomes specialized for the vocal timbres in one's

environment after 6 months of age. Intriguingly, this specialization may occur earlier for human vocal timbres than for non-human vocal timbres.

Music & Language 3

GOWEN 301, 16:30 - 17:30, Thursday 26 Aug 2010

Probabilistic Finite-State Grammars of Text-Tune Association

Panayotis Mavromatis; New York University, USA

PA109, Time: 16:30

Tune-text association (TTA) examines how linguistic prosodic features of text that is set to music align with musical features of the underlying melody, most notably rhythm and pitch. TTA has been studied in many different musical idioms using a variety of formalisms, including statistical profiles, preference rules, optimality theory, and probabilistic finite-state grammars. Different formalisms have occasionally been compared to each other using goodness-of-fit (GOF) against an available corpus of melodies. While this diversity of approaches is illuminating, it may obscure essential similarities in TTA principles among different idioms. Moreover, GOF may not be the only relevant criterion for model selection; other criteria, such as parsimony or predictive power, may also be necessary. This paper examines a variety of TTA theories under the common framework of probabilistic finite-state grammars, facilitating comparison of TTA rules for different idioms and establishing a secure framework for model comparison and selection. The states, transitions, and output symbols of the grammar are determined so as to accommodate the allowed text-tune patterns prescribed by each constraint. A Hidden Markov Model algorithm is then used to estimate the probabilities of the grammar's transitions and output symbols. In the probabilistic finite-state framework, similarities in TTA between different idioms become apparent, indicating cross-cultural preferences for metric alignment and pitch contour. Moreover, different TTA rule sets can be readily evaluated for GOF and parsimony using the Minimum Description Length criterion.

Metrical Hierarchies and Musical nPVI: A Re-Analysis of Patel and Daniele

Justin London, Katherine Jones; Carleton College, USA

PA015, Time: 17:00

The "normalized pairwise variability index" or nPVI is a measure of the variability of successive syllabic durations in spoken language based on vowel length. Using a modified form of the nPVI, Patel and Daniele (2003) found differences in the surface rhythms of music by French versus English composers that corresponded to the nPVI differences found in spoken French and English. Patel and Daniele hypothesized this may be due to the influence of a composer's native language. The nPVI only compares the durations between events on the rhythmic surface of language or music. Yet musical rhythm is highly hierarchic in nature: surface elements cluster to form rhythmic groups which in turn form higher-level structures. The current study re-analyzes the data from Patel & Daniele (2003) to (a) examine nPVI measures on higher levels of rhythmic structure, (b) assess of the relevance of metrical type (duple vs. triple), and (c) explore the correlation between surface and higher-level nPVI. No significant differences were found for French vs. English in triple meters at either surface or higher levels, but significant differences were found for duple (surface $F(1,160) = 7.183$, $p = .008$; higher levels $F(1,160) = 6.380$, $p = .013$). There was no significant difference between duple and triple meters for English melodies at either surface or higher levels, but for French significant differences were found between duple vs. triple on both surface ($F(1,135) = 10.984$; $p = .001$) and higher ($F(1,135) = 26.541$; $p < .001$) levels.

Rhythm & Timing 2

SMITH 120, 16:30 - 17:30, Thursday 26 Aug 2010

Spontaneous vs Intentional Entrainment to a Musical Beat

*Alexander P. Demos, Roger Chaffin, Kerry L. Marsh;
University of Connecticut, USA*

PA134, Time: 16:30

We compared spontaneous vs intentional entrainment of rocking to a musical pulse. Participants sat in a rocking chair and rocked. As a cover task, in 13 of the 15 trials, they were asked to memorize five words and recall them after 45 seconds of rocking. In eleven of the trials, participants were exposed to a steady drum/cymbal beat. The tempo of the musical pulse either increased or decreased by 2 bpm on each trial (between 60 to 80 bpm) or was ordered randomly. Two baseline measurements of rocking tempo were taken at the beginning of the experiment and two more at the end.

Thirteen participants were instructed to rock at a comfortable pace (spontaneous condition); eighteen were instructed to rock with the beat (intentional condition). The motion was recorded at 60 Hz using a magnetic tracking system. We examined the synchronization of participants' back-and-forth movements in the rocking chair with the musical pulse. In the spontaneous entrainment condition, participants showed no evidence of synchronization, although they did rock faster with music than without it. In the intentional condition, some participants entrained to the actual beat, others doubled the beat, and others showed behavior that was more complex and not always stable. Overall, evidence for entrainment was not clear, but those in the intentional condition were clearly affected by the musical beat.

A Kinematic Model for Perceived Musical Tempo

Aysu Erdemir, Erdem Erdemir, John Rieser; Vanderbilt University, USA

PA149, Time: 17:00

Final Ritardando with its dynamic range of temporal variability is an ideal candidate for studying expressive timing in music. There have been attempts to model ritardando with reference to parameters of physical action; however, second-order systems have never been proposed as a possible kinematic approach. Herein we offer a second-order differential equation modeling approach, used to describe a variety of real world physical systems such as diffusion processes, control of electrical/mechanical devices and human arm/hand/leg movements to capture the temporal pattern of final ritardando. In the first experiment, the model parameters were changed iteratively to simulate several second-order systems until we find the system output that was closest to the data profile. The model was shown to produce a good fit with the deceleration curves generously shared by Friberg & Sundberg (1999). In the second experiment, we provided a perceptual evaluation of the model by synthesizing music based on modified model parameters. Damping ratio is particularly important as a mathematical means of expressing the level of damping in the system; hence a listening experiment was carried out to assess preferred damping levels (curvatures of deceleration) among various ritardandi samples. The resulting samples differed only with respect to final temporal pattern; and they were rated by musically experienced judges, based on how musical and aesthetically pleasing the performance of the ritardando sounds. Slightly under-damped versions received highest ratings, indicating a common preference for a particular shape of motion. Results provided further support for the common analogy between music and physical motion.

Invited Symposium: Motivating Music in Cultural Context: Interdisciplinary Perspectives on Participation and Learning

KANE 110, 08:30 - 10:30, Friday 27 Aug 2010

Motivating Music in Cultural Context: Interdisciplinary Perspectives on Participation and Learning

Andrea Emberly, Jonathan McIntosh, Jane Davidson, Robert Faulkner; University of Western Australia, Australia

SYM070, Introduction

The development of musical skills depends upon a wide range of cognitive, perceptual and action processes. In many Western education settings the acquisition of such skills is often regarded as a prerequisite to musical fluency. Intrinsic rewards, however, may only be attainable after long-term investment in strategies that often emphasize the need for solitary practice in pursuit of musical competency. That these processes are often unsatisfying is evident in the limited numbers of individuals who choose, because of personal engagement and/or the value that communities place on musical participation, to continue instrumental or vocal pursuits into adulthood. In contrast, settings that embed fluency in the processes by which musical skills are developed often emphasize the ritual, the musical event and the everyday. In these contexts, skills are typically learnt through participation rather than participation being afforded to those already in possession of specialized musical skills.

When accounting for skill development in Western educational settings, motivation theories (e.g. Deci and Ryan 1985, 2002) have been applied to learning in general and more recently to music education processes in particular. In these theories, concepts of autonomy, competency, and relatedness have been used to explain the different ways in which individuals find costs and benefits in musical learning and participation. Examining notions of motivation in a broad range of social and cultural settings facilitates the expansion of these theories beyond the limited scope of Western music education, and may even inform and enhance existing educational models and practices.

By drawing from the fields of anthropology, ethnomusicology, music education and music psychology, this interdisciplinary symposium seeks to widen discourse surrounding motivation theory as an emerging area of music research and theory. Reflecting upon research conducted with children, young people and adults in diverse ethnographic locations ranging from South Africa to Australia, Indonesia to Iceland, these papers seek to situate musical motivation theory within specific cultural contexts. Thus, by exploring notions of cognition, perception, teaching and learning, this symposium aims to provide fresh perspectives on our understanding of musical development and participation.

Music in Our Lives: Investigating 12 Years of Musical Engagement

Jane Davidson, Robert Faulkner; University of Western Australia, Australia

SYM071, Time: 08:30

In 1997, we 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. Factors crucial to continuing or quitting the musical learning included 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.

The paper aims to investigate the current role of music in the lives of young adults (20-21 years old) who had formal music learning opportunities in primary school and who either persisted or gave up performance in the interim. The paper presents results from the

most recent investigation of the study cohort in which 120 of the original cohort are revisited, 10-12 years after the initial contact.

After initial correspondence to re-establish contact with all original participants, an on-line survey asked questions relating to whether or not they were still playing their instrument; the role of music in their lives, with topics ranging from factual to attitudinal. Follow-up face-to-face qualitative interviews were undertaken with a sub-sample of those still learning and those who had given up.

In total, results show that 25 of the students are still playing. Only one is playing and studying at a pre-professional level. Of the continuing players, the majority achieved Year 12 successes in their music studies. The majority now play in social contexts such as community bands, folk groups and orchestras. The data reveal very diverse biographical traces linking back to childhood motivations and individual psychological needs. Indeed, even those who gave up reveal that music has a very strong role in their lives.

We shall discuss these unusually diverse data in terms of a new theoretical model that attempts to encapsulate a range of conditions sufficient for a variety of musical engagement and accompanying fulfilment of individual psychological needs.

This paper adds new and important data to the literature, building on the bedrock of data from first musical learning to adulthood engagement.

What Makes Me Venda? Motivations for Teaching and Learning Musical Culture

Andrea Emberly; University of Western Australia, Australia

SYM072, Time: 09:00

In the northern South African province of Limpopo, one manner in which children are imbued into Venda culture is through music, dance, singing and play. Although historically musical learning was centered in the homes and villages of families and local members of particular Venda chiefdoms, today much of this musical learning is found in the government sanctioned classrooms of primary and secondary students throughout the province. Therefore, learning culture through music has shifted from being a predominantly home-centered practice to a broader locale of arts and culture in the classroom setting. Since the end of apartheid, the South African educational curriculum has undergone significant changes and currently mandates an arts and culture learning area where children study music, art, drama and culture. The current curriculum goals are motivated by the need to promote both national unity and to protect individual cultural identities in the rainbow nationhood of South Africa.

The shift of learning, from the home to the classroom, has markedly significant impacts on the modes and motivations of musical learning in children's lives. Venda musical culture is a mode for children to both relate to each other and to identify themselves as Venda within the greater South African culture and this musical identity centers children and grounds them in both a history and tradition of Venda musical culture.

This paper will explore the multiplicity of motivations behind teaching and learning Venda musical culture in the present day with a goal of coming to a deeper understanding of how Venda children learn music and simultaneously use music to learn about Venda culture. Reflecting on a historical overview of Venda musical culture through the work of John Blacking, this paper will contribute to the ways in which we understand how musical learning in South Africa today is both culturally specific and nationally motivated.

Through music and dance, children participate and graduate into adulthood grounded in a musical community that is at the core of Venda culture. In addition to examining how children learn Venda music, this paper will explore the motivation behind preserving and upholding Venda musical culture in an institutionalized setting and why music is considered one of the primary bases for human existence in Venda culture.

Motivating and Motioning 'Tradition': Children's Participation and Performance in a Balinese Dance Studio

Jonathan McIntosh; University of Western Australia, Australia

SYM073, Time: 09:30

Dance continues to be an element fundamental of Balinese culture practised by adults as a sign of religious devotion throughout their lives. Children's participation in dance activities enables them to participate in the process of what it means to be Balinese from an early age while also ensuring that the necessary skills needed to participate in various genres are transmitted from one generation to the next. Nevertheless, following the institutionalisation of traditional dance in the late 1960s, significant changes have affected the teaching of dance at village level. As a result, conservatory trained graduates return to the local villages and instruct children according to tertiary methods. At present, many children now attend dance community organizations (*sanggar tari*) where, by learning in large groups, they tend to develop generic dancing skills rather than specialising in a particular dance or style of performance.

The paper aims to examine how changes affecting the teaching of Balinese dance at tertiary level have impacted upon the children's motivation to participate in dance activities and performances.

Children's motivation to participate in traditional Balinese dance is important due to the integral nature of dance within the Bali-Hindu religion, upon which daily life is based. Changes to 'traditional' teaching methods now facilitate greater access to lessons which in turn motivates children to participate in dance as a traditional, recreational and ceremonial activity. Moreover, the introduction and impact of cassette players and karaoke machines, and the continued use of Western-style analytical teaching methods pose considerable implications for the teaching and performance Balinese dance. Understanding these evolving motivations for teaching and learning provides insight into children's participation in dance activities and the continuation of the tradition.

Instead of posing an immediate threat to 'traditional' dance, changes affecting dance pedagogy have afforded more children the opportunity and engage in lessons and participate in dance performances. Nevertheless, such a process also has implications regarding who can and cannot perform various dance genres in specific contexts.

Relatedness in Vocal Events: The motivation for Singing in Adult Community Settings

Robert Faulkner, Jane Davidson; University of Western Australia, Australia

SYM074, Time: 10:00

This study aims to explore participant motivation and the nature of experience in three adult singing groups. The social benefits of adult choral participation are often theorised as extrinsic motivational factors that might be afforded by any number of activities, but that view may only be sustainable from a perspective that makes no differentiation between socialization in general and the possibility that collective vocal behaviour has the potential to configure uniquely special and highly valued forms of relatedness. In the findings reported, sharing songs in rituals and vocal events appears far less distinguishable from peak aesthetic experiences — usually theorised as intrinsic forms of motivation — than is often supposed. This paper relies upon qualitative data collected through interviews and diaries with a range of participants in various settings. Results show that participants in the choral singing groups give many and varied accounts of motivational factors that contribute to their engagement. Prominent among these are social benefits some of which relate simply to the notion of meeting and making friends, whilst others concern that ways in which singing together affords particular kinds of social contact that are highly valued. These socio-vocal benefits accrue in the everyday act of singing together, especially in harmony, and also in more formal vocal performances where social identity in song is enforced by the presence and approval of audience others. The results lead the authors to argue for a re-configuration of simplistic views of extrinsic and intrinsic motivation and a careful

deconstruction of concepts of relatedness and social involvement as they apply to singing.

Neuroscience 1

GOWEN 201, 08:30 – 10:30, Friday 27 Aug 2010

Individual Differences in Rhythmic Abilities: Behavioral and fMRI Studies

Jessica A. Grahn¹, Dirk Schuit²; ¹MRC Cognition and Brain Sciences Unit, UK; ²University of Maastricht, The Netherlands

PA013, Time: 08:30

Rhythmic abilities vary widely in the population, but little is known about why. This variability can be seen in a simple measure: rhythm reproduction (hearing a rhythm and reproducing by tapping). Differences in rhythm reproduction may relate to general short-term memory capacity — greater short-term memory capacity enables better memory for the rhythm. Another possibility is that the ability to structure, or chunk, rhythmic patterns differs between individuals. Previous work indicates that temporal sequences with a regular beat structure (such as in music) are more accurately reproduced than irregular sequences. Thus, differences would be expected if individuals vary in their ability to detect or use beat structure to chunk the rhythm. The current behavioral and fMRI studies examine these possibilities, measuring how phonological short-term memory (pSTM) and ability to find beat structure correlate with individual differences in the ability to reproduce short, novel rhythms. We found that digit span and score on the Beat Alignment Test (BAT) both significantly correlated with the percentage of accurately reproduced rhythms. Digit span and BAT score did not significantly correlate with each other, suggesting phonological short-term memory and ability to detect beat structure both relate to rhythmic ability, but are independent from each other. In fMRI, activations related to individual differences in digit span and beat alignment test score were found in posterior auditory areas, rather than motor areas traditionally associated with rhythm processing, suggesting that differences in auditory-motor interactions may be important for explaining differences in rhythmic ability.

Mechanisms of Beat Perception: Top-Down Control of Rhythm Interpretation Modulates Early Auditory Responses

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

PA053, Time: 09:00

Our perceptions are jointly shaped by external stimuli and internal interpretation. The perceptual experience of a simple rhythm, for example, strongly depends upon its metrical interpretation (where one hears the beat). Such interpretation can be altered at will, providing a model of the voluntary cognitive organization of perception. To study the mechanisms involved, we measured brain responses as participants listened to a repeating rhythmic phrase, using magnetoencephalography. In separate trials, listeners (n=11) were instructed to mentally impose different metrical organizations on the rhythm by hearing the downbeat at one of three different phases in the rhythm. The imagined beat could coincide with a note, or with a silent position (yielding a syncopated rhythm). Since the stimulus was unchanged, observed differences in brain activity between the conditions should relate to active rhythm interpretation. Two effects related to endogenous processes were observed: First, sound-evoked responses were increased when a note coincided with the imagined beat. This effect was observed in the beta range (20–30 Hz), consistent with earlier studies. Second, in contrast, induced beta responses were decoupled from the stimulus and instead tracked the time of the imagined beat. The results demonstrate temporally precise rhythmic modulation of beta responses that reflect the active interpretation of a rhythm. Given the suggested roles of beta in motor processing and in long-range intracortical coordination, it is hypothesized that the motor system is involved in the metrical interpretation of sound, even in the absence of overt movement.

Theta Band Oscillations During Simultaneous Processing of Music and Language

Elisa Carrus¹, Stefan Koelsch², Joydeep Bhattacharya¹;
¹Goldsmiths University of London, UK; ²Freie Universität Berlin, Germany

PA031, Time: 09:30

Music and language are two of the most unique faculties of our species. Both are rule-based and structured: they have syntax. But are the musical syntax and linguistic syntax related or isolated? Patel (2003) proposed a hypothesis suggesting a possible overlap of neural resources in the processing of musical and linguistic syntax, which has received recent support by electrophysiological research based on event-related-potential (Koelsch et al, 2005). Here, we extended this investigation further by studying the patterns of oscillatory brain responses, a robust marker of higher cognition. We applied wavelet based time-frequency analysis to multivariate EEG signals recorded during simultaneous processing of harmonically regular/irregular chord sequences and (syntactically/semantically) correct/incorrect sentences. Irregular chords when presented simultaneously with syntactically correct words produced an early spectral power decrease in the upper theta band at anterior frontal regions and a late increase in both the delta and the theta band at posterior parietal regions. The latter effect was also found when syntactically incorrect words were presented simultaneously with regular chords. Interestingly, this late effect was diminished when syntactically incorrect words were presented simultaneously with music-syntactic irregularities. Furthermore, semantic incongruities occurring simultaneously with regular chords produced a significant increase in later delta-theta power at posterior regions; this effect was also diminished when the identical semantic violation occurred simultaneously with a music syntactical violation. The results support a putative role of low frequency oscillations, particularly theta band, as a general substrate for syntactical and semantic integration, which may be shared by music and language.

Differences in Brain Responses to Vowels and Musical Intervals

Elika Bergelson¹, Michael Shvartsman², William Idsardi³; ¹University of Pennsylvania, USA; ²University of Michigan, USA; ³University of Maryland at College Park, USA

PA103, Time: 10:00

Music and language share many properties: both are acoustic signals that unfold over time, consisting of small units grouped into larger, complex units. We investigated whether the brain processes two-formant vowels and two-note musical intervals in the same way. Using MEG, we compared the mismatch-response (MMN/MMF, an early, pre-attentive difference-detector occurring approximately 200ms post-onset) to music intervals and vowels composed of matched frequencies. Subjects heard blocks of two stimuli in a passive oddball paradigm in three conditions: sinewaves, piano tones and vowels. For each condition the stimuli included three intervals: major 7th, octave, and two octaves. Phenomenologically, musical 7ths are quite dissimilar from octaves, whereas octaves and two-octave intervals sound very similar. In contrast, when the same frequencies are used to create vowels, 7ths and octaves sound like variants of the same back vowel (as in "cut") whereas the two-octave vowel sounds quite different from the octave vowel (the latter as in "get"). These psychoacoustic intuitions were borne out in our MEG results: after about 200ms, the MMN octave deviant response amplitudes varied significantly across music and vowel conditions. Musical octaves and 7ths are more dissimilar (s8:s7 >> s8:s16, p8:p7 >> p8:p16) whereas vowels of different places of articulation are more dissimilar (v8:v16 >> v8:v7). Summarily, our results show that within 250 milliseconds of hearing a complex auditory stimulus, the brain calculates the relationship between this stimulus and a preceding one, with the electrophysiological response of what makes stimuli 'similar', just as the behavioral one, differing significantly depending on whether the sounds music or language.

Movement in Performance

GOWEN 301, 08:30 - 10:30, Friday 27 Aug 2010

Effects of Tempo on Bow Arm and Center of Mass Movements in Highly Skilled Cellists and Their Pedagogical Implications

Erika Donald, Marcelo M. Wanderley, Isabelle Cossette;
 McGill University, Canada

PA085, Time: 08:30

Increased understanding of playing movements may contribute importantly to musicians' teaching and learning practices, helping to advance technical ability, enhance musical expression and prevent injury. In string playing, how are body and bow arm best coordinated for efficient body use and optimal musical expression? How do movements change throughout the learning process, and when playing at different tempi? Previous studies examined patterns of intralimb coordination in the bow arm of string players; a preliminary study involving the authors looked at the relationship between center of mass (COM) and bow arm motion in cello playing. Movements of five cellists playing an excerpt from Brahms' *Sonata in E minor* at five wide-ranging tempi showed that COM movements were less constrained than bow and arm movements, following the kinematic chain, and that COM direction reversals were strongly coupled to bow arm movements in slower playing. COM movements varied considerably within and between cellists, particularly around a salient change in harmony, illustrating the intimate connection between playing movements and musical intent. Movements of the five cellists can be loosely grouped into three coordinative strategies: two played using generally more bow and therefore arm motion, while only one frequently changed COM direction before the bow. Cellists showed both consistent organization and great variability in adapting their movements across tempi. Results will be examined in light of prominent pedagogical methods and literature. The relationship between bowing and COM should be further explored as a means to facilitate bowing technique and desired musical expression in string playing.

Mass Balancing Oscillations: An Indication of Expertise in the Bowing of Violinists — A Quantitative Micromotion Study

Julia von Hasselbach¹, Wilfried Gruhn², Albert Gollhofer¹; ¹University of Freiburg, Germany; ²Freiburg University of Music, Germany

PA140, Time: 09:00

Three-dimensional computer supported analysis of arm kinematics in violin playing has been published since 2003 (Shan & Visentin 2003) and aimed to reduce the high percentage of performing artists suffering from overuse syndromes (OS). Without explicit reference to medical objectives, the aim of this micromotion study is to give evidence of a characteristic pattern in expert violinists' motion that might explain part of their artistic development. Both virtuosity and prevention of OS focus on physical economy during training. Mass balancing oscillations which compensate inertia and the use of ballistic effects seem to be measurable features in expert performance and sonority-advancing solutions.

Six university music students (at three levels of expertise) performed a fundamental control task. The motions of elbow and hand were captured using a three-dimensional motion capture system (zebris medical). The motions could be complementary dephased in cases of mass balancing oscillations, or run in parallel in cases of inefficient activity of big muscles working against the tendency to compensate inertia. An algorithm quantified these qualities of the dependent variable. The variance between the levels was significant. A post hoc analysis revealed that only the variance between the lowest level of expertise 1 and the upper two was significant, whereas the variance between the higher levels 2 and 3 might have been incidental.

To economize movements while differentiating musical parameters is a big challenge in string playing. It may be helpful to consider mass balancing oscillations in violin pedagogy to stimulate artistic development and prevent occupational injuries.

Violinists Experience a Relatively Large Chin Force During Musical Performances

Hiroshi Kinoshita, Satoshi Obata; Osaka University, Japan

PA088, Time: 09:30

The purposes of this study were to develop a chinrest to enable direct measurement of chin force, and to provide base-line data for this force during musical performances. Miniature load cells were built by the present authors, and they were fixed between a chin-cup and the top plate of a violin. The static mechanical loading test of this sensor revealed strong linearity and high resolution of measured force. Force data were obtained from 11 trained violinists while playing sets of scales and melody tasks. The scales were performed at the 1st hand position at different dynamics (*p*, *mf*, and *f*) and three tempi (1, 4, and 8 Hz). In the scale tasks, the effects of vibrato, and jumps between the 1st and 8th hand positions were also tested. Excerpts from Concerto in G-minor by Max Bruch, and symphony No 9 in E minor by Antonin L Dvorak were performed for the melody tasks. Mean and peak forces were evaluated from the measured data. It was concluded that the chinrest developed provided a fairly accurate record of the time-history of chin force during violin performances. Typical force to stabilize the violin between the left chin and shoulder during an ordinary musical performance was less than 30 N, but it could exceed 50 N when performing technically demanding musical pieces. The inter-violinist difference in chin force was relatively large, possibly reflecting their playing habits.

The Left Finger Force During Violin Vibrato

Satoshi Obata¹, Hidehiro Nakahara², Takeshi Hirano¹, Hiroshi Kinoshita¹; ¹Osaka University, Japan; ²Morinomiya University of Medical Sciences, Japan

PA125, Time: 10:00

This study investigated the nature of the longitudinal ("shaking") and normal ("press") components of string clamping forces during various technique of vibrato sound production on the violin. A violin installed with a 3-D force transducer was used for the measurement of the force at the D5 tone position. Twelve trained violinists produced an A4 (open) tone for 2 sec followed by a D5 (vibrato & force measurement) tone for 30 sec at different vibrato rates (4.5, 6 Hz, and no-vibrato) and dynamics (*p*, *mf*, and *f*) using each of the four fingers. The effect of vibrato width (cent of the tone) was also examined. The average, amplitude, and peak-to-peak time of shaking force, and mean press force were evaluated. During vibrato, an oscillated pattern was observed in each of the three component (normal, longitudinal, and lateral) forces while the shaking force demonstrated the largest periodic oscillation. The mean press force and the amplitude of shaking force significantly increased with the rate of vibrato as well as the dynamics of the sound generated. Both forces were also significantly increased with increased vibrato width. These force variables did not differ among the four fingers. The shaking force ranged from 1.0 to 4.2 N among the violinists, indicating a relatively large inter-violinist variation in this force. It was concluded that violin vibrato involved a fair amount of active oscillating shear force which depended on intended dynamics, width, and rate of vibrato, and perhaps difference in physical characteristics and educational backgrounds of the violinists.

Health

SMITH 120, 08:30 - 10:30, Friday 27 Aug 2010

The Relationship Between Music and Health: A Cross Cultural Study

Tara French¹, Raymond MacDonald¹, Jane Davidson²; ¹Glasgow Caledonian University, UK; ²University of Western Australia, Australia

PA065, Time: 08:30

While there is considerable research highlighting the functions and importance of music there is still much to learn about the effects and

centrality of music listening and participation from a number of perspectives. For example, there is a need for research investigating the effects of music on quality of life and psychological wellbeing from cross cultural perspectives. This study investigated the patterns, functions and importance of music in samples drawn from Scotland and Australia. The study also investigated the possible relationship between music and measures of quality of life and psychological wellbeing.

This study employed the use of a music listening questionnaire adapted from North et al 2000 and Mitchell et al 2006, the World Health Organisation Quality of Life Scale and the Ryff and Keyes (1998) Psychological Wellbeing scale. Questionnaires were distributed to members of the general public in Scotland and Australia and to students at Glasgow Caledonian University and the University of Western Australia.

Using a series of ANOVA's, the patterns and functions of music listening across the different samples will be presented. The relationship between music and measures of quality of life and psychological wellbeing will be discussed. Conclusions will be drawn based upon the results derived from the statistical analysis and discussed within the wider context of music and health research.

Music Perception and Musical Behaviors in Children and Adolescents with ASD

Anjali Bhatara¹, Eve-Marie Quintin²; ¹University of California at Los Angeles, USA; ²McGill University, Canada

PA124, Time: 09:00

Individuals with Autism Spectrum Disorder (ASD) exhibit above average auditory processing abilities including enhanced pitch memory (Heaton, Hermelin, & Pring, 1998) and discrimination (Bonnell et al., 2003). They can also recognize basic emotions in music (Heaton, Hermelin, & Pring, 1999). However, few studies have collected information on use of music in everyday lives of individuals with ASD. We collected information on everyday use of music from groups of children (7-17 years old) with ASD and with typical development (TD). We found that there were more participants with ASD than TD who showed unusual fright or sensitivity in response to certain sounds in early childhood ($p < .001$). Children with ASD were viewed as being generally more musical than children with TD ($p = .01$), but the amount of interest in music was greater for the TD group than the ASD group ($p = .04$). Though the parents of children with ASD in our study reported more frequent hypersensitivity to sounds than parents of children with TD, this hypersensitivity appeared to have no detrimental effect on the musicality of children with ASD. Musical responsivity in everyday life seems to be similar in ASD and TD. This preserved responsivity and the positive view of parents with regards to their child's musicality can fuel ideas for therapeutic use of music in family therapies for ASD.

Music and Pain Perception: Investigating the Role of Attention

Laura A. Mitchell¹, Jeffrey S. Mogil², Daniel J. Levitin²; ¹Glasgow Caledonian University, UK; ²McGill University, Canada

PA126, Time: 09:30

An increasing number of clinical and laboratory studies have demonstrated effects of music listening on perception and experience of pain. Two theoretical frameworks for the effects are frequently proposed: distraction of attention and modulation of mood via emotional valence or arousal properties of the music. The attentional hypothesis has so far not been directly tested, and the emotion modulation hypothesis has been tested only with experimenter-selected music. The present study uses an auditory detection task to hold attention constant while manipulating engagement with the music. The engagement manipulation was accomplished in two ways while participants were subjected to standard thermal pain protocols. First, participants heard either self-selected, other-participant selected or experimenter-selected music. Second, all music was re-presented in a scrambled form which maintained all psychoacoustic properties

of the music, but disrupted temporal structure and therefore the potential for engagement. Throughout, the auditory task required participants to listen for slight unilateral changes in decibel level presented in headphones at random intervals. In this way, any differences found in pain thresholds can be attributed to aspects of engagement other than distraction. Repeated measures analysis of variance will compare listening conditions (the independent variables) on tolerance of painful stimulation (measured in seconds of submersion, the dependent variable), self-report ratings of pain unpleasantness and intensity, mood and anxiety (covariates). Evidence of underlying mechanisms will provide the pain sufferer and clinician the ability to optimize the intervention, while increasing theoretical understanding of our engagement with self and other-selected musical stimuli and their influence on health parameters.

Sonata Analgesica: Pain, Music and the Placebo Effect

Eduardo A. Garza-Villarreal¹, Elvira Brattico², Lene Vase¹, Leif Østergaard¹, Peter Vuust³; ¹Aarhus University, Denmark; ²University of Helsinki, Finland; ³Royal Academy of Music, Denmark

PA074, Time: 10:00

Music is used for different medical purposes, such as to relieve pain. However, the overall mechanisms, effects and even dosage of music as an analgesic are still poorly understood. The aim of this study is to investigate the effects of listening to music on acute pain, and determine if emotion and the placebo effect are some of the mechanisms behind the analgesic effect.

Symposium: Music as a Social Integrative Tool

KANE 110, 11:00 – 12:30, Friday 27 Aug 2010

Music as a Social Integrative Tool

Stefanie Stadler Elmer¹, Mayumi Adachi², Raffaella Bissig¹, Mikko Myllykoski³, Pirkko A. Paananen³, G.F. Welch⁴; ¹University of Zurich, Switzerland; ²Hokkaido University, Japan; ³University of Jyväskylä, Finland; ⁴IOE University of London, UK

SYM100, Introduction

Music is a social event, or is socially mediated. Technological development during the last century made it possible for a large population to listen to music at any place and time. Previously, a musical event was unique, and it existed only once, as a live human product at a certain place and time. The social functions of music in Western societies drastically changed. This symposium brings together researchers from three different countries that all address the social functions of music in our modern societies from their viewpoints as music educators and psychologists. Myllykoski deals with new technology-based ubiquitous learning in music education. He provides an overview and characterizes new possibilities for flexible, calm, and seamless learning. Ubiquitous music learning environment provides versatile communication and collaboration possibilities, and therefore, can serve as a socially integrative tool. Stadler Elmer, Bissig, & Welch present an overview on the concept of social inclusion, its theoretical backgrounds and methodologies used in social, developmental, and educational psychology. The aim is to generate rationales for applying this concept to the musical domain and for the design and evaluation of empirical methods that are used to substantiate and evaluate social integrative effects. Paananen describes recent findings and features of computer-mediated and game-based activities (JamMo, jamming mobile), and musical features, which are essential in designing a learning environment for children with Attention-deficit hyperactivity disorder (ADHD). The musical games with specifically designed structures and user interface features are assumed to facilitate learning and social inclusion of children with ADHD.

Ubiquitous Music Learning Environment Scenario Analysis

Mikko Myllykoski; University of Jyväskylä, Finland

SYM101, Time: 11:00

The salient forms of current ubiquitous music culture can be seen in the fast-changing fields of mobile music distribution, listening and storing. In education, ubiquitous-learning (u-learning) is taking its first steps assimilating the wide possibilities of ubiquitous computing systems. Music education has an essential role in this step taking into account the long history in computerized music making and the latest innovations in mobile music technology; there's an urgent need to conceptualize and define u-learning for music learning and education purposes. In ubiquitous music learning environment, it's possible to sing, compose, improvise, store and discuss about music, alone or in collaboration at any time and in any place with mobile devices. The aim of this article is to pull together current multidisciplinary knowledge on ubiquitous learning environments and to present and categorize ubiquitous musical collaboration and communication aspects, which are closely related to music learning. Within this theoretical dissection, a new concept 'Ubiquitous music learning environment' (UMLE) will be derived. As a result, this paper presents an UMLE scenario analysis, which utilizes the scenarios from the ongoing UMSIC research project and furthermore links current theoretical and empirical knowledge on ubiquitous musical communication, collaboration and learning together. The scenario analysis defines possibilities and constraints for ubiquitous musical practices, communication, collaboration and tuition in different stand-alone, ad-hoc, public and networked social contexts. The current technical aspects and especially limitations of different wireless networking technologies are largely considered in the scenario analysis.

Does Music Enhance Social Inclusion?

Stefanie Stadler Elmer¹, Raffaella Bissig¹, G.F. Welch²; ¹University of Zurich, Switzerland; ²IOE University of London, UK

SYM102, Time: 11:30

Music is considered to have social bonding effects. If this is true, music can serve as a tool for enhancing social inclusion. The concept of social inclusion is used in the social policy domain to assure equal access to public services (health care, education, labor market, security) to all inhabitants, including sub-groups, of a nation or society. It is closely related to exclusion; they logically oppose and imply each other. Social inclusion implies subjective feelings of social belonging, participation, group coherence, and a positive national or cultural identity. Our EC-funded study 'The usability of music for the social inclusion of children' aims at (i) clarifying the relationship between music and social inclusion /exclusion, (ii) designing, piloting and evaluating methods for gaining empirical evidence with school age children, and (iii) generating guidelines/rationales for empirical or practical projects. Literature is analyzed with respect to a) basic conceptual dimensions and assumptions in studies on social inclusion, b) methods that are used to substantiate and evaluate social integrative effects, c) temporal aspects (e.g. states, processes, and age periods), d) contents or domains, and in particular, e) the domain of music. Results concern (i) historical aspects, conceptual dimensions, and related concepts, ii) methods applied in the context of social, developmental and educational psychology, (iii) an evaluation of the methods, including validity, reliability, practicability for children, and ethical issues, and (iv) theoretical and methodological considerations in applying the concept of social inclusion to the musical domain in empirical research contexts.

Game-Based Learning in Music: Designing for Children with ADHD

Pirkko A. Paananen; University of Jyväskylä, Finland

SYM103, Time: 12:00

ADHD symptoms increase poor school and academic functioning, risk for dropping out school, social problem such as peer rejection, aggression, and have negative effects on self-esteem. During the last ten years computer-mediated and game-based learning has become

a growing area of interest in studying these children's learning. With games or game-like tasks, reduction of off-task, disruptive behavior and improvement has been found in mathematics and reading. In music therapy contexts, music has been shown to have positive effects on executive functions. Moreover, music making may work as a motivating real-life activity especially when it is provided in a game context. The current study describes recent findings and features of cognitive support, computer-mediated and game-based activities, as well as musical features, which are essential in designing a learning environment for children with ADHD. The structure of the musical games (JamMo orientation games 7-12) targeted to children with ADHD of 7 to 12 years of age, is described as well as the pedagogic use of these games in social contexts, to enhance social inclusion.

Neuroscience 2

GOWEN 201, 11:00 - 12:30, Friday 27 Aug 2010

Keeping an Open Mind's Eye: Mediation of Cross-Modal Inhibition in Music Conductors

Donald Hodges¹, W. David Hairston², Joseph Maldjian³, Jonathan Burdette³; ¹University of North Carolina at Greensboro, USA; ²ARL Aberdeen Proving Ground, USA; ³Wake Forest University, USA

PA001, Time: 11:00

When a task requires focusing on one particular sense (e.g., audition), the "suppression" of non-task-relevant information from other senses (e.g., vision) is often necessary for maintaining perceptual accuracy. Music conductors, because of their training in combining sight and sound (e.g., reading a musical score and watching an entire ensemble while listening to a performance), may not require an extensive inhibition of non-relevant sensory modalities. We investigated whether conductors would show differences in the extent of cross-modal deactivation while focusing on an auditory task. Conductors and controls performed auditory temporal discrimination tasks at two levels of difficulty in conjunction with fMRI. In the "high difficulty" condition, stimuli for the test pitch frequency were centered around their own previously determined threshold values. In the "moderate difficulty" condition, the values were increased to be above threshold, while remaining challenging for that individual (target 80-85%). To avoid difficulty with performing the tasks in the noisy scanner environment, BOLD images were acquired using a sparse acquisition sequence in a block design. Conductors minimally deactivated visual cortices during performance of the auditory discrimination task, but the degree to which this occurred was not influenced by the difficulty of the task. This is in stark contrast to individuals without musical training, who showed a dramatic decrease in visual cortical activity as the difficulty of the auditory task increased. Additionally, conductors showed differences in right fronto-insular and parietal regions as well, also reflecting a mediation in functional decreases relative to changes in task demand.

Music and Action: Do They Share Neural Resources?

Daniela Sammler¹, Eleanor E. Harding¹, Alessandro D'Ausilio², Luciano Fadiga², Stefan Koelsch³; ¹MPI CBS, Germany; ²Italian Institute of Technology, Italy; ³Freie Universität Berlin, Germany

PA034, Time: 11:30

Intense research of the past years has established a strong connection between the processing of syntax in language and music, e.g., by showing similar bimodal event-related potential (ERP) patterns of early negativity and late positivity, as well as activations in Broca's area when presenting syntactic violations in either domain. More recently, it has been proposed that also human action may possess a "syntactic-like" structure that may depend on similar processing mechanisms like in language and music. However, it remains unclear to what degree the neural resources that monitor the processing of structure overlap in all these different domains. The current study addressed this issue for music and grasping actions by coupling progressions of five chords and sequences of five pictures (one per

chord) that portrayed a hand trajectory and object grasp. The final chord and grip were either both correct or only the chord, only the grip or both were incorrect. Irregular chords elicited an early right anterior negativity (ERAN) and an N500 indicating the detection and integration of the harmonic violations, respectively. Incorrect grasps elicited an early negativity as well as a late positivity that were reminiscent of bimodal ERP patterns classically observed for rule violations in language, music or arithmetics. Although no interaction was found between the brain signatures for musical and motor expectancy violations, suggesting that they involved different neural resources, the bimodal pattern evoked by observed grasping errors encourage future studies to clarify the similarities of processing structure in language, music, and the action domain.

The Rewards of Music Listening: The Role of Midbrain Dopamine in Musical Anticipation

Line Gebauer¹, Peter Vuust²; ¹Aarhus University, Denmark; ²Royal Academy of Music, Denmark

PA113, Time: 12:00

Aim: To review the literature associating music and pleasure, shedding light on the underlying psychological and neurobiological mechanisms. In extension, we propose anticipation as a fundamental mechanism behind musical pleasure, and dopamine as a prime agent in coding musical anticipation and thus an important mediator between music and pleasure.

Main contribution: Dopamine is critically involved in anticipation, especially with regards to reward anticipation and registration of prediction errors, which occur when the anticipations are not fully met. Dopamine is likewise suggested to be involved in pleasure, but here we suggest that dopamine merely mediates musical pleasures through anticipation and hence do not cause the pleasure *per se*.

Implications: A better understanding of the anticipatory interplay between musical structures and expectations in the listener, may bring us closer to an understanding of both *how* and *why* music is capable of inducing strong emotions and pleasure in the listener, and thus why music is an essential part of most people's lives.

Movement

GOWEN 301, 11:00 - 12:30, Friday 27 Aug 2010

Influence of Musical Features on Characteristics of Music-Induced Movements

Birgitta Burger, Marc R. Thompson, Suvu Saarikallio, Geoff Luck, Petri Toiviainen; University of Jyväskylä, Finland

PA003, Time: 11:00

Music has a close connection to both sound and movement. These relations have been more extensively investigated with respect to music production than for music perception. In particular, there is a lack of research on how musical features affect the characteristics of music-induced body movements. This study aims at investigating this relationship by analyzing these kinds of movements in relation to the musical stimuli that induced the movements. Participants were presented with 30 short excerpts of popular music and were asked to move to the music. Their movements were recorded with an optical motion capture system. Subsequently, 55 movement and 44 musical features were extracted from the respective data. We performed Principal Component Analysis on the movement data to reduce the number of relevant features and correlated the resulting five Principal Components scores with the musical features. The outcome of this analysis suggests that a clear pulse in the music tends to increase the overall amount of movement, as it might be encouraging to move to. Music with a clear rhythmic structure in the low frequency range seems to make people move much on the spot, while a less clear structure in this frequency range rather tends to let people wander around, as if they were "searching for the beat". The outcome of this study indicates that musical features influence bodily movement to a great extent.

The Impact of the Bass Drum on Body Movement in Spontaneous Dance

Edith Van Dyck, Dirk Moelants, Michiel Demey, Pieter Coussement, Alexander Deweppe, Marc Leman; Ghent University, Belgium

PA054, Time: 11:30

When dancing at parties or in clubs, people usually synchronize with the beat of the music. But other properties of the music also have an effect on the style and intensity of their movement. One musical element that takes a prominent position in current dance music is the bass drum. In the study presented here, the effect of the dynamics of the bass drum on a dancing audience is explored. A club-like environment was constructed and 100 adolescent and adult subjects (50 male and 50 female) were asked to dance in groups of five to a 10 minute and 30 second musical mix consisting of six songs, three bass drum solo parts and some transitional material. Each song consisted of one section that was repeated three times, with a different dynamic level of the bass drum. The methodology was based on motion capture and motion sensing technology. The motion sensing acceleration data of the hips was collected, while a motion tracking system monitored head movement. The research demonstrated that the dynamic change of the bass drum does have an important effect on the intensity of movement while dancing. It seems a phenomenon that occurs commonly unnoticed by dancers. These results show that the increasing role of the bass drum in contemporary dance music is not just a stylistic element, but indeed has a positive effect on the amount of movement made by the dancers.

Exploring the Characteristics of Body Movements Contributing to Ensemble Coordination

Kenji Katahira; Osaka University, Japan

PA135, Time: 12:00

The present study investigated whether the relationship of body movements between co-performers is related to ensemble coordination. It has been pointed out that body movements contribute to ensemble coordination. Previous research has discovered the formation of specific relationships of body movements among ensemble performers. The present study aimed to examine the association between such body movements and ensemble coordination through quite simple ensemble situation in the experimental settings. Eight pairs of participants synchronized isochronous patterns on the electronic drums as well as they could. Their ensemble coordination was measured in terms of the synchronization between simultaneous taps by two participants, and we divided them into two groups by asynchronies of tapping. From the data analyzed motion of the wrist used for tapping, three indicators of body movement were computed for each tap; (a) the explicitness, (b) the similarity in size, and (c) the similarity in temporal pattern. Three two-way mixed design ANOVAs revealed that participants in the high-synchronization group formed more similar body movement than in the low-synchronization group. The results from this study confirmed the association between ensemble coordination and co-performers' specific relationships of body movements, and showed that similar body movement between participants related to the high synchronization. This study found that similarity of body movement between co-performers would be important in ensemble coordination.

Auditory Perception 4

SMITH 120, 11:00 - 12:30, Friday 27 Aug 2010

The Effect of Scale Degree Modifications on Average Interval Size

David Huron, Matthew J. Davis; Ohio State University, USA

PA150, Time: 11:00

In speech prosody, small pitch movement is characteristic of sadness. Small melodic interval size is similarly known to be correlated with judgments of sadness in music perception. Starting with melodies in the major mode, a study is reported in which the effect of different

scale modifications on the average interval size is examined. Lowering the third and sixth scale tones from the major scale is shown to provide an excellent way of reducing the average melodic interval size for a sample of major-mode melodies. The results are consistent with the view that melodic organization and the major-minor polarity are co-adapted, and that the minor mode is well-tailored to evoke, express or represent sadness.

Applying the Schematic Knowledge of the Musical Genres to Enhance Audio-Based Models of Emotions in Music

Tuomas Eerola; University of Jyväskylä, Finland

PA136, Time: 11:30

A drawback in understanding how musical features contribute to various emotions concerns the lack of musical context of such endeavors. An account of schematic knowledge of music is needed to make significant advances in prediction of emotional content of music. The primary aim is to demonstrate the importance of schematic knowledge by means of predicting the emotions in music (a) without and (b) with the contextual information. The ratings of valence and arousal in five published studies of music and emotions were used as the analysis material. The mean ratings of perceived emotions were predicted by linear regression using the musical features extracted from the stimuli by uncontextual and contextual method. Comparisons were carried out within and between the stimulus sets to establish the generalizability of the models. In the contextual method, the ratings were predicted by similarly extracted but genre-contextualized features, based on a large sample of real music. The fit between the ratings and features with those stimulus sets that were based on same musical genres (e.g., classical) were 10-41% higher than those that represented different genres (classical vs. pop) using the uncontextualized method. However, the contextual method reduced the loss of generalizability between the results between the different genres, although the fit did not reach the same level as the results obtained within the same musical genres. Despite being limited to few musical genres, the results revealed how the musical features better accounted the emotions when contextualized within the typical feature values of the genres.

Effect of Direction and Rate of Acoustic Intensity Change on Event-Related Skin Conductance Response

Kirk N. Olsen, Catherine J. Stevens; University of Western Sydney, Australia

PA005, Time: 12:00

A continuous increase of intensity (up-ramp) can signal a looming (approaching) sound source, whereas a continuous decrease (down-ramp) can signal a receding sound source. There is evidence that up-ramps relative to down-ramps elicit adaptive behavioural biases to looming versus receding auditory motion. Such a bias may be accompanied by differences in autonomic activation of the sympathetic nervous system; for example, human skin conductance response (SCR). An experiment investigated event-related autonomic arousal (SCR) in response to brief up-ramp and down-ramp stimuli. Nineteen participants were presented with eight stimuli consisting of a violin timbre, with intensity profiles of 60-90dB up-ramps and 90-60dB down-ramps. Independent variables, intensity direction (up-ramp, down-ramp), layer (monotone, chord), and duration (1.8 s, 3.6 s), were manipulated within-subjects. The dependent variables were: (1) SCR latency; (2) SCR rise time; and (3) SCR magnitude. Because of the faster rate of intensity change in 1.8 s stimuli (16.67dB per second), relative to 3.6 s stimuli (8.33dB per second), it was hypothesised that SCR latency is shorter, rise time longer, and response magnitude greater for 1.8 s up-ramps, relative to 3.6 s up-ramps. No differences were predicted between 1.8 s and 3.6 s down-ramps. In support of the hypotheses, as the rate of up-ramp intensity change increases, event-related autonomic arousal responses are instigated more rapidly, last for a longer duration, and are greater in magnitude than from slower rates of intensity change. Results are discussed in relation to physiological correlates of music perception and cognition.

Symposium: Music as Affect Regulation in Everyday Life

KANE 110, 14:00 - 16:00, Friday 27 Aug 2010

Music as Affect Regulation in Everyday Life

*Suvi Saarikallio*¹, *Alexandra Lamont*²; ¹University of Jyväskylä, Finland; ²Keele University, UK

SYM090, Introduction

Affect regulation is one of the most important reasons why people engage with music. Music has been shown to be an effective means for the regulation, and various regulatory strategies have been defined. The use of music for affect regulation has become an increasingly important part of everyday life due to the various portable and personalized technologies, and the self-selected music has become a valuable source for emotional self-therapy. Knowledge on the self-regulatory use of music is relevant for both social psychological and therapeutic perspectives, and has implications beyond the everyday life to a range of educational and health settings. The amount of music-and-affect-regulation-related studies has been growing, but there is still a serious need for a better understanding of the conceptual aspects, connections to various personal and contextual factors, and possible effects on wellbeing.

The symposium brings together an international group of researchers approaching the topic from four complementary perspectives: Suvi Saarikallio presents results of a survey study about the connections of music-related affect regulation to broader emotional dispositions. Marie Skånland introduces the viewpoint of current portable technologies and presents an interview study about mp3-players in affect regulation. Thomas Stegemann brings in the health perspective, and presents a study conducted at a psychiatric clinic on the connections between non-suicidal self-injury and music-related affect regulation. Annelies vanGoethem introduces an intervention study about improving wellbeing in everyday life through advancing music-related affect regulation skills. In conclusion of the symposium the discussant, Alexandra Lamont, draws together and reflects on the varying viewpoints.

Connections Between Music-Related Emotional Self-Regulation and General Emotionality

Suvi Saarikallio, Katja Löytynoja; University of Jyväskylä, Finland

SYM091, Time: 14:00

Music has been identified as a common and effective means for emotional self-regulation, but little is known about individual differences in this regulatory behavior. The current study investigated whether broader emotional tendencies would play a role in explaining these differences. 526 young adults, 169 males, and 357 females, with a mean age of 23.97 years, filled in a web-questionnaire. Music-related emotional self-regulation was measured through the Music in Mood Regulation (MMR) scale and general emotional abilities and dispositions were assessed through three aspects: emotional intensity (Reduced Emotional Intensity Scale, EIS-R), sensation seeking and impulsivity (Impulsive Sensation Seeking Scale, ISSS), and emotion regulation (Emotion Regulation Questionnaire, ERQ). Music-related emotional self-regulation correlated with all three aspects of general emotionality. MMR correlated more strongly with positive than negative emotional intensity, and more strongly with sensation seeking than impulsivity. Regarding emotion regulation, the general emotion regulation strategy of reappraisal correlated positively with all music-related regulatory strategies, especially with the use of music for mental work and distraction. Conversely, the general emotion regulation strategy of suppression had no positive correlations with any of the music-related regulatory strategies, and correlated negatively with the use of music for getting strong emotional experiences. The results clarified the role of music-related emotional self-regulation within the broader scheme of general emotional abilities and tendencies, and showed some promise as regards to understanding the possible health-effects of music.

MP3-Players as a Technology of Affect Regulation

Marie Strand Skånland; Norwegian Academy of Music, Norway

SYM092, Time: 14:30

The focus of this paper is the use of the mp3-player as a technology of affect regulation, understood as an individual's efforts to maintain or change the intensity or duration of affect. The ability to understand and regulate affects has implications for mental health and well-being, and among the strategies for such regulation, engagement in music has proved to be especially successful.

The mp3-player offers a unique availability of music which raises questions about its impact on the user. The study is based on interviews with six men and six women who are regular users of mp3-players. The semi-structured interviews focused on how the subjects used their mp3-players according to bodily, cognitive and affective states. My preliminary findings suggest that the mp3-player can function as an efficient tool for affect regulation. The mp3 users can listen to whatever they want whenever they want, and can create personalized playlists for the purpose of managing and regulating moods and emotions. Indeed, the subjects in this study use the music on the mp3-player not only to 'feel good', but also as a tool for describing, clarifying and understanding their emotions and moods. Hence, the mp3-player becomes a valuable and highly available technology of affect regulation.

The Function of Music in the Context of Non-Suicidal Self Injury and Suicidality in Adolescents

Thomas Stegemann; University Medical Center Hamburg-Eppendorf, Germany

SYM093, Time: 15:00

Background: Music and non-suicidal self injury (NSSI) are both of extraordinary importance for adolescents with respect to expressing emotions on the one hand and demonstrating protest on the other. Nevertheless, little is known about the connection between these phenomena, in particular about the function of music in the context of NSSI. Aims: The aim of our study was to investigate the connections between music and auto-aggressive behaviour and suicidality in adolescents. Methods: We developed a specific questionnaire for this purpose, which was used together with a self-reporting depression inventory in 40 subjects in a child and adolescent psychiatric clinic. We enrolled adolescents between 13 and 18 years who had presented with NSSI and/or suicidality during the last three months. Results: Music proved to be very important to the patients and seemed to have an emotionally elevating function. Moreover, music was in some cases part of the NSSI, but also was used to inhibit auto-aggressive tendencies. In a qualitative analysis, it could be demonstrated that music and lyrics are associated with affect regulation, anti-dissociation and interpersonal influence. Conclusions: Music seems to fulfil similar functions as have been described for NSSI and can thus be considered to have a protective effect. There were no indications that specific music preferences are directly linked to NSSI or suicidality.

Affect Regulation with Music: A Diary Intervention Study

Annelies van Goethem; Keele University, UK

SYM094, Time: 15:30

The ability to regulate affect is considered vital for a healthy psychological life. Music listening has been recognized as a successful and widely applicable affect regulation device. Previous studies suggest that participation in an everyday life diary study increases insight in one's own behaviour, which possibly helps to develop or increase affect regulation skills. The aim of this study was to investigate whether people would be able to increase their amount of use of music listening for affect regulation on request, and whether this increase in music use would be beneficial for them. Additionally, it was expected that mere participation in the study would be beneficial through gaining insight into one's own affect regulation habits. Participants conducted a three-week diary-intervention study reporting their affect regulation habits. In the second week intervention groups were requested to use more music to regulate affect. The diary

control group just reported on their affect regulation habits for three weeks, and the control group (no diary) just reported their positive and negative affect on a weekly basis. Music listening was found to be the second most used tactic (after talking to friends). Outcomes suggest that participants were capable of increasing their music use on request, and continued to use more music after the intervention. Interaction groups maintained their positive affect while participants without a diary (control) became less positive. By participating in a diary (intervention) study people can learn to understand more about their affect regulation habits, and increase their skills for healthier psychological functioning.

Aesthetic Perception

GOWEN 201, 14:00 - 16:00, Friday 27 Aug 2010

Expression and Perception of Formal Structure in an Unmeasured Prelude for Harpsichord

Meghan Goodchild, Bruno Gingras, Pierre-Yves Asselin, Stephen McAdams; McGill University, Canada

PA023, Time: 14:00

Research linking music-theoretical analysis and performance has recently reoriented toward collaboration between analyst and performer, even investigating the performer's concept of formal structure. We examine harpsichordists' performances and analyses of an unmeasured prelude — an ideal genre for investigating the link between temporal patterns and structure due to its semi-improvisatory nature. Perceptual studies have found that continuous musical tension ratings decrease sharply at structural boundaries and that structural segmentation co-occurs with drops in tension ratings. We also analyze the tension ratings of participants who listen to these performances to explore the perception of phrase-structure. Twelve professional harpsichordists performed the *Prélude non mesuré No. 7* by Louis Couperin on a MIDI harpsichord and submitted their analyses of the main formal subdivisions. In a perceptual experiment, harpsichordists, musicians and nonmusicians used a slider to continuously rate perceived tension of the performances. This research on the unmeasured prelude reveals intriguing insights into the link between analysis and performance. Although there was some agreement on main structural boundaries, harpsichordists used different strategies to convey phrase structure, but they generally convey large-scale form through the amount of tempo variability. The perceptual study shows that tension peaks occur at major phrase boundaries and that there is a connection between overall tension and tempo variability. The perceptual results indicate differences between the three listener groups, with the nonmusicians providing the highest overall tension ratings, harpsichordist listeners responding more closely to local level performer nuances and musicians mainly responding to the global structure across performances.

Do the Words Get in the Way? Verbalizing and Recognizing Sound Quality of Music Performers

Helen F. Mitchell¹, Raymond MacDonald²; ¹University of Sydney, Australia; ²Glasgow Caledonian University, UK

PA128, Time: 14:30

Listeners' perception of individual music performers' 'sound' requires a complex synthesis of sensory information. Verbal descriptions of this sound quality may only be effective when a performer's sound translates easily and completely into words. A verbal overshadowing (VO) effect may occur when a verbal description distorts listeners' recall of the original aural memory. This exploratory study tested the impact of verbal description on listeners' recognition accuracy and confidence of classical singing voices to see if musical listeners are susceptible to VO in recognizing individual performers. Singers (n=5) performed *Caro mio ben* twice for a recording. Listeners (n=50) each attended a single listening session and were informed that the purpose of the study was to investigate the effect of visual and verbal tasks on the ability to recognize aural stimuli. Listener participants were assigned to either a verbal description group or a non-description control group. All listeners heard a single target voice (at encoding) and were later asked to identify that voice from a

homogenous line-up of all five singers. Providing a verbal description of the singer's voice reduced listeners' identification accuracy of the target voice, but did not reduce listeners' confidence rating of their decision. Results suggest that verbalisation of singing voices is problematic and limits subsequent voice recognition. The study builds on VO research in visual and auditory domains to assess the value and limitations of language in describing singers' unique sound quality.

"Looming Tunes": Effects of Intensity Direction, Tempo and Tonality on Loudness Change in Melodies

Catherine J. Stevens, Roger T. Dean, Freya Bailes, Kirk N. Olsen; University of Western Sydney, Australia

PA052, Time: 15:00

In auditory looming, loudness change is perceived as greater when a sound increases in intensity than when it decreases by the same magnitude. A within-subjects experimental design manipulated: intensity direction (increasing, decreasing) and region (low, high), tempo (fast, slow), and tonality (tonal, atonal) of monophonic melodies. Resultant perceived loudness change was measured as the difference between the mean from continuous ratings of loudness assigned during the opening 1-2 s and closing 11-12 s of the melodies. We hypothesized that perceived loudness change is: i) greater in melodies that increase in intensity compared with those that decrease by the same amount; and ii) greater when tempo is fast and tonality unfamiliar. Thirty-five participants rated loudness continuously. Stimuli comprised tonal and atonal 13 note (5+5+3) repetitive cycles lasting for 12 s; sweep size was 15dBa in low (55-70 or 70-55) and high (70-85 or 85-70) intensity regions; tempi were 129.6 and 64.8 beats per minute (bpm). Consistent with our hypothesis, there was an interaction between direction and region giving significantly greater perceived change in the high region when intensity increases rather than decreases, and also greater change than for low region increases. Perceived change for decreases was similar across regions. A significant direction x tempo interaction revealed a greater difference in perceived change between increasing and decreasing intensity when tempo was fast than when tempo was slow. We suggest that emotional reactions to crescendi may be associated with an adaptive response to auditory looming.

Performance 4

GOWEN 301, 14:00 - 16:00, Friday 27 Aug 2010

The Magaloff Corpus: An Empirical Error Study

Sebastian Flossmann¹, Werner Goebel², Gerhard Widmer¹; ¹JKU Linz, Austria; ²University of Music & Performing Arts Vienna, Austria

PA017, Time: 14:00

Musicians at all levels of proficiency must deal with performance errors and have to find strategies for avoiding them. As their level of skill increases, errors occur less frequently, tend to be more subtle, and mostly go unnoticed by the audience. The phenomena of performance errors have been investigated before. However, precise performance data is difficult to acquire, as the automatic extraction of information related to timing and dynamics from audio data is still not possible at the required level of precision. Hence, most studies focus on data gathered on computer-controlled pianos under laboratory conditions. We present a study conducted on a unique corpus of precisely measured performances: the complete works for solo piano by Chopin, performed on stage by the Russian pianist Nikita Magaloff. The data was recorded on a Bösendorfer SE computer-controlled grand piano in a series of public recitals in Vienna in 1989. In this first large-scale error study, we examine Magaloff's performances from qualitative, quantitative, and perceptual standpoints.

Altered Auditory Feedback Effects on Keyboard and Singing Performance

Peter Q. Pfordresher, Thomas Varco; University at Buffalo, USA

PA055, Time: 14:30

Past research that has investigated the effects of altered auditory feedback (AAF) on keyboard production suggests that fluency in action planning may be sensitive to both the timing and the contents of auditory feedback. Furthermore, the effect of AAF that manipulates feedback timing (synchronization of feedback with actions) typically disrupts the production of timing whereas manipulations of feedback contents (such as shifting the sequential relationship of feedback pitches relative to the action sequence) typically disrupts accuracy (e.g., Pfordresher, 2003). A limitation of research supporting this dissociation has been the exclusive use of keyboard production, whereas other action systems — vocalization in particular — may rely in different ways on auditory feedback (cf. Howell et al., 1983). We ran two studies that test whether the results found for keyboard production generalize to vocal production, here singing. Participants sang melodies that were learned and memorized through imitation, and then produced melodies repeatedly at a prescribed rate while hearing different AAF conditions that were designed to simulate the kinds of manipulations used in keyboard studies. Experiment 1 focused exclusively on singing whereas in Experiment 2 participants engaged in both singing and keyboard production tasks. Results overall suggest that the effect of AAF is consistent across effector systems, and analyses of individual differences suggest that the amount of disruption experienced during production with one effector system predicts sensitivity of the other effector system to similar manipulations of feedback. These results support the view that disruption from AAF is based on abstract, effector independent, response-effect associations.

Playing by Ear at 95: A Case Study

Eleanor Selfridge-Field; Stanford University, USA

PA075, Time: 15:00

A 95-year-old subject with non-Alzheimer's dementia retains perceptual, organizational, and gestural skills acquired from musical training that began in early childhood and continued through college. She was then largely divorced from organized musical activity until she reached her Nineties. She no longer reads music, but she retains in active memory the lyrics of nearly all of her current repertory of several hundred songs popular between 1900 and about 1975. She is also able to play by ear newly presented songs. Her playing style is abundantly full of improvised embellishments that are generally regarded as "professional."

Embodied Effects on Musicians' Memory of Highly Polished Performances

Kristen T. Begosh¹, Roger Chaffin¹, Luis Claudio Barros Silva², Jane Ginsborg³, Tânia Lisboa⁴;

¹University of Connecticut, USA; ²Universidade do Estado de Santa Catarina, Brazil; ³Royal Northern College of Music, UK; ⁴Royal College of Music, UK

PA114, Time: 15:30

A professional pianist's and a professional soprano's ability to begin playing from the middle of a previously memorized piece was tested using a modified cued recall task. Stimuli tested the musicians' ability to begin playing from different types of *performance cues* (PCs) — retrieval cues to which they attend as they perform the piece from memory — as well as the effect that movement had on their ability to utilize PCs. For the vocalist we also tested how the order in which the stimuli were presented (either the same order as they occur in the piece or random order) influenced her response times.

The pianist was faster to respond to *expressive cues* (locations where he intended to convey a new musical meaning) than to *basic cues* (locations where he needed to attend to a technical element). His response times were also faster when he was able to move as stimuli were presented, compared to when he remained still. For the vocalist,

response times were fastest in the no movement-sequential condition and movement-random condition.

The pianist's results replicate previous findings implying that instrumentalists would be likely to use expressive cues to recover from a memory failure, and suggest that movement might benefit overall performance. The vocalist's results imply that she would be likely use a strategy different from that of the pianist to recover from memory failure and that movement is only beneficial in certain circumstances.

Auditory Perception 5

SMITH 120, 14:00 - 16:00, Friday 27 Aug 2010

26 Years of Music Perception: Trends in the Field

Anna K. Tirovolas, Daniel J. Levitin; McGill University, Canada

PA073, Time: 14:00

In this review, we sought to document the longitudinal course of empirical studies published in the journal *Music Perception*, dating from the journal's inception in 1983 to present day. The aim of this project was to systematically characterize the nature of experimental work published in one of the principal peer-reviewed outlets for work in our field, and consider these data as a sample representing the field of music perception. Specific areas examined within each paper were: the sub-topic represented within the broader context of music perception, the types of subjects employed in the experiments (including levels of musical training), the nature of stimuli presented, the apparatus used to carry out experiments, the types of outcome measures, as well as bibliographic information such as geographic region. Every empirical paper in the journal was examined, and relevant details extracted. Trends and findings will be presented.

An Exploration of the Importance of Phase in Polyphonic Processing and Analysis

Brian King, Les Atlas; University of Washington, USA

PA072, Time: 14:30

Polyphonic audio processing and analysis are popular areas of research and have many exciting applications, including source isolation, remixing, and polyphonic music transcription. The key to these technologies is the ability to separate an instrument from the mix. One of the latest, most promising methods of separation is non-negative matrix factorization, which uses matrix factorization techniques on the magnitude of a short-time Fourier transform to create a set of bases that can be additively combined to synthesize individual sources. However, the assumption that sources are additive in the magnitude spectral domain is false, as superposition does not hold. For example if two instruments are playing together, the combination of their waveforms at times can either add together, when they're both positive or negative sign, or cancel one another, when they have opposite signs, but non-negative matrix factorization makes the assumption that they will always add and never cancel. However, superposition holds in the complex spectral domain, when the phase is used in conjunction with the magnitude. Despite the satisfaction of superposition with the new complex version, researchers often still make the assumption that the resulting differences are insignificant and ignore phase.

Instead of relying on this past assumption, we demonstrate how ignoring the phase in processing affects the results. We will present how using only the magnitude introduces distortion both theoretically and empirically. We will also explore when the use of magnitude-only signals is satisfactory and when the complex domain is necessary.

Approaching an Audience Model of Listening Experience

Finn Upham, Stephen McAdams; McGill University, Canada

PA060, Time: 15:00

Continuous ratings have become a popular source of data for the investigation of the temporal experience of music, but the inter-

pretation of these collections of time series continue to pose some challenges. Data collected from two audiences who rated experienced emotional intensity in response to the same concert program (four Mozart symphonic movements) show some surprising variability in responses. By inspecting the proportion of participants increasing or decreasing ratings over time intervals of a few seconds, we find that individual participants do not respond in the same way at the same time, and ratings often show contradictory responses. Instead of trying to model the time series of individual participants' ratings, we consider this rating change activity to be a description of the audience's response and ask whether the variation in this activity is different from what would be expected from a random process. We test the distribution of changes in ratings and demonstrate that audiences' reported responses to music are not always sufficiently coordinated to justify rejecting the null hypothesis of random behavior. In such cases, even the time series of average ratings should not be used for analysis. However, when the audience is highly coordinated, their responses share many moments of strong and mixed increasing and decreasing rating activity. Although ratings of a given musical stimulus hardly ever include simultaneous rating changes in more than 40% of the participants, the same stimulus does induce similar temporal rating patterns in both audiences (live and recorded versions of the same concert).

Perceptual and Neural Representation of the Temporal Attribute of Timbre

Blair Bohannon, Hiroko Terasawa, Steinunn Arnardottir, Marcos Perreau-Guimaraes, Patrick Suppes; Stanford University, USA

PA167, Time: 15:30

The temporal attribute of sound plays an important role in timbre perception. In this work, we investigated the relevance between perceived timbre and neural activity when a sound's temporal attribute is manipulated. We focused on the effect that a quickly decaying sound with a strong attack changes its timbre dramatically when played backward; we presented such forward- and backward-playing sounds to our participants, and measured the perceived timbre dissimilarity and EEG response. The register and instrument type were also varied for comparison. In the perceptual experiment, the stimuli were presented in pairs, and the participants rated the dissimilarity using numerical scaling. The dimensions of temporal attribute and register contributed strongly to the perceived dissimilarity, whereas the dimension of instrument type contributed less. In the EEG experiment, the participants listened to the stimuli sounds passively, and we analyzed the neural responses using linear discriminant classification. The stimuli grouped by temporal attribute showed the highest classification rate, followed by instrument type and register, which indicates that among the three dimensions, changes in temporal attribute produce the most distinct neural activity pattern. These results point to a possible correlation between perceived timbre difference and neural response due to changes in the temporal attribute.

Keynote Address

KANE 130, 16:30 - 17:30, Friday 27 Aug 2010

Spatiotemporal Music Cognition

Petri Toiviainen; University of Jyväskylä, Finland

Closing, Time: 16:30

Music is commonly regarded as being primarily an auditory phenomenon, and the bulk of research on music perception focuses exclusively on this sensory modality. Only recently have the multi-modal aspects of music processing gained significant attention. In addition to the auditory, other sensory modalities such as visual, tactile, and proprioceptive, play a significant role in the processing of musical information. A common feature of the latter modalities is that they rely on corporeal movement.

Examples of the important role of movement in music are abundant. For instance, in most cultures music is associated with dance. Furthermore, we tend to move while listening to music, in particular

when the music has a clear pulse. Additionally, corporeal movement is important for the interaction and communication between musicians, helping to maintain synchronization and convey expressive intentions. Lastly, movement is an important ingredient in social interaction associated with music listening. Music can thus be regarded as a fundamentally spatiotemporal phenomenon.

While research on music and movement has already shed some light on spatiotemporal music cognition, there remain some important challenges. For instance, most of the work to date has been kinematic, focussing on description of motion in terms of position, velocity, acceleration and so on, whereas kinetic approaches, focussing on explanations of motion in terms of force, torque and so on, are almost nonexistent. Another challenge involves understanding the kinematics of collective interaction and entrainment. While making sense of the kinematics of the musical activity of a single person is already a challenging task, having several persons interacting adds significantly to the complexity of the phenomenon. To gain a better insight into such interactions, methods of complex system dynamics might be useful.

Poster Session 1

KANE HALL - WALKER AMES ROOM
17:30 - 18:30, Monday 23 Aug 2010

Music Choice and Embarrassment: An Investigation of the Role of Context, Social Identity and Age

Anna M.J.M. Paisley, Laura A. Mitchell; Glasgow
Caledonian University, UK

PO001, Poster

While musical preferences have been shown to influence our social evaluation of others and to play an important role in our own personal identity, little research has investigated the potential for embarrassment relating to specific musical choices. This questionnaire study examined the roles of age, context and identity in prevalence of embarrassment felt in relation to musical taste, and the remedial tactics employed to ameliorate this. Three hundred and eighteen respondents reported their experiences of feeling embarrassed by their musical preferences, reluctant to admit to certain preferences or fearful of negative judgment by others, and the social contexts in which these experiences had taken place. Age differences were found, with younger participants being significantly more likely to report incidence of embarrassment, reluctance and fear of judgment. Participants of both age groups for whom music played an important role in everyday life and for whom musical taste was a prominent index of identity further reported significantly more embarrassment. Overall, embarrassment was most often experienced in the company of peers and friends. These findings suggest embarrassment as a feature in our relationship with music varies with age, yet remains a salient phenomenon across the lifespan in those for whom music forms a significant part of social and personal identity.

Does Synchrony Really Affect Social Variables?

Adena Schachner, Laura Garvin; Harvard University,
USA

PO004, Poster

Recently it has been reported that synchronized movement increases prosocial behavior, such as cooperation. We aimed to replicate the effect of synchrony on cooperation, as reported in previous work (Wiltermuth & Heath, 2009); and to extend these findings to another social variable, conformity.

Experiment 1 attempted replication of Wiltermuth and Heath (2009; experiment 3), with the added control that experimenters were blind to condition. Groups of three subjects sang/moved either in synchrony or asynchrony with each other (IV); then played a public goods game to measure cooperation (DV).

Experiment 2 looked for effects of this same synchrony manipulation on another social variable, conformity. One subject and three confederates sang/moved either in synchrony or asynchrony (IV, as above); then, confederates and subject answered feedback questions about the experiment verbally on a 0-10 scale. Confederates always answered first; subjects' level of conformity to confederates' opinions was measured (DV). Experimenters and confederates were kept blind to the relevant information.

The synchrony manipulation used in previous work did not appear to affect levels of cooperation when experimenters were blind to condition. The same manipulation also did not significantly affect levels of conformity. Thus some effects reported in this literature may be artifacts of subtle, unconscious differences in experimenter behavior across conditions. More recent studies have found effects of synchrony on social variables even with experimenters blind to hypothesis using different manipulations. Thus synchrony may indeed increase prosociality using more powerful manipulations. However, it is crucial that work on synchrony is very carefully controlled.

Brain Correlates of Musical Feature Processing During Listening to Modern Tango

Vinoo Alluri¹, Petri Toiviainen¹, Mikko Sams², Iiro Jääskeläinen², Elvira Brattico³; ¹University of Jyväskylä, Finland; ²Aalto University, Finland; ³University of Helsinki, Finland

PO009, Poster

Over the past two decades, neuroimaging studies on music processing have attempted to identify brain structures involved in the perception of pitch, tone patterns, sensory dissonance, and rules of chord succession. Typically these studies have utilized simplified stimuli where only the perceptual processes of interest were manipulated, compromising the ecological validity of the findings. Our aim was to study how the brain is activated during listening to continuous music and to find out how various musical features are processed in a natural condition. To this end, we used a novel approach of combining fMRI with computational acoustic feature extraction. Eleven participants were measured with fMRI while they were listening to Astor Piazzolla's *Adios Nonino*. This piece was chosen for its affordable duration (8 minutes) and varying acoustic structure. The BOLD signal per voxel was extracted. Forty-three acoustic features were extracted from the stimulus and reduced to nine components via principal component analysis (PCA). Subsequently, the PC scores were correlated with the BOLD signal of each voxel. The low-level spectrum-related PCs, identified as *brightness* and *event density* activated widely the brain in auditory, motor, limbic, somatosensory and imagery-related areas, and cerebellum, whereas PCs related to higher order features activated distinct brain structures in a more focal way. Particularly, besides the auditory areas, *key clarity* activated the dorsolateral prefrontal cortex and one portion of the somatosensory area whereas *pulsation* generated neural activity in motor-related regions including the basal ganglia, the supplementary motor area and the cerebellum, and in limbic and reward areas.

A comparison of Facial Muscle Activity Between Advanced and Novice French Horn Players

Takeshi Hirano¹, Michiko Yoshie², Kazutoshi Kudo², Tatsuyuki Ohtsuki², Hiroshi Kinoshita¹; ¹Osaka University, Japan; ²University of Tokyo, Japan

PO012, Poster

The present study investigated activities of embouchure-related facial muscles for advanced and novice French horn players. Subjects were recruited from two groups of players. One professional, and eleven French horn performance-major music students formed an advanced player group, and ten amateur French horn players formed a novice group. Long-tone production and octave tone production tasks were tested for each subject. For the long tone task, F2, F3, F4, F5, and B3-flat tones were produced for about 6 sec at three levels of sound dynamics (*pp*, *mf*, and *f*). For the octave-tone task, the F3 tone was produced first for 1.5 sec, followed by the F4 tone for 1.5 sec and the F5 tone for 3 sec at *mf* without slur articulation. Surface electromyography was recorded from 5 selected facial muscles. The results showed that for the long-tone task, activation of all muscles was significantly increased at stronger dynamics, as well as at higher pitches. There was no group difference. For the octave tone task, on the other hand, the novice players had greater activity of the levator labii superioris, and zygomaticus major muscles. It was concluded that dynamics and pitch of the tone produced changed activity of the facial muscles for the formation of embouchure, which agreed with the findings of a trumpet study. The upper lip-controlling muscles differed between the advanced and novice players when performing the octave pitch modulation. These muscles thus play an important role in the formation of the embouchure for complex pitch control.

The Effect of Tonal and Rhythmic Auditory Training on Attentional Achievement of Children with ADHD — An MEG and MRI Study

Christine Groß¹, Wilfried Gruhn², Ulrike Halsband¹;
¹University of Freiburg, Germany; ²Freiburg University of Music, Germany

PO015, Poster

In the last decade, contributions from cognitive sciences, experimental psychology, behavioural neurology, and neuropsychology have significantly extended the understanding of the neuronal effects of musical training. Brain-imaging studies have shown that playing music induces structural and functional brain changes in adults (Gaab & Schlaug, 2003; Münte 2002; Gaser & Schlaug, 2003) and in children (5–9 years old) after one year of instrumental training (Schlaug et al., 2005). There is little known about musical training and ADHD, but recent research provides some positive evidence.

This study aims to investigate how attention deficit hyperactivity disorder can be attenuated by a specific tonal and rhythmic auditory training and how this training affects the neural mechanisms that cause this disorder. This hypothesis will be tested by a random assignment of a sample of children with ADHD (N=20) aged 7 to 9 years to two different types of a specific auditory training (tonal or rhythmic) or to a control group of children with ADHD (N=20) who perform other clearly defined activities such as sports or other regular, instructed training, but do not receive any musical training. The visual and auditory attention span, listening habit, school relevant domains and synchronized tapping tasks will be measured before and after intensive auditory rhythmic or tonal training. To identify structural and functional effects of auditory training on brain activation, MRI brain scans along with DTI and MEG scans will be implemented.

Neurological and Behavioral Basis for Auditory-Motor Transformations in Music Performance

Rachel Brown¹, Joyce Chen², Avrum Hollinger¹,
 Virginia Penhune³, Caroline Palmer¹, Robert Zatorre¹;
¹McGill University, Canada; ²University of Oxford, UK;
³Concordia University, Canada

PO018, Poster

When musicians perform music, they may rely on different auditory-motor mechanisms to produce pitch and temporal sequences; pitches may be mapped directly to motor targets (e.g. piano keys) while the timing of pitches may be mapped indirectly via temporal structure to motor acts. Distinct regions of auditory-motor cortical networks, particularly ventral and dorsal premotor cortex, are proposed to be differentially involved in direct and indirect sensory-motor mapping. We compared the neural and behavioral correlates of pitch-motor and timing-motor mapping in music performance. Pianists underwent fMRI scanning while they listened to musical sequences and subsequently played them back on a piano keyboard. We manipulated whether pitch or timing information in the musical sequences changed or remained the same across series of consecutive trials; information that remained the same across trials was expected to elicit decreased neural response. Pianists later performed a recognition task for the pitch and timing sequences heard during scanning. Timing sequences recruited bilateral dorsal and left ventral regions of premotor cortex, and pitch sequences also similarly recruited left dorsal and left ventral regions of premotor cortex. Thus, these regions were engaged when pianists both listened to and performed pitch and timing sequences. Pianists performed pitch sequences less accurately when timing information changed over trials. Pianists recognized both pitch and timing sequences but were better at recognizing pitch sequences. Results support a close link between auditory perception and production in music performance and suggest that pitch-motor and timing-motor transformations may be partially integrated processes in music performance.

Pitch Perception of Vibrato Among University and High School String Players

John M. Geringer¹, Rebecca B. MacLeod²; ¹Florida State University, USA; ²University of North Carolina at Greensboro, USA

PO021, Poster

Although empirical studies using electronic stimuli indicate that perceived pitch of vibrato tones generally corresponds to the mean of the vibrato, influential string pedagogues advocate that vibrato should oscillate from the conceived pitch and below. We used tones of acoustic instruments (violin and cello) as stimuli and asked whether there are differences in pitch perception between: vibrato and non-vibrato tones, high school and university string players, and cello and violin stimuli. Participants were 96 high school string players and 96 university string players. Listeners heard a series of tonal pairs: One tone of each pair was performed with vibrato and the other without vibrato. The second tone was in-tune, 15 cents sharp, or 15 cents flat relative to the first tone. Participants discriminated between sharp, in-tune, and flat pairs. Significant interactions were found between vibrato condition and instrument, and vibrato condition and experience. Non-vibrato tones were heard as sharper than vibrato tones (with the same mean) for violin but not for cello tones. University students rated sharp tones as more sharp, and flat tones as more flat than high school string players. Violin tones with vibrato were judged as lower in pitch than corresponding non-vibrato stimuli, more so among high school string players than university students. For cello tones, vibrato and non-vibrato tones were judged similarly, consistent with previous findings that perceived pitch matches the vibrato mean. Results for both instruments thus contradict some pedagogical views and for violin are contrary to some but not all empirical research.

An Investigation of the Implicit Learning of Metrical and Non-Metrical Rhythms Using the Serial Reaction-Time Task

Ben Schultz¹, Catherine J. Stevens¹, Barbara Tillmann¹,
 Peter E. Keller²; ¹University of Western Sydney,
 Australia; ²MPI CBS, Germany

PO024, Poster

Implicit learning (IL) of Musical Rhythm and its properties (e.g. meter) has received minimal attention. According to the dynamic attending theory (DAT), metrical frameworks should strengthen expectancies for event onsets. It was hypothesized that learning occurs more readily for metrical patterns (MP) than non-metrical patterns (NMP). Two experiments using the serial reaction-time task (SRTT) investigated IL of Musical Rhythm. In the SRTT, learning is traditionally characterized by decreases in RT over blocks containing the exposure pattern, RT increases when a new pattern is introduced, and RT recovery upon reintroduction of the exposure pattern. Following the SRTT, the Process Dissociation Procedure (PDP) was used to ascertain IL. Experiment 1 employed a task where participants were to identify syllables (order random) that followed either a MP or NMP. Experiment 1 demonstrated no evidence of learning within the SRTT for MPs or NMPs. In Experiment 2, tones were presented through the left or right headphone, or binaurally. Experiment 2 used two different tasks: a multiple response (MR) task requiring the identification of stimuli, and a single response (SR) task requiring responses to the stimulus-onsets (regardless of identity). Results for Experiment 2 indicate learning for MPs in the SR task, but not the MR task. The PDP suggests IL of the MP for both tasks. This signifies that IL of MPs can be revealed in the SRTT via responses to stimulus-onsets. Future experiments using an NMP pattern in an SR task is necessary to ascertain that, as per DAT, metrical frameworks strengthen expectancies.

Assessing the Influence of Instrumental and Vocal Timbres on Melodic Dictation Outcomes

Garrett Michaelsen, Mitch Ohriner; Indiana University, USA

PO027, Poster

The piano tends to be the sole instrumental timbre used in university-level aural skills courses. Our study investigates the effect this focus on the piano timbre has on melodic dictation outcomes in the aural skills class. We administered 18 melodic dictations to 84 second-year students over the course of a semester. For each dictation, half of the students dictated piano melodies and half dictated one of a set of nine other timbres. We found that, on the whole, students performed better on piano dictations than on any other timbre. Pianists enjoy a larger «piano bump» when hearing their native timbre compared to all other students. Students also performed better on treble dictations than on bass dictations. In individual cases, certain vocalists and instrumentalists also showed very substantial gains dictating their native timbre, sometimes exceeding one standard deviation, but we did not find a general trend. We believe the results of our study show that students in aural skills classes are being ill-prepared for the timbral diversity they will be exposed to in their musical careers. Aural skills classrooms should therefore strive to include a wider variety of instrumental and vocal timbres in their curricula.

Unattended “Silent” Beats Enhance Visual Attention

Nicolas Escoffier, Darren Yeo, Annett Schirmer; National University of Singapore, Singapore

PO031, Poster

Musical rhythms can entrain attention thus modulating attending periodically over time. A similar effect has been recently described for visual rhythms. This suggests that the processes supporting these entrainments might be shared across modalities. We aimed at testing this idea by investigating whether a musical rhythm could entrain visual attention and modulate response time to visual events. We explored whether the effect would be modulated by the social relevance of the material or the participants' musical expertise. Participants were presented with pictures of faces or houses and judged picture orientation (upright or inverted). They performed the task in silence or in presence of a syncopated musical rhythm comprising a beat in the absence of a sound. Visual stimuli were presented either on or off the silent beat. Participants responded faster to pictures presented on as compared to off-beat or in silence. This effect was comparable for faces and houses and did not correlate with the number of years of musical training. Together these results provide evidence that an unattended musical rhythm can modulate attention in the visual modality regardless of stimulus type and listener background. Thus one may infer a shared mechanism for rhythmic attending in the visual and auditory modality with a possible crossmodal influence. Moreover, this mechanism appears to be universal suggesting a fundamental role for the emergence of music in human evolution.

Absolute Pitch in Children with Congenital Visual Impairment: A Preliminary Study

Maria Dimatati¹, Adam Ockelford¹, Pamela Heaton², Linda Pring², John Downing¹; ¹Roehampton University, UK; ²Goldsmiths University of London, UK

PO035, Poster

A high incidence of absolute pitch (AP) has been reported among individuals with visual impairment (VI). One question is whether children and adolescents with congenital VI show superior memory for pitch compared to sighted chronological age-matched controls. Children with congenital VI, together with age-matched controls, participated in an online experiment testing pitch memory. The results indicated that the group with VI outperformed the sighted group in the extent of the total number of accurate pitch identifications. Additionally, a ceiling effect was revealed in the subgroup of blind males, while individuals with some light perception and a specific syndrome tended to show superior performance. These findings suggest enhanced memory for pitch in individuals with VI. However,

the study is ongoing with a larger sample and our further aim is to investigate the effects of the syndrome variability and the timing of blindness onset on auditory performance.

Motivations to Engage in Amateur Music-Making: Does the Audience Matter?

Alexandra Lamont, Christopher Marshall; Keele University, UK

PO038, Poster

There is a growing literature on the motivations behind children's involvement in music training and music ensembles, and other factors such as family support and socio-economic variables that can influence this. In order for learning to be successful, many motivation theorists such as Dweck and colleagues have argued that a shift towards intrinsic motivation and learning goals rather than performance goals is necessary. This thus suggests that appreciating an activity for its own sake is valuable to sustain long-term engagement. Despite around a third of school leavers having the necessary skill to continue making music, many young adults cease this activity. However, some young adults join organised groups to continue with both the social and performance elements of music-making. It thus appears that performance goals in terms of playing with others and/or playing for others might be necessary to sustain musical involvement throughout the lifespan, at least for particular types of adult. As yet no research has systematically explored the effects of personality on such choices.

This paper aims to explore why individuals choose to engage in music-making at an amateur level individually, in a group, and for a performance. It is part of a wider project comparing motivations for engaging in music and sport. The study includes two different groups of adult (undergraduate student) amateur music-makers: those pursuing music for its own sake, and those in organised ensembles preparing for a performance. A mixed-methods approach will be employed combining quantitative measures (motivation to practice, both structured and unstructured; to play; to attend rehearsals; enjoyment; engagement; a personality measure; and quality of life) and in-depth interviews. Data collection is ongoing and full results will be available at the conference. The results will be compared with recent findings by Harackiewicz et al. (2002) that suggest multiple goals (both learning and performance) may be more beneficial for predicting engagement with an activity, particularly for college students. Since music making has considerable benefit for lifelong well-being, the results will provide important insights into the opportunities that can be offered to adults in order to sustain their interest in this kind of activity, whether it be personal or social.

Expressive Synthesis of Melody Using Prosodic Labeling

Christopher Raphael; Indiana University, USA

PO043, Poster

I propose a method for automatic expressive synthesis of melody.

The majority of past work on expressive synthesis mostly concerns piano music, largely due to the simplicity of representing a piano performance — by one way of reckoning, one need only express the start time, end time, and initial loudness of each note. Such a representation is not rich enough to capture the expressive considerations that arise for the violin, oboe, trumpet, and other “continuously controlled” instruments. I introduce a minimal, yet usable, performance representation consisting of two time-varying functions, one for frequency and one for intensity. Through this representation, one can express pitch, rhythm, within- and between-note dynamics, vibrato, articulation, glissando, pitch bending, as well as other aspects of melody interpretation.

Past approaches to expressive synthesis mainly try to map observable score attributes (rhythms, pitch contours, etc.) directly into performance decisions (warping of time, increase in dynamics, etc.). No attempt is made to understand or represent any aspect of the interpretation itself; rather the consequences of the interpretation are treated. My approach differs by explicitly representing the interpretation by tagging each melody note with a prosodic label

capturing the role it plays in a larger context. The labels reflect local notions of direction and repose, but higher level grouping implicitly emerges from the labeling.

There are at least two advantages to this approach. One is that a simple logic governs the way the prosodic label sequences behave. When this logic is captured by an appropriate probabilistic model, the problem of estimating the hidden sequence of labels is solvable. I phrase the interpretation problem as one of estimating the most likely hidden sequence of labels, using time-honored machine-learning techniques such as hidden Markov models, classification trees and logistic regression. The sequence estimator is trained using a hand-labeled data set of about 50 folk-like melodies. The estimated interpretation is then deterministically mapped into the frequency and intensity functions which, in turn, give the audio performance.

The second advantage is that the prosodic labeling is naturally positioned between the musical score and the observable aspects of the interpretation. Thus the separate problems of estimating the prosodic labeling and generating the actual performance from this representation require shorter leaps, and are therefore easier than directly bridging the chasm that separates score and performance.

Examples are presented on the data set used for training using the usual "leave one out" train/test paradigm. Examples can be heard at <http://www.music.informatics.indiana.edu/papers/ismir09>

Jazz or Classical — Does Personality Influence Choice of Genre in Professional Musicians?

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PO048, Poster

Despite the obvious importance of deciding which career to pursue, little is known about the influence of personality on choice of career. Here, we investigated the relation between sensation seeking, a supposedly innate personality trait, on career choice in classical and 'rhythmic' students at the academies of music in Denmark. We compared data from groups of 36 classical and 36 'rhythmic' students matched on age and gender who had performed a psychological test battery comprising the Zuckerman Sensation Seeking Scale, the Spielberg State Trait Anxiety Inventory as well information about demographics and musical background. 'Rhythmic' students had significantly higher sensation seeking personality, pre-dominantly driven by higher boredom susceptibility, than did classical students, whereas classical student showed significantly higher levels of state anxiety, imagining themselves just before entering the stage for an important concert. The higher level of anxiety related to stage performance in classical musicians could not be attributed to general anxiety level differences between groups and are presumably a consequence of differences in musical rehearsing and performance practices of the two styles of music. The higher sensation seeking score observed in 'rhythmic' students, however, suggests that personality plays a major role in choosing which musical career to pursue.

Influence of Teacher Praise, Parental Support and Peer-to-Peer Communication on Pupils' Self-Assessment and the Development of Self-Concept Beliefs in Musical Ability

Margit Painsi, Thade Buchborn; University of Music & Performing Arts Vienna, Austria

PO051, Poster

Assessment for learning in music mainly aims to help pupils be aware of their actual standard of performance and to develop strategies to achieve their next developmental level. This formative assessment is achieved mainly by means of dialogue between teachers and pupils and is characterized by its process-orientation and focus on future goals in contrast to summative assessment that essentially looks back on the work that pupils have done (Nicol & Macfarlane-Dick, 2006). Besides teachers, parents also provide feedback as do peers in the musical learning community by engaging in lively dialogue with each other. The study aimed to investigate the feedback that young musicians get from their teachers, parents and peers. The

sample comprised forty 11 to 12-year-olds from a secondary school which participated in an extended music programme. Data was collected by video observation and semi-structured interviews. Results indicate that feedback from teachers, parents and peers differ in essential aspects. Whereas verbal feedback is predominant in the communication between pupils and teachers as well as between pupils and parents, pupils mentioned verbal feedback between themselves and their peers only in passing. Peers gain information about the quality of their achievement by drawing conclusions out of social comparisons that mainly rely on behavioural interactions. Whereas praise from teachers is attributed to effort and achievement, positive feedback coming from parents is often attributed to their emotional relationship. Peer-to-peer feedback seems to be evoked by an unconscious intention of the children themselves that may be influenced by their motivational needs.

Cognitive Modeling of the Cross-Cultural Understanding of Improvised Modal Music

Olivier Lartillot¹, Mondher Ayari²; ¹University of Jyväskylä, Finland; ²University of Strasbourg, France

PO054, Poster

This multidisciplinary research, articulating field musicology, experimental psychology and computer science, undertakes a cognitive study (both perceptive and computational) focused on improvised music, encompassing various levels of the hierarchical articulation of music as heard, from perceptive low-level Gestalt rules to cultural high-level formal and stylistic knowledge. Tunisian traditional musicians, European jazz and non-jazz musicians analyzed two modal improvisations from distinct cultural origins (a Tunisian traditional *Istikbâr*, and a solo by John Coltrane). Individual listening strategies are explored with the help of an experimental protocol based on identification of musical material, recognition of mode and modulation, and segmentation and reduction task. Segmentations were clustered across subjects, according to the underlying segmentation heuristics, as indicated by the listeners during a final interview phase. A cognitive model of segmentation strategies has been developed, based so far mainly on low-level heuristics of local discontinuity and parallelism, and has been tuned and articulated so as to maximize the correspondences between the computational predictions and the subjects' responses. Most of the segmentation positions proposed by the subjects can be partly explained by the presence of local discontinuities along time and pitch dimensions. Strong local discontinuities relate to listeners' segmentation decisions; weaker discontinuities, on the contrary, cannot explain the perception of segmentation unless they are combined with other factors such as parallelism. Experts tend to overlook slight boundaries, concentrating rather on other factors, even perceptually insignificant, that are related to high-level structures.

Amplitude Envelope and Auditory Alarms

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PO057, Poster

Auditory alarms are an important feature in medical devices, allowing doctors to monitor patients' vital signs by ear while simultaneously observing them visually. However, such alarms rely on a doctor's ability to remember associations between sounds and messages, a task that has proven difficult even when using the sounds recommended by the International Electrotechnical Commission, which use flat amplitude envelopes (exhibiting a long sustain and an immediate offset). We found that alarms based on sounds with percussive envelopes (exhibiting an immediate exponential decay with no sustain) may be preferable for such applications by asking participants to associate various household objects (e.g., cell phone, key, credit card) with 4-note melodies made of tones using one of two amplitude envelopes: "flat" or "percussive." Participants repeated a training block in which they were exposed to ten melody-object pairs until able to recall at least 7 of the 10 melody-object associations. Participants then performed a distracter task, after which we evaluated retention using a modified version of the old-new paradigm allowing for testing of both melody recognition and melody-object association. We found that participants listening to melodies of percussive tones

required 40% fewer trials to learn the associations, yet performed no differently in the final evaluation (either with respect to the old/new judgments, or to the melody-object associations). We conclude that envelope shape may play an important role in explaining previous problems with designing effective auditory alarms in medical devices, a finding that raises theoretical questions about learning, memory, and timbre.

Musical Conceptual Blending: Music Exists Only Between Sounds

Sebastian Schmidt, Thomas A. Troge; University of Music Karlsruhe, Germany

PO060, Poster

In the last decades, tremendous progress was seen in the field of neurosciences, which dealt among other things with consciousness, cognition and perception. And furthermore empirical findings in musical research often create the basis to develop cognitive descriptions of music. But it is possible to develop cognitive musical concepts, if the scientist who developed these concepts, is not integrated as 'observer' (Foerster, 2003)?

We do not think so, and therefore, as a first step in this paper, we show that a comprehensive description of music is possible when you leave the paradigm of scientific realism and look at music descriptions with the 'epistemology of constructivism' (Glaserfeld, 2002). On this basis, we present the huge potential residing in Gilles Fauconnier's & Mark Turner's 'Blending Theory' (Fauconnier & Turner, 2003) to develop a cognitive musical description. The next step this paper develops a 'Musical Conceptual Communication Model' based on neurobiological realizations from 'Autopoiesis' (Maturana, 1972), epistemological aspects of Constructivism, and sociological constructions from 'System Theory' (Luhmann, 1995) in order to try to integrate the scientists in this concept.

Afterwards, we explain the tools important from the 'Blending Theory' in connection to musical examples and hope to put forward a line of arguments that help to understand why 'Music Exists Only Between Sounds'.

Consequently, we present a first sketch of a 'Musical Conceptual Blending Theory' that respects our 'Musical Conceptual Communication Model'. This approach is not bound to traditional notation and, because of this, it integrates the 'subjective aspects of music' (Huron, 2008).

Lastly, we conclude music could only be described as a mental room of possibilities.

Attitudes, Perceptions and Behaviours of Singing Students in Tertiary Environments

Jessica O'Bryan; University of Queensland, Australia

PO065, Poster

This paper reports on the perceptions of tertiary students studying voice, in particular, highlighting commonalities of student singers and interrogating current approaches to teaching and learning singing in higher education.

Singing students were the focus of an anonymous, online survey that investigated student attitudes toward their tertiary institution experiences, their prior learning, their singing teacher and their one-to-one singing lessons. The survey was designed using Survey-Monkey. It was intended to provide initial data to inform a future case-study examining tertiary vocal teaching and learning approaches in higher education. A range of questions employing forced choice and six-point Likert-type responses were administered to tertiary voice students Australia-wide (N=73). Five key areas were targeted: tertiary music experiences; prior music learning; singing experiences; one-to-one singing lessons; and singer identity. Data were analyzed by frequency and percentage.

Preliminary findings indicate that tertiary experiences of singers are generally positive. Considerable prior music learning factored strongly in the participant cohort, and singing experiences included substantial involvement in formal and informal musical events outside the one-to-one lesson. Findings in singing pedagogy and planning, singing teacher knowledge and relationships reported

significant positive responses of engagement, trust, and respect within the one-to-one singing lesson.

Musical Expectation Effect in Appreciating Musical Climax in the Brain: 3T fMRI Study

Sujin Hong, Seiji Ogawa, Hyeon-Ae Jeon, Sang-Han Choi, Uk-Su Choi, Yul-Wan Sung, Young-Bo Kim, Zang-Hee Cho; Gachon University of Medicine & Science, Korea

PO069, Poster

Climax is the prominent musical passage to evoke a feeling, and neural understanding of expectation while appreciating climax may suggest a way of mechanism in emotional response to music. Using functional Magnetic Resonance Imaging (fMRI), we scanned the participants while passively listening to three types of music; each 12s, 18s, 24s duration of music stimulus includes the same 6s climax passage in the end. The participants got an oral notice that listen carefully when the climax comes. The comparison among three types of music showed the significant large activation in 24s music ($p < 0.05$, $N=11$). The activation of a limited condition of 6s climax passage including post music period of 3 scans showed a same trend. Left anterior insula showed the remarkably enhanced hemodynamic response function (HRF) in the post music period compared to right anterior insula. Also, the cluster of left auditory cortex and left insula showed more various patterns compared to the cluster of right auditory cortex and right insula by multi-voxel pattern analysis (MVPA). We are doing an in-depth analysis of regions of interest including anterior insula, auditory cortex, middle frontal gyrus, lentiform nucleus, cerebellum and so on. Detecting musical climax is a top-down expectation task, and also it is one of paths to the emotional feeling. ROIs in this study will be verified to know how the various activation patterns of bilateral auditory cluster area as well as the different HRF decay patterns of post music period are related with the feeling of musical climax through expectation.

Toward a Comprehensive Model of Consumer Response to Advertising Music

Lincoln G. Craton, Geoffrey P. Lantos; Stonehill College, USA

PO072, Poster

Many broadcast ads include music, and most discussions of music in advertising assume that including music will add value to the commercial. This paper challenges that assumption. The authors — a psychologist and a professor of marketing — provide a novel, integrative review of the relevant literatures in the psychology of music and the marketing literature on music in broadcast commercials. We introduce a new consumer response variable, attitude toward the advertising music (A_{am}). We then outline a conceptual model of consumer response to music in broadcast commercials that identifies key external variables (consumer, situational, and musical stimulus) and internal variables (ad processing and music processing) that influence A_{am} .

Live Performance Computer System with Pitch and Dissonance Models

Alexandre Torres Porres; University of São Paulo, Brazil

PO076, Poster

CANCELLED

Temporal Development and Cognitive Processes in Free Improvisation

Erkki Huovinen¹, Atte Tenkanen²; ¹University of Minnesota, USA; ²University of Turku, Finland

PO081, Poster

Musical analyses of improvisations easily remain mere descriptions of stylistic features, leaving the improvised nature of the music without concern. Our aim is to address this problem by examining processes of temporal development in a large corpus of free improvisations using computer-aided methods, demonstrating how recurring patterns of embodied, cognitive processes may be analyzed on the basis of the improvised musical works.

Our research focuses on a corpus of 750 MIDI-recorded free keyboard improvisations by a professional improviser, situated in the tradition of organ improvisers within western art music. These improvisations were subjected to computational analyses exploring the relative presence of selected musical features in the temporal course of the performances.

The results trace the development of several simple parameters (e.g., density of note onsets, registral range, key velocity) as well as musically more sophisticated ones (e.g., the relative presence of diatonicism or “constructive” musical materials such as the octatonic scale) within the temporal course of the improvisations. By comparing such temporal processes in a large number of improvisations by a single musician, we will (i) describe typical, recurring strategies of improvisatory problem-solving during the first two minutes of an improvisation, and (ii) point out typical temporal areas for apparent cognitive and/or physical breaking points in the improvisations. The relationship of such features to the improviser’s own views on his artistic goals and improvisatory strategies are discussed. Overall, this case study suggests further avenues of research for a cognitively oriented, but nevertheless music-analytically anchored research program of musical improvisation.

Art Song: The Necessary Coordination of Sound and Motion

Eric Vatikiotis-Bateson, Adriano Vilela Barbosa, Esther deMonteflores, Rena Sharon; University of British Columbia, Canada

PO084, Poster

Why is Art Song so boring? This study examines the spatial and temporal coordination of body motion and voice during Art Song performance, and shows how performance style influences audience perception. Our aim is to show a clear linkage between performer action and audience perception that can be used in both Art Song pedagogy and control of listener bias.

It is physically implausible to produce expressive vocalizations at high acoustic amplitudes without concomitant motion of the head and torso. This is due to inherent coordination of the postural, respiratory, and upper airways structures. Furthermore, it is known that motion facilitates learning complex sequences in music and language. Art Song combines complex linguistic and musical skills. However, Art Song practitioners are trained to minimize body motion during performance, limiting their expressive behavior to the face, eyes, and voice. Quantitative analysis of the correspondence between visible motion (using *optical flow analysis*) and vocal acoustics for different styles of Art Song performance by three singers study suggest that suppressing physical motion during Art Song training minimally

results in expressive deficits during performance, which are further exacerbated by the growing dependency of modern audiences on multimodal dynamism. Perceptual evaluation by naïve and musically trained listeners corroborates the measured production differences.

Is There a Musical Ganong Effect?

David Temperley, Daphne Tan; University of Rochester, USA

PO089, Poster

The Ganong effect refers to the effect of context on the categorization of speech sounds: an ambiguous phoneme tends to be perceived as the category that is more likely in context. In this study we examine whether there is a Ganong effect in music. By analogy with language, we might expect that, given a pitch that is tuned in between two chromatic-scale categories, listeners would perceive the pitch category that is more likely or appropriate in context.

To test this prediction, we designed short melodic fragments containing one note in between two chromatic-scale categories: for example, E-D-[C/C#]-B, where [C/C#] was tuned 33 cents, 50 cents, or 67 cents above C. We presented the fragment in two contexts: one in C major (in which C is a more likely pitch than C#) and one in B minor (in which C# is more likely); the fragment was always at the end of the melody. Following the phrase, participants heard two perfectly tuned versions of the fragment (E-D-C-B and E-D-C#-B) and judged which was more similar to the fragment they had heard in context.

There was no main effect of context: hearing the fragment in a context of C major did not make participants either more or less likely to categorize the pitch as C rather than C#. We will discuss the implications of these findings, particularly as they relate to differences between music and language perception.

Effects of Violin, Keyboard and Singing Instruction on Spatial-Temporal Reasoning and Music Aptitude of Young Children

Tzu-Ching Tai; University of Maryland at College Park, USA

PO094, Poster

Music learning has been considered an important educational tool that helps cognitive development of young children. Research on early childhood music education has shown that active music learning enhances young children’s spatial-temporal reasoning and music aptitude. Given a wide variety of music learning, however, the concern of what pedagogical endeavors have effects on children’s development of spatial reasoning and music aptitude remains unanswered. The aim of this study was to examine effects of the three music instructional conditions — violin, keyboard, and singing instruction on spatial-temporal reasoning and music aptitude of children from 4 to 7 years of age. Results of this study showed that children in the violin and keyboard groups had significant increase on scores of spatial-temporal reasoning over the four weeks of music instruction, while children in the singing group did not have a significant improvement. The younger group (4-5 year olds) improved significantly on the spatial-temporal reasoning scores while the older group (6-7 year olds) did not improve significantly. Regarding music aptitude, the four- to five- year-old children in the singing group scored significantly higher than children in both the violin and keyboard groups on tonal aptitude. This study suggests that musical effects on spatial-temporal reasoning may be related to instrumental learning. The singing instruction may help young children develop their tonal aptitude.

Pitch Shifting Does Not Disrupt Song Recognition in the European Starling

Micah R. Bregman¹, Aniruddh D. Patel², Timothy Q. Gentner¹; ¹University of California at San Diego, USA; ²Neurosciences Institute, USA

PO097, Poster

Musical absolute pitch is rare among humans, who attend primarily to the relationship between pitches even if they have some memory

for absolute pitch. In contrast, previous research has suggested that songbirds perceive relative pitch only in limited contexts, and are only able to recognize novel stimuli on the basis of relative pitch within a range constrained by the absolute pitch of the training stimuli.

Our results suggest that the European starling, a species of songbird is able to recognize conspecific song even when the absolute pitch is shifted while preserving relative pitch. This ability to generalize was unconstrained by the training range. Strikingly, there was no difference in acquisition rate between a training set consisting of 64 stimuli (16 shifted versions of 4 song excerpts) and the training set containing only the original 4. Moreover, both groups of subjects were able to recognize novel pitch-shifted exemplars both within and outside of the training range. These results suggest that the full extent of avian pitch processing has not been fully explored, especially within the context of more natural stimuli.

The Relaxing Effect of Sounds: Using Monochord Sounds in Gynaecological Oncology

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PO101, Poster

The monochord is often used in music therapy in central Europe for alleviation of pain, perception of body by means of vibration, as well as for relaxation. The empirical studies investigating primarily the effect of the monochord sound show that monochord sounds positively affect the body and the psyche. In the psycho-oncological context, the monochord is used in particular to promote relaxation in patients. The aim of this study is to investigate further the therapeutic effect of monochord sounds in gynaecological oncology. A total of 63 patients receiving chemotherapy participated in this study: monochord sounds (n=22), progressive muscle relaxation (n=21) and control group (n=20). We collected data using questionnaires (the State Anxiety Scale of Spielberger's STAI and a bipolar mood questionnaire about their physical and mental states) and electroencephalography.

We showed that the monochord works as anxiolysis and improves the physical and mental states of patients during chemotherapy as effectively as progressive muscle relaxation. The results suggest that the monochord as well as progressive muscle relaxation can be used as a therapeutic support for gynaecologic oncological patients during chemotherapy. Further investigation into the therapeutic effect of monochord sounds is necessary to develop an adequate concept and moreover to anchor music therapy in systems for health provision.

The Effect of Performing Music on the Mood of the Performers Themselves

Teruo Yamasaki; Osaka Shoin Women's University, Japan

PO104, Poster

In this study, it was explored whether engaging in the collaborative music activity could affect the mood of the performers themselves. Subjects who had played pianos or other keyboard instruments for 6 to 17 years but did not take professional lessons in music, participated in the performance experiment. Pairs of subjects rehearsed a piano piece for four hands together and played the piece in a duet. Their mood states before and after the performance were measured using by the POMS. To add to it, they were asked to evaluate various aspects of their activity, that is the satisfaction at the activity, the enjoyment of the activity, the quality of the collaborative performance, the quality of the individual performance, the task, the self, the partner, and the interpersonal aspects of the activity.

The results of the experiment revealed that their moods after performance improved significantly in comparison with their moods before performance. Therefore performing music affected the moods of performers themselves. Although the multiple regression analysis was conducted in order to investigate the relation between the positive evaluations, that is the satisfaction at and the enjoyment of

the activity, and the change of moods of performers, any systematic relations were not found. On the other hand, the multiple regression analysis suggested that the satisfaction at the activity resulted from the positive evaluations to the quality of performance and the enjoyment of the activity related to the evaluations to the self, the partner, and the interpersonal aspects of the activity.

Correlation Between the Reasons for Students to Enroll in a Music Course of a University, Their Adjustment to It, Their Perspective of Their Future and Their Personalities

Jiro Isobe, Shigeki Okino, Noriko Sato; Tokai University, Japan

PO110, Poster

In his article 'Individual Differences in Musical Behavior' (in: *The Social Psychology of Music*, 1997), A.E. Kemp insists that musical development reflects the kind of person musicians tend to be as well as the environment in which they tend to be nurtured. To study musicians' personality and temperament, as Kemp continues, may open up new ways of understanding their motivational drives. This view is the starting points of our study and the purposes of our study are 1) to clarify the personality traits of music students, 2) to examine the correlations between those traits and the development of professional technique and 3) to investigate variables which may affect such personality and ability of them. As the first step for the diachronic research, present study focused on analyzing the responses to a questionnaire which were obtained from students in a university music course and examining the correlations to a personality inventory. The questionnaire was composed of four categories; reasons for entering the music course, possible factors that may have hindered entrance, adjustment to the course, and perspective of the future. 67 female freshmen enrolled at the university in 2008 and 2009 were asked to answer the questionnaire and their responses were investigated with the Five Factor Inventory. From the investigation of the data from the questionnaire and the personality inventory, significant correlations were found, and most of them could be explained from the five domains of personality traits. This may serve as a useful index in the educational guidance for music students.

A Psychological Study of Strong Experiences Induced by Listening to Music: Relationship Between Strong Experiences with Music, Physical Reactions and Emotions

Shoko Yasuda; Doshisha University, Japan

PO115, Poster

The phenomenon referred to as strong experiences with music (SEM) is experienced by many people (Yasuda and Nakamura, 2008). Gabrielsson and Lindström's (2003) survey on this phenomenon suggested that SEM has seven components: 1) General characteristics, 2) Physical reactions and behaviors, 3) Perception, 4) Cognition, 5) Feelings/Emotions, 6) Existential and transcendental aspects and 7) Personal and social aspects. However, the mechanism of SEM as well as the relationship between SEM and each component remains to be elucidated. Against this background, we have focused our research on the two abovementioned components of physical reactions and emotions, conducting experiments in order to reveal the mechanism of SEM. We found that SEM was strongly related to the synthesis of five physical reactions (Yasuda & Nakamura, 2008) and revealed that a synthesis of eight emotions was strongly associated with SEM (Yuki et al., 2003; Nakamura et al., 2004; Yasuda et al., 2007). Moreover, in 2009, the author examined the relationship between physical reactions and emotions which were strongly related to SEM. As a result of a factor analysis, three factors were extracted: "emotions of valence", "emotions of arousal" and "physical reactions". In addition, the factors of "emotions of arousal" and "physical reactions" showed a highly positive correlation, and such a correlation indicates a latent factor may exist which is common to both factors.

The order in which SEM is generated has yet to be elucidated. Therefore, in the present study, we aimed at clarifying this aspect by

investigating the relationship between physical reactions, emotions and SEM.

Fifty-three students participated in this study. They listened to two musical pieces and rated the degree of SEM, the abovementioned five physical reactions and the eight previously identified emotions which they experienced while listening. Thus, we closely examined how “emotions of valence”, “emotions of arousal” and “physical reactions” influenced SEM by using structural equation modeling. It was revealed that the latent factor which is common to “physical reactions” and “emotions of arousal” and the factor of “emotions of valence” induce SEM in parallel.

By revealing the relationship between physical reactions, emotions and SEM, this study contributes to the quantitative clarification of the mechanism of SEM.

Altered Temporality and Acoustic Perception Under the Influence of THC

Jörg Fachner; University of Jyväskylä, Finland

PO119, Poster

Attention focus and according working memory load seem to modify the experience of temporality. This may reflect the consciousness state of a subject and its cognitive and attentional behaviour during state-related timing processes. The mechanisms behind altered temporality remain unclear. Drug-induced altered temporality is a well-known effect of cannabis action that is utilised from musicians and music listeners for music appreciation since the early days of jazz and calls for scientific explanation. Cannabis is reported to be ‘used creatively’ for free musical activities like improvising but can hinder exact playing i.e. of sheet music in an orchestra or big band as well. Today, drug use and a referential sound design in popular music are part of popular culture. Cannabis has an influence on timing processes at short time scales of hundreds of milliseconds as shown in tapping studies, proving evidence of an altered cerebellar functioning. For interval timing, task-related and activated neural networks (discussed are thalamo-cortico-striatal circuits, i.e. basal ganglia, supplementary motor cortex, prefrontal cortex, posterior parietal cortex) are serving as a timekeeper and are detecting coincidences in synchronous brain activation and processing of different neural populations. The change of the scalar property of auditory events may lead to a change in the metric frame of reference when perceiving acoustic and spatial relations and seemed to inspired sound design in popular music. Cannabis induced reframing of acoustic events may be of benefit for people with hearing impairment.

The Role of Performers’ Experienced Emotions in the Construction Process of an Expressive Performance

Anemone G.W. van Zijl¹, John A. Sloboda²; ¹University of Jyväskylä, Finland; ²Royal Holloway University of London, UK

PO123, Poster

Do performers feel sad when they perform a sad piece of music, or do they perform sadness? Not much is known about the relationship between felt and performed emotions in musicians. This study aimed to investigate the relationship between performers’ experienced emotions and the construction of an expressive performance. Eight performers completed an introductory interview, a monitoring period during which they filled out a Diary, and an in-depth interview based on the Diary. Four phases in the construction process of an expressive performance were identified. In Phase 1, performers focused on perceived and felt emotions. In Phase 2, practice-related emotions prevailed. In Phase 3, music-related emotions came to the fore. As learning proceeded, ‘feeling’ the musical emotions transformed into ‘knowing what to do’ to convey them. In Phase 4, performers focused on felt emotions again. These findings provide insight into an under-studied aspect of music performance as a creative practice.

Improvising Musicians’ Looking Behaviours: Duration Constants in the Attention Patterns of Duo Performers

Nikki Moran; University of Edinburgh, UK

PO126, Poster

The study focuses on the communication processes in improvised music performance by duos, exploring the relationship of musical communication to movement in spontaneous, everyday human social interaction. The study presented here examined improvising instrumentalist musicians’ looking behaviours (their ostensive direction of attention as presented by the face). Original video recordings of North Indian classical instrumental duo performances, and video material of oral music traditions harvested from a video streaming website were analysed. The material included traditional, jazz, and folk music duos. Excerpts were analysed to identify the onset and duration of the looking behaviours, which were identified by the way in which the musicians’ faces were presented (towards the audience; towards their duo partner; or towards their own hands/lap). The results show that these looking behaviours occur with fairly consistent durations in the region of one to four seconds. The duration of these behaviours does not appear to co-vary with aspects of musical structure including tempo, or with the social context of performance (such as the familiarity of the musicians, or whether the context of the musical interaction is a rehearsal or public performance). The results suggest evidence of underlying timing mechanisms that may support social interaction processes, facilitating interpersonal communication.

Emotional Expressivity and Positive Mood Increase Music-Induced Move

Suvi Saarikallio, Geoff Luck, Birgitta Burger, Marc R. Thompson, Petri Toiviainen; University of Jyväskylä, Finland

PO129, Poster

Music is intrinsically related to both movement and emotions, but little is known about how moods and emotional tendencies affect the ways people move to music. The current study investigated the effects of two different features of emotional behavior on music-induced movement: the effects of both trait emotional expressivity and state positive and negative mood. Participants were 64 young adults who were asked to move spontaneously to 30 musical excerpts representing a range of musical styles. Participants’ movements were tracked with an optical motion capture system, and movement characteristics were quantified with 55 variables that assessed the amount and type of movements of different body parts. Trait emotional expressivity was measured through the Emotional Expressivity Scale (EES), and state mood through the Positive Affect Negative Affect Schedule (PANAS). Both trait emotional expressivity and state positive mood correlated positively with greater amount of movement indicated by a range of variables, whereas state negative mood did not correlate with any of the movement variables. Moreover, emotional expressivity was strongly related to the overall amount and area of movement, whereas positive mood appeared to induce an increase particularly in the amount of hand and head movements. The current study provides preliminary information about how emotional factors affect music-induced movement, and offers new viewpoints to understanding the role of music as a means for self-expression.

A Developmental Trajectory for the Processing of Pitch Direction

Amy Fancourt¹, Fred Dick², Lauren Stewart¹; ¹Goldsmiths University of London, UK; ²Birkbeck University of London, UK

PO132, Poster

This study investigated maturational changes in children’s pitch processing abilities. Musically untrained subjects in nine age groups (5, 6, 7, 8, 9, 10, 11, 13 year olds, and adults) completed two psychophysical adaptive threshold tasks designed to measure the ability to detect a change in pitch and to discriminate the direction of a pitch change. Thresholds were measured for digitally generated tones

centred on 500Hz using a three interval, forced-choice procedure. Analyses with age as both a categorical and continuous variable revealed that children from 5-13-years did not differ significantly from adults in their capacity to detect a pitch change. However, when discriminating the direction of pitch changes, age was a significant predictor of performance, with performance thresholds decreasing linearly from 6 to 11 years at which point adult-like thresholds were achieved. The findings from this study indicate that the capacities to detect a change in pitch and to discriminate the direction of pitch changes follow different developmental trajectories. Because the discrimination of pitch direction develops only gradually, this may make it more susceptible to developmental delay or arrest, resulting in knock on effects on pitch pattern processing and contour building in disorders such as Congenital Amusia.

The Effect of Initial Attack in Slurred Melodic Gestures on Instrument Identification by Senior Adults

Amanda L. Schlegel¹, Jeremy S. Lane²; ¹Louisiana State University, USA; ²University of South Carolina, USA

PO137, Poster

The purpose of this study was to determine the effect of articulation (initial attack) and register on senior adults' ($N = 42$) ability to perceive and identify instrumental timbre in short, slurred melodic gestures. Two groups of senior adults (Musicians, $n = 24$, and Non-Musicians $n = 18$) listened to a stimulus CD containing thirty-two, three-note descending melodic gestures played by the following eight instruments: flute, oboe, clarinet, alto saxophone, trumpet, horn, violin, and cello. Each instrumental timbre appeared four times on the CD: twice in a lower register and twice in a higher register. Within each register pairing, one excerpt included the initial attack, and the other did not. Using a written form, participants responded by identifying the instrument they thought played on each excerpt.

Results indicated significant differences between groups (musicians were more accurate in identifying instruments than were non-musicians) and a significant effect related to instrument type. Register was not a significant factor in instrument identification; the presence of initial attack, however, was a significant factor affecting instrument identification.

Can Expert Listeners Hear if a Piece is Improvised or Composed?

Andreas C. Lehmann¹, Reinhard Kopiez²; ¹University of Music Würzburg, Germany; ²Hanover University of Music & Drama, Germany

PO140, Poster

Although a performer knows if he or she is improvising or performing a rehearsed piece of music, this distinction may not be evident to the audience. However, it is possible that typical aspects of performance resulting from more deliberation and preparation or spontaneity induce perceptually salient cues that the listeners can utilize to infer whether a piece is composed or not. In other words, the listeners may be able to identify the music's generative type. The goal of our study was to test expert listeners' ability to discern between same-style compositions and non-compositions. Three composed pieces of different styles of music (classical, romantic, free jazz) were matched with highly similar non-composed excerpts. In a listening experiment, 102 college music students rated the excerpts on the scales "rehearsed/coherent" (RC) and "spontaneous/improvised" (SI). Retest-reliabilities for the ratings were satisfactory. As expected, SI and RC ratings were negatively correlated (-0.71). Using repeated measures ANOVA, significant main effects were found for style, generative type, and style by type interaction. Both, style effect and the interaction were elicited by the jazz piece. The listener rated its improvised example as more SI than the composed excerpt, which they rated more RC. Apparently, expert listeners had problems distinguishing improvised from same-style composed music of the classical and romantic era. In the case of the free jazz example they might have extracted performative cues (e.g., varying degrees of tightness in ensemble playing and rhythmic accuracy) that led them to correctly infer the generative type of the piece.

The Musical Ear Test: A New Reliable Test for Measuring Musical Competence

Mikkel Wallentin¹, Andreas Højlund Nielsen², Morten Friis-Olivarius¹, Christian Vuust³, Peter Vuust³; ¹Aarhus University Hospital, Denmark; ²Aarhus University, Denmark; ³Royal Academy of Music, Denmark

PO148, Poster

This paper reports results from three experiments using the Musical Ear Test (MET), a new test designed for measuring musical abilities in both musicians and non-musicians in an objective way with a relatively short duration (<20 min.). In the first experiment we show how the MET is capable of clearly distinguishing between a group of professional musicians and a group of non-musicians. In the second experiment we demonstrate that results from the MET are strongly correlated with measures of musical expertise obtained using an imitation test. In the third experiment we show that the MET also clearly distinguishes groups of non-musicians, amateurs and professional musicians. The test is found to have a large internal consistency (Cronbach alpha: 0.87). We further show a correlation with amount of practice within the group of professionals as well as a correlation with a forward digit span test.

Connection Between Auditory and Visuomotor Representations of Piano Performance in Relation to Practice

Chie Ohsawa¹, Yoko Oura¹, Ken'ichi Miyazaki¹, Hiroshi Kinoshita²; ¹Niigata University, Japan; ²Osaka University, Japan

PO151, Poster

The aim of this study was to investigate the tightness of the connection between auditory and visuomotor representations for practice-related learning of a musical piece on the piano. Using a digital piano, twenty-four music major undergraduate and graduate students practiced two novel pieces of piano music in 3 sessions per piece. Before and after the each of the practice sessions, the participants were asked if sequences in the practiced piece shown by lighting the keys and simultaneously given sound were perfectly matching or not. If the connection between two kinds of representation were tightly built up, the participants would show high accuracy in the identification task. It was found that the correctness of identification continuously improved in the initial three identification tests, but it dropped at the fourth test. Thus it was concluded that the tightness of the connection between auditory and visuomotor representations became stronger during the early phase of learning to play a novel musical piece on the piano, but it became less afterwards. Immediate after each identification tasks, the participants played through the piece, and MIDI of this performance was recorded. If the connection was a deciding factor for learning of performance, there would be a high correlation between the accuracy of performance and the correctness of identification. The result from the analysis of correlation revealed a low r-value, suggesting that the connection played a minor role in learning to play a novel musical piece on the piano.

The Relative Roles of Melody and Rhythm in Music Therapy for Two Boys with Autism

Krystal Demaine; Lesley University, USA

PO155, Poster

Deficits in imitation may be responsible for the characteristic lack of social empathy and inability to develop language in children with autism spectrum disorder (ASD). Other than echolalia, which does not lead to meaningful communication, the imitation abilities which typically occur at 18 months do not develop in children with ASD. During music therapy sessions, two boys with ASD demonstrate divergent imitation qualities. When performing a singing task each child either (a) imitated melodic intoning without rhythm or (b) imitated vocal rhythm with out melodic contour. When performing a musical instrumental task each child either (a) imitated rhythmic pattern or (b) did not imitate at all. Treatment interventions built

upon each child's musical imitation aided in developing of functional motor and expressive language; and shed light on the important link between melody and rhythm in music, the rhythm and prosody of speech.

Exploring Affiliative Effects of Entrainment in Passive Listening

Sarah Knight, Neta Spiro, Ian Cross; University of Cambridge, UK

PO165, Poster

Music is postulated to convey meaning. One way in which it is suggested to do so is through *socio-intentional* processes: our interpretations of the human agency and intentionality underlying it. Functioning alongside such interpretations is entrainment. During collective musical behaviour, entrainment affords the perception of the human action and intentionality derived from socio-intentional interpretations as *joint* action and *shared* intentionality, thus fostering interpersonal affiliation and trust.

However, music nowadays is frequently experienced not communally but in isolated and "passive" contexts. This shift, though, is not necessarily experientially problematic. Socio-intentional interpretations endure: musical events are thought to be nevertheless interpreted as traces of human behaviour, allowing us to experience some kind of agency or persona in the music. Entrainment, an automatic neural response, also occurs during passive listening, but it is unknown whether its affiliative powers persist. Such a suggestion may seem incongruous outside the collective context. However, if socio-intentional processes are still present — that is, if we experience a virtual persona in the music — this would provide a focus for the experience of joint action and shared intentionality. This experiment therefore seeks to test the hypothesis that, during passive listening, entrainment promotes affiliation between the listener and the attributed musical agency.

Do Children Benefit from Music Training?

Ingo Roden¹, Gunter Kreutz¹, Stephan Bongard², Kamala Friedrich², Emily Frankenberg²; ¹Carl von Ossietzky University of Oldenburg, Germany; ²Frankfurt University, Germany

PO168, Poster

Long-term effects of musical training on nonmusical abilities have raised considerable research interest. Preliminary evidence suggests that instrumental music tuition may have beneficial influences on cognitive processing in primary school students. However, there is still debate as to which cognitive components are affected. One goal of this study is to examine to what extent music training modulates cognitive components including attention, memory and working memory in cohorts of third- and fourth-graders. A further goal of the study is to explore effects of musical training in these cohorts on emotional vulnerability and self-regulation. A total of 500 children (7 to 9 years of age) are currently participating in various programs including music training. Control groups consist of 100 children who receive no additional lessons, and further 150 children who receive specialized education in non-music domains such as mathematics and natural sciences. Socio-economic background and general intelligence are assessed for each participant. A longitudinal design is applied which involves repeated measurements at three intervals over two school years. Music children obtain one additional formal music lesson per week, which is part of an extended music program. Dependent variables include standard psychometric test batteries (attention, working memory and stress regulation) biological and clinic markers (saliva cortisol concentrations and cardiovascular activity under rest and stress conditions, problematic behaviors, medical diagnoses and medical prescriptions). Preliminary results from baseline measurements will be presented and discussed at the conference.

Comparison of Indices for the Subjective Evaluation of the Loudness of Musical Sounds

Tadasu Hatoh¹, Tohru Kato², Sonoko Kuwano³, Seiichiro Namba³; ¹Toho Gakuen College of Drama & Music, Japan; ²Otemon Gakuin University, Japan; ³Osaka University, Japan

PO173, Poster

The application of loudness level to temporally varying sounds was examined using sounds of music performance. The mean energy level of 1/3 octave band was used for averaging temporally variation. The loudness was judged using magnitude estimation. It was found that both loudness level based on ISO532B (*LLz*) and loudness level based on ANSI S3.4 (*LLm*) show good correlation with loudness judgment. This suggests that energy based averaging is a good method in order to apply loudness level to temporally varying sounds.

Suzuki Rhythm Mnemonics in Pedagogical Theory and Actual Realization

Zachary Ebin, Jay Rahn; York University, Canada

PO176, Poster

The *Suzuki Violin School* volumes begin with variations on "Twinkle, Twinkle, Little Star." Each variation consists of a repeated rhythmic figure. Suzuki teachers use mnemonics to teach these rhythmic figures. Two of these variations are pedagogically problematic. Both comprise six onsets: one consists of two triplets; the other repeats a figure comprising an eighth note and two sixteenths. Teachers have been observed using mnemonics for one variation that others use for the other variation.

This study examines the rhythms produced and identified on reading 9 mnemonics that Suzuki teachers commonly employ. Thirty participants were asked to speak the mnemonics and their responses were recorded and measured with *Audacity* software. Twenty participants who were either Suzuki teachers or trained musicians were also asked which notated rhythm each mnemonic corresponded to. Interonset intervals in the recordings were measured to determine the timing of the syllables in the spoken mnemonics. These timings were compared with the notated rhythms that had been identified by Suzuki teachers and the other trained musicians.

Among the results, some mnemonics that Suzuki teachers have regarded as representing one rhythm were actually recited in a manner that more closely corresponded to the other. Two of the mnemonics were rendered closer to "swing" rhythm, and one of the mnemonics was often realized as five syllables rather than the anticipated six. This study has implications for Suzuki pedagogy, as well as music education more generally, as using verbal mnemonics to teach rhythms is a widespread teaching technique.

Tonal Music Theory — A Psychoacoustic Explanation?

Andrew J. Milne; Open University, UK

PO180, Poster

From the seventeenth century to the present day, tonal harmonic music has had a number of invariant properties such as the use of specific chord progressions (cadences) to induce a sense of closure, the asymmetrical privileging of certain progressions, and the privileging of the major and minor scales.

The most widely accepted explanation has been that this is due to a process of enculturation: frequently occurring musical patterns are learned by listeners, some of whom become composers and replicate the same patterns, which go on to influence the next "generation" of composers, and so on. In this paper, however, I present a possible psychoacoustic explanation for some important regularities of tonal-harmonic music. The core of the model is two different measures of pitch-based distance between chords. The first is voice-leading distance; the second is spectral pitch distance — a measure of the distance between the partials in one chord compared to those in another chord.

I propose that when a pair of triads has a higher spectral distance than another pair of triads that is voice-leading-close, the former pair is heard as an alteration of the latter pair, and seeks resolution.

I explore the extent to which this model can predict the familiar tonal cadences described in music theory (including those containing tritone substitutions), and the asymmetries that are so characteristic of tonal harmony. I also show how it may be able to shed light upon the privileged status of the major and minor scales (over the modes).

A Critical Review of the Neuromusiological Research in Subjects with Williams-Beuren Syndrome

Katherine Lynn Campe; Harvard University, USA

PO181, Poster

A fascinating group of individuals with the rare genetic disorder known as Williams-Beuren Syndrome (hereafter WS) has been described by Oliver Sacks as “A Hypermusical Species” in his book *Musicophilia*. WS causes a variety of complications — physical, neuronal, and developmental — yet produces subjects that have innate musical interests and skills. Due to the delicate intricacies of their disorder, WS subjects have been the focus of many neuromusiological studies in the past decade.

This discussion will approach the three types of studies that have included WS subjects and music, including research on the musical skills of WS subjects, research utilizing music to discover and interpret the limits of the disorder, and studies that involve imaging techniques such as fMRI. Specifically, the author will address work done in the past 20 years, and assess the validity of results given in these studies. Although all studies in the discussion appear experimentally sound, it is important to consider the purely musical attributes of the experimental methods being utilized in these projects. Specific associations and conceptions govern the music of the Western canon; its idiosyncrasies must not be trivialized in an experimental setting. The results and conclusions of these studies are therefore interpretable, and partially invalidated due to improper controls, ambiguous stimuli and questioning, and a lack of concern for authenticity in regards to the Western Tonal idiom.

The Impact of Emotion Regulation on the Expressed and Induced Emotions by Music

Golazin Memar Ardestani, Changiz Mohiyeddini; Roehampton University, UK

PO183, Poster

Music can evoke powerful emotional reactions. However, people do not have the same reaction to the same song, which according to previous researches can be moderated by listener's personality characteristic. Although regulation of emotions is considered as one of the subcomponents of emotional reactions to music, the impact of dispositional emotion regulation has not been yet investigated in this line of research. One of the beneficial strategies to be used in the process of emotion regulation is “hedonistic emotion regulation” which can be performed in three ways: “(a) regulating a negative emotion by changing it to a positive emotion; (b) maintaining a positive emotion or (c) intensifying a positive emotion” which occur to maintain positive affect in order to conserve the benefits of this emotional state. The aim of this study was to investigate whether hedonistic emotion regulation can influence the expressed and perceived emotions of the music.

A Comparison of Pitch Identification in Auditory Imagery and Perception Tasks

Johannes Stelzer, Merle T. Fairhurst, Peter E. Keller, Robert Turner; MPI CBS, Germany

PO189, Poster

Individuals possessing absolute pitch (AP) are not only capable of identifying tones without a reference sound but also can internally generate or imagine tones of the desired pitch.

The following study attempts to quantify this imagery ability in terms of accuracy and time course of image generation. To investigate the relationship between auditory imagery and perception, these aspects of imagery are compared to the performance of the same individuals in a perceptual identification task.

In the imagery task, eight participants possessing AP were prompted

visually to imagine the specified tone. The participants rated the vividness of their imagery using a continuous response device. A probe tone was then presented to the participants and they were instructed to indicate, as quickly as possible, whether this tone was lower, the same as or higher than the visually cued imagined tone. In the perceptual identification task, participants were required to label the pitch of acoustic stimuli.

Vividness ratings across the imagined events revealed that the peak times of ratings varied across imagined tones and across participants. Interestingly, peak times were significantly lower — suggesting faster image generation — for white piano keys than for black keys. Furthermore, imagined tones from the fourth octave were generated fastest. Performance in the image-probe comparison task was positively correlated with accuracy in the perceptual identification task across individuals.

The outcome of this study suggests that there is a tight relationship between imagery and perceptual processes in AP individuals.

Explaining Variation in Absolute Pitch Ability

E. Glenn Schellenberg¹, Patricia Vanzella²; ¹University of Toronto Mississauga, Canada; ²University of Brasília, Brazil

PO194, Poster

Absolute pitch (AP) requires memory for specific pitches as well as learned associations with note names. We recruited a large on-line sample of participants with empirically verified AP. Our goals were to examine variation in note-naming ability as a function of the timbre of the stimulus tones and participants' music background. AP possessors were required to identify the names of tones presented in four timbres: piano, pure tones, natural voice, and synthesized voice. They exhibited better note naming for non-vocal than for vocal test tones. This difference could not be attributed solely to vibrato in the vocal stimuli because the natural vocal tones had more vibrato than the synthesized tones, yet performance was similar in the two vocal conditions. Note-naming performance across the four timbres was better for participants who started music lessons by age 7, and for participants who began their music training on piano. These two factors had an interactive effect on performance, with equivalently good abilities evident among (1) AP possessors who started music lessons on piano at a later age (after age 7), and (2) possessors who started music lessons by age 7 on any instrument. These findings lead to two general conclusions about variation in AP ability. First, the human voice's inextricable link with language and meaning appears to interfere with note naming. Second, lessons on piano or other fixed-pitch instruments may enhance note-naming abilities and extend the sensitive period for exposure to music lessons in order for good AP to emerge.

An Enriched Environment? An Investigation of Intelligence in Musicians

Kathryn Schenk, Karen Sullivan, Doug Mahar; Queensland University of Technology, Australia

PO200, Poster

A series of recent studies has suggested that there may be a link between musical training and intelligence. Schellenberg demonstrated that children in music lessons had a greater improvement in intelligence (IQ) than children in drama lessons or those who received no extra lessons. Two further studies by Schellenberg showed a modest correlation between musical training and IQ for both children and adults. The purpose of the present study was to re-examine IQ with a more thorough inspection of music training variables, including classroom music, school-based instrumental music, and private tuition. Also, because working memory is often highly correlated with IQ, a number of measures of the extended Baddeley and Hitch model of working memory were included in the investigation. The study ($N = 65$) showed that participation in late high school classroom music was the best predictor of IQ as measured by the K-BIT2, with a similar proportion of variance accounted as has previously been found. The other musical training variables showed no consistent relationship with IQ. However, when demographic and working memory variables were accounted for, the relationship between late classroom music

lessons and IQ was no longer significant. The results from this study suggest that we need to look more closely at cognitive performance in related areas before claims about the role of music training on IQ can be supported.

Group Dancing Leads to Increased Person-Perception

Matthew Woolhouse¹, Dan Tidhar²; ¹University of Cambridge, UK; ²Queen Mary University of London, UK

PO206, Poster

An experiment was conducted in order to test the hypothesis that music-induced motor coordination between individuals (as in dance) leads to increased person-perception. The experiment used 2-channel silent disco radio headphones, a marked-up dance floor, two types of music, and memory identifiers (sash colours and symbols). The dancers are split into two groups, A and B, with five dancers in each group. Each dancer wore radio headphones, and a different coloured sash and symbol. Using silent disco technology, one type of music was transmitted to group A, while at the same time another type of music was transmitted to group B. Pre-experiment, the dancers' faces were photographed. Post-experiment, the dancers were presented with photos of all the other dancers in turn and asked to recall each participant's sash colour and sash symbol. The results showed that dancing at the same tempo as other people significantly enhanced sash colour and sash symbol memory, and thus facilitated person perception.

Using Word Syllabus to Enhance Children Music Rhythmic Learning

Dennis Ping-Cheng Wang; University of Macau, China

PO218, Poster

This study aims at using word syllables and speaking intonation to enhance children musical rhythmic learning. Comparing with other music concepts, learning rhythm is the most challenge task in music learning for most children. Children often have difficulty to comprehend the different note values and the combination of various rhythmic patterns.

Speaking is an inborn talent for most of children; therefore, integrating the phonics and rhythmic patterns together would enhance students learning different rhythms efficiently. In this study, the author integrated the inborn speaking gift with the complicated rhythmic patterns and concluded a learning strategy for students learning music. By providing children the phonics and syllables on musical rhythm learning, students were aware of the structures and intonation of rhythmic patterns. Moreover, the author applied the speaking intonation of short sentences on music phrases so that this approach provided students an easy shortcut to learn musical rhythms and offer music teachers an efficient approach on teaching music rhythms.

This study not only gives all music educators an easy shortcut in rhythmic teaching, but also provides both students and teachers efficient music approach and confidence on music learning. By providing students the phonics and syllables on musical rhythm learning, students are able to easily comprehend the different structures of rhythmic patterns. The author suggests that the relevant study should be granted and encouraged by all level music teachers and school principals so that the students can be benefited by successful teaching and efficient music learning.

An Evolutionary Theory of Music Origins: From 4 Million Years Ago to Musical Chills

Mark S. Riggle; Causal Aspects, USA

PO221, Poster

We develop a theory framework showing how and why music evolved. We postulate the existence of a neural mechanism causing pleasure from entrained motion with rhythmic sounds. The postulate starts a viable evolutionary path leading to music pleasure, including emotions. If entrainment to rhythmic sounds is pleasurable, and supplying pleasure confers a reproductive advantage, then males with the ability and motivation to create rhythmic sounds gain a reproductive advantage, and this strongly selects on ability and

motivation. Creation of rhythmic sounds requires new cognitive abilities. We discuss the nature of those cognitive changes and how they lead to deep musical pleasure. This pleasure creates additional selective forces leading to greatly improving memory for music by reusing the emotional circuits. Emotions to music are a side-effect of memory system reuse. We cover the underlying assumptions for this theory, some supporting data and experimental predictions. The framework theory implies 7 surprising results; (1) Evolutionary selection for music may have started 4 million years ago. (2) Evolution shaped humans to make and enjoy music. (3) Selection for music may have directly increased the intelligence of the human ancestral line. (4) Music preceded language and may have created the neural mechanisms needed for language. (5) Six separate pathways generate pleasure from music. (6) Evolutionary sexual selection created music, but the sex dimorphism will be in motivation and pleasure, not in ability. (7) Emotions and chills for music were directly selected and serve the needs of music memory.

"Human Music" — A Theoretical Model of How Music Induces Affect in Human and Nonhuman Listeners

David Teie; University of Maryland at College Park, USA

PO230, Poster

This theory proposes that: 1) the auditory system is predisposed to efficiently and clearly process certain types of sounds, such as those resembling the human voice, and that most musical instruments create sounds that benefit from this clear processing, 2) each element in music induces an independent emotional response by presenting an acoustic stimulus that is a match for a preexisting template of recognition, 3) many of these templates are imprinted in the developing structures of the limbic system in the acoustic fetal environment, 4) as these elements are presented in music, concurrently and consecutively, the recognition triggers appropriate emotional, neurochemical responses, and 5) the accumulation of neurochemical reactions from the recognition responses is the cornerstone of emotional response to music. For the purposes of this presentation "emotional response" refers to any stimulation of the brain structures responsible for our emotions, this includes the barely perceptible reaction to pattern recognition as well as the more obvious responses commonly associated with emotion.

The origins of these elements can be classified into four categories. The first two categories involve responses triggered by auditory processing and recognition: 1) limbic system development and 2) emotionally generated vocalizations. The other two categories trigger responses that have been exapted by music: 3) linguistic processing and 4) visuospatial processing.

One published and two unpublished experiments have shown that applications based on the limbic system development and emotionally generated vocalization components of this theory (with appropriate adjustments for other species) have led to effective species-specific music (Snowdon & Teie, 2010). There may be a constant set of principles to be derived from human music that can be applied to music for many mammalian species. The musical analysis of animal communication needed to create this music also shows promise of providing a greater understanding of animal communication.

Poster Session 2

KANE HALL – WALKER AMES ROOM
13:00 – 14:00, Wednesday 25 Aug 2010

Differentiating Rock from Bach, Identification of Mainstream Recordings Requires Only Brief Excerpts

Shannon Layman, W. Jay Dowling; University of Texas at Dallas, USA

PO002, Poster

We tested listeners' ability to identify 500-msec excerpts from the beginnings of recordings of mainstream songs. Previous studies have shown that subjects can recognize familiar tunes well above chance in as little as 200-msec. These studies were limited by the small number of stimuli and the presence of a list of the songs during the experiment. We sought to extend the previous findings by using a broader and more selective range of stimuli than those used in earlier experiments. Our stimuli were drawn from a survey of 200 familiar songs of multiple genres that was distributed to a diverse panel of undergraduate students from the University of Texas at Dallas. Students made judgments of familiarity on a scale from 1 (not familiar) to 7 (extremely familiar). The 56 most familiar songs served as the primary stimuli in our experiment. 56 unfamiliar songs were drawn mostly from recorded but unpublished music available in Lawrence, Kansas circa 2004. During the experiment participants heard 500-msec of each of the stimuli twice and were asked to rate their familiarity on the same 1-to-7 scale and give any additional information they could provide. Participants did extremely well in parsing out the familiar versus unfamiliar tunes with only a short amount of contextual information. Our experiment further strengthens the previous research on music perception and memory, setting the stage for a future extension into the electrophysiological realm.

Neural Processing of Serial Correlation in Melodies as Revealed by Magnetoencephalography (MEG)

R. Dumas, A.C. Leuthold, A.P. Georgopoulos; Brain Sciences Center at VAMC, USA

PO005, Poster

We used MEG to investigate the brain mechanisms underlying the processing of serial correlation (SC) in tone sequences. Seven human subjects listened to an audio file of 666-s total duration consisting of 10 tone sequences of 60-s duration each, alternating with 6-s noise segments. Each tone sequence comprised a random permutation of 240 pure tones (0.25-s/tone) from a set of pitches in the key of C major (2-octave range: freq. 261.6 Hz–987.86 Hz). These sequences were designed to have SC from 0.0 to 0.9 over 5 lags. MEG activity was recorded using 248 axial gradiometers (Magnes 3600WH, 4-D Neuroimaging) at a sampling rate of 1017 Hz. We then computed the means for each of the 240 notes per sequence (across subjects) to obtain a serial correlation-processing vector (SCPV), for each of the 248 MEG sensors. Next, all pairwise correlation coefficients were calculated ($N=30,628$) between sensor SCPVs to quantify the similarity of SC processing between sensors: positive correlations would indicate similar SCPVs, and vice versa for negative correlations. We found the following. (a) Highly significant positive and negative correlations were found. (b) Positive correlations occurred ~4x more frequently than negative correlations. (c) Pairs of sensors with positive correlations were clustered in left and right temporo-occipital regions. Finally, (d) pairs of sensors with negative correlations were typically in opposite hemispheres and occurred more frequently in frontal regions than in posterior regions. Results indicate that serial correlation is being processed by segregated neural networks with intricate interrelations that are currently being further analyzed.

Physiological and Self-Reported Music Relaxation in Hypertension Patients

Joanna Kantor-Martynuska, Ewelina Szyszko; Warsaw School of Social Sciences & Humanities, Poland

PO010, Poster

Short-term effectiveness of music relaxation in lowering physiological arousal and psychological tension was studied in hypertension patients and healthy controls. The moderating role of neuroticism in the relaxing effect of music on physiological and self-reported tense arousal was also tested. We hypothesized that listening to the relaxing music would lower the blood pressure and subjective tense arousal in both hypertension and healthy participants. We also expected that the drop in blood pressure and decrease in self-reported arousal would be less salient in high neuroticism scorers than in the participants showing high emotional stability.

40 hypertension patients and 40 control group members volunteered for the study. To measure neuroticism, they filled out the Eysenck Personality Questionnaire-Revised and to measure self-reported arousal — Thayer's Adjective Check List (ACL). Then, they had their blood pressure taken and listened for about 6 minutes to relaxing music. Following the music relaxation procedure, the participants had their blood pressure taken again and completed the ACL.

We observed a significant drop in systolic and diastolic blood pressure levels, pulse, and self-reported energetic and tense arousal both in hypertension and healthy individuals. However, the drop in blood pressure and the reduction of tense arousal was slightly more salient in the clinical than control group. Neuroticism had no moderating effect on the size of the drop in either blood pressure or subjective arousal. The study documents the short-term effectiveness of using relaxing music to reduce blood pressure and subjective arousal in people suffering from hypertension and in healthy individuals.

The Influence of the Lyric Contents on the Emotional Contagion of Music

Kazuma Mori, Makoto Iwanaga; Hiroshima University, Japan

PO013, Poster

The present study examined the influence of the lyric contents on the emotional contagion of music. Juslin & Västfjäll (2008) suggested emotional contagion by music might be due to internal mimic of perceived emotion of music, such as sad emotion of music elicited sad feeling in listener. However, Merriam (1964) said that songs provide socially acceptable means of expressing negative sentiments. We guessed that even if people listen music added negative lyrics, they are not felt unpleasure emotion. To examine the influence of lyric contents on the emotional contagion, we presented music with lyrics in a foreign language that participants could not understand, and texts of the lyrics that contents were translated into Japanese. We used two experimental conditions: presentation of only music (M) and that of music and lyrics in Japanese texts (ML). We tested a regression model of emotional contagion, which independent variables were perceived emotions of happy, relax, sad and fear, and dependent variables were felt emotions of arousal and valence in line with circumplex model (Russel, 1980). The regression model was analyzed by the Partial Least Square (PLS) regression method. The results showed that, in bird's eye view, perceived emotion of music and felt emotion of music are equal in emotional quality. For example, positive emotions of music elicited pleasure feeling to listeners. However, in ML, sad perceived emotions of happy music added sad lyrics induced pleasure feeling to listener. This result suggests feeling elicited by music added lyrics could have particular quality.

Language-Selective Interference with Long-Term Memory for Musical Pitch

I-Hui Hsieh¹, Kourosh Saberi²; ¹National Central University, Taiwan; ²University of California at Irvine, USA

PO016, Poster

The existence of language-specific components in accessing pitch memory is somewhat debatable with limited neuroimaging evidence suggesting involvement of the posterior dorsolateral frontal area as a candidate region underlying linguistic-pitch associations. However the same region has also been implicated when associations are formed with nonlinguistic cues. The present study investigated whether musicians trained in different solmization systems during 3-5 years of age show differences in pitch encoding strategy, and whether cortical activation patterns are modulated by linguistic codes during musical-pitch processing. Western and solfege-trained absolute-pitch musicians identified the pitch of randomly selected mismatched syllable-pitch hybrids while attempting to ignore their speech content. Voiced solfege syllables whose fundamental frequencies and harmonic structures were digitally shifted to precisely map onto a target musical note were found to selectively interfere with pitch identification by solfege-trained but not Western-trained musicians. Interference diminished systematically as the stimulus spectrum was increasingly lowpass filtered to remove its broadband speech features. In neuroimaging (fMRI) experiments, musicians covertly identified the pitch of matched, mismatched, and various bandpass-filtered syllable-pitch hybrid stimuli in a randomized block design. The mismatched-matched contrast for the western-trained musicians showed no suprathreshold activation; however, this same contrast in the solfege-trained musicians showed a number of significant activation peaks including left posterior dorsolateral region of the frontal cortex, left inferior frontal gyrus, and right inferior frontal gyrus. Findings suggest a form of highly specific linguistic association in facilitating the retrieval of pitch from long-term memory that is contingent on musical training during formative stages of language development.

Effects of Musical Training on Auditory Attention: Implications from Imitative Counterpoint Perception

Karen Chan, Richard Ashley; Northwestern University, USA

PO019, Poster

Musicians have enhanced cortical responses to the musical timbre of their native instrument. Still, we do not know the behavioral manifestations of such neural enhancements. In order to determine the impact of musical training on music listening, we investigated the role of musical timbre in driving the perception of multiple musical streams. Specifically, we asked how experience with different instrumental timbres affects the perception of Baroque imitative counterpoint. Subjects trained as violinists, clarinetists or pianists listened to Telemann canonic duo sonatas played by a clarinet and a violin. Both lines contained several quarter-tone-flat mistuned notes, which were considered *target tones*. Subjects were asked to press a button when they heard a target tone as quickly as possible. We hypothesized that violinists are more likely to respond quickly and accurately to target tones in the violin line while clarinetists are more likely to respond quickly and accurately to target tones in the clarinet line. Pianists acted as a control group, as they play an instrument that does not require online manipulation of intonation and the piano timbre was not used in this experiment. Pilot data indicated preferential responses to target tones in lines played by the native instrument. Full results to be presented at the conference. We interpret these results as indicative of musicians' enhanced auditory attention and/or neural activation to the timbre of their own instrument. Outcomes demonstrate how musical training and experience shape auditory attention and perception when confronted with complex musical stimuli.

An Analysis of Affective Content in the Second Movement of Beethoven's Pathétique Using an Acoustic Ethological Model

Joshua Albrecht, David Huron; Ohio State University, USA

PO022, Poster

Two studies were carried out regarding the perceived expressive content for the second movement of Beethoven's *Pathétique* sonata (No. 8, Opus 13). In the first open-ended study, listeners provided descriptive terms for 5-second recorded excerpts. A content analysis was carried out on the terms resulting in 15 affective dimensions. In the second study 19 listeners judged the affective content for 5-second excerpts from the same work for all 15 dimensions. The amalgamated data provide a diachronic portrait of how the music changes over time. The relationship of the affective content to objective features of the music are discussed and interpreted using concepts from an ethological model of communication.

Brain Activity Accompanying Melody and Rhythm Processing: Comparison of Auditory Neuropathy with Musicians and Non-Musicians

Assal Habibi, Arnold Starr; University of California at Irvine, USA

PO025, Poster

Auditory Neuropathy (AN) is a hearing disorder affecting temporal processing due to impaired synchrony and magnitude of auditory nerve activity. We presented musicians, non-musicians and AN subjects with short novel musical phrases. Each phrase consisted of a target melody followed in 1.5 second by a comparison melody. The comparison melody was either identical to the target or contained a diatonic pitch or rhythmic deviance. Subjects were instructed to press response buttons indicating whether the comparison melody was "same" or "different". We recorded scalp electrode ERPs to these melodies. In pitch condition, both musicians and non-musicians successfully detected the deviant note. Further, we found that a positive ERP component to the deviant pitch differed in amplitude at 200-290 ms between deviant and standard conditions. However, AN subjects did not detect the deviant pitch nor showed a differential correlated ERP response.

In the rhythm condition both musicians and non-musicians successfully detected the deviant pattern and a positive potential was identified in both groups at 250-350ms after the time when the beat should have occurred.

AN patients showed impaired detection of the temporal change. However, the deficit was not as pronounced as that seen to the tonal deviant condition. No significant change in the amplitude of the ERP correlate to the deviant rhythm was observed in AN patients.

The results illustrate that AN patients demonstrate impaired performance and brain response to music-related tasks compared to musicians and nonmusicians. However, they display better performance in detecting temporal deviance compared to tonal change.

On Detecting Different Levels of Sensorimotor Activity in Musicians and Non-Musicians During Musical Direction: Evidence from Fractal EEG Analysis

Stelios Hadjidimitriou¹, Asteris Zacharakis², Panagiotis Doulgeris³, Konstantinos Panoulas¹, Leontios Hadjileontiadis¹, Stavros Panas¹; ¹Aristotle University of Thessaloniki, Greece; ²Queen Mary University of London, UK; ³Delft University of Technology, The Netherlands

PO028, Poster

The present study examines the effect of orchestral music on the perception of related conducting gestures by exploring the different levels of sensorimotor cortical activity. Electroencephalogram recordings were acquired from orchestral musicians and non-musicians, during audiovisual and visual experimental modes. The auditory stimulus consisted of an excerpt of Beethoven's fifth symphony, and

the visual one presented a conductor directing the same excerpt. Initially, the electrophysiological signals were processed using fractal dimension (FD) analysis and subsequently, a video-based signal of the conductor's mobility was correlated to the FD data. Results showed stronger sensorimotor activity in the case of orchestral musicians compared to the non-musicians when both auditory and visual stimuli were present, while, on the absence of the acoustic stimulus, the response of the two groups converged. These findings point to the general fact that depending on the level of musical skillfulness, music stimuli can improve the perception of related actions.

Can Background Music and Caregiver Singing Benefit People with Dementia? Results of a Study in a Scottish Care Home

Elizabeth Dennis, Nikki Moran; University of Edinburgh, UK

PO032, Poster

In order to investigate the effect of music during the morning care session for patients with dementia in a residential care home, this study monitored a control period and two conditions. The first condition involved background music that was familiar to, and known to be enjoyed by each resident; during the second condition the caregivers sang. Seven female case studies are presented here in order to assess music's affect in dementia care. The results indicate that the music interventions encouraged greater active communicative engagement by the resident, possibly by promoting a heightened stimulatory environment. The presence of familiar music at this time of day saw a reduction in negative behaviours associated with dementia as well as evidence of better moods and positive social behaviours. Caregivers noted that, in addition to their work becoming easier during the music sessions, a closer bond was experienced with the residents during the caregiver singing sessions. After six months, a follow-up interview explored whether the caregivers had continued the practice of singing or using familiar background music at this time of day. This interview examined the caregivers' views on the practical implementation of music as a significant part of their caring role.

The Significance of Motion for Infants' Perception of Visual Rhythm

Melissa Brandon, Jenny Saffran; University of Wisconsin-Madison, USA

PO036, Poster

Many studies have demonstrated that infants exhibit robust auditory rhythm discrimination, but there is limited research on infants' perception of visual rhythm. In particular, the role of motion in infants' perception of visual rhythm remains unknown. In the current study, we directly examined the role of motion in infants' discrimination of visual rhythms by comparing experimental conditions with moving rhythmic stimuli versus stationary rhythmic stimuli. The only difference between the two conditions was whether the stimuli moved across the screen or pulsed in one location. A preferential looking paradigm was used with seven-month-old infants. Infants succeeded at discriminating visual rhythms only when the visual rhythm occurred with a motion component. When the visual rhythm flashed in a stationary location, infants failed to discriminate the two visual rhythms at test. These results indicate that motion plays a role in the perception of visual temporal information for infants. These findings are consistent with the manner in which natural rhythms appear in the visual world — they are typically accompanied by visual motion.

Dyadic Entrainment and Interaction in African Dance

Tommi Himberg, Marc R. Thompson; University of Jyväskylä, Finland

PO040, Poster

Studying embodied cognition in cross-cultural settings can highlight how skills are learned and what is involved in a particular set of skills and behaviours. We studied interpersonal entrainment and interaction in a setting where expert and novice dancers of a Kenyan "Luo"

dance-style were performing a short choreography in pairs that were either 'matched' or 'mixed' in expertise and cultural background. A visual motion capture system was used to record the performances. The analysis suggests that in addition to the expertise of the dancers, having a 'matched' pair is a contributing factor for higher synchrony.

Responses to Foreign Music as Windows into Social Cognition: A Preliminary Study on Ethnic and National Stereotypes

Beatriz Ilari; Federal University of Paraná, Brazil

PO044, Poster

Listening to a short musical excerpts can trigger cognitive schemas that may influence how listeners process musical and non-musical information (Shevy, 2008). Few studies to date have investigated the relationship between preferences for music of foreign cultures and stereotypes. The purpose of this exploratory and ongoing study is to investigate the relationship between music majors' and children's perceptions of world music and their cultures of origin. Experiment 1: 82 Brazilian music majors heard 12 excerpts of traditional music from Senegal, Sweden and China. They were asked to rate each excerpt according to preference and familiarity, identify and describe the corresponding culture of origin of each excerpt. Experiment 2 (ongoing) is investigating the responses of school-aged children to the same excerpts, using a visual-matching game. Results obtained so far suggest that preference and familiarity were moderately correlated and equivalent in all three cultures. Perceptions of cultures of origin appeared to be based primarily on distinct categories - from musical properties to learned stereotypical associations. Conclusions will be presented at the conference along with the analyses of children's responses.

Dimensions and Perspectives of Musical Self-Concept

Maria Spsychiger, Franziska Olbertz, Lucia Gruber; Frankfurt University of Music & Performing Arts, Germany

PO049, Poster

If considered at all, musical self-concept in research has so far been conceived as a sub-dimension of ability-concept, addressing musicians, music teachers, and musically gifted children. Looking at a general population, however, leads to new perspectives and extends the dimensions of musical self-concept. The goal of the presented study was to empirically model the construct, and then to create a questionnaire by which a person's musical self-concept can be diagnosed.

A first investigation (study 1) was carried out by conducting semi-structured interviews with 79 persons, male and female, of various backgrounds in age, musical interest and activity, and professional occupation. Subjects were allocated by cross tabulation to 5 groups of age, and 5 groups indicating different levels of musical expertise and involvement (Professional, Amateur, Leisure, Music worker, Consumer). Content analyses of the transcribed inter-views revealed that all of the subjects hold representations about who they are and what they can do with regards to music in their life. The reports were on many more aspects than ability, including musical taste, experienced effects of music reception (of which most interviewees spoke in detail), music-related social community, spiritual, physical and aesthetic experiences through music, music related intellectual occupations, interest in technical devices in order to deal with music, etc. These contents were confirmative of a multi-dimensional model of musical self-concept, addressing also the variable of "nearness-to-self", a measurement of how close each dimension to one-self is (estimated on a 5-point scale, per subject, and groups by level of expertise).

This model and numerous statements made by the interviewed persons provided the theoretical and practical basis of the 2nd study, based in quantitative methods. It is dedicated to the development of the above mentioned questionnaire, named "Musical Self-Concept Scales" (MuSS). It's first version operated with the large number of 212 items, the second with less than half of it. The third and final version includes 63 items, of which the first 42 are to be responded by subjects of all types of musical involvement and levels of musical

expertise, the remaining 21 items only by musically active subjects. The full sample of study 2 is $n=740$. An exploratory factor analysis explains 51% of variance, representing the following components: (1) music-related ability, (2) mood regulation, (3) dance and movement, (4) ideal self, (5) spirituality, (6) technical interest and information seeking, (7) change of musical experience during life course, and (8) community experience. This final version of the questionnaire will be presented with all of its items, and discussed with regards to its relevance for further research and practical application.

The Hierarchical Sequential Memory for Music: A Cognitively-Inspired Model for Music Learning and Composition

James B. Maxwell, Philippe Pasquier, Arne Eigenfeldt; Simon Fraser University, Canada

PO052, Poster

In this paper we present a refinement of our Hierarchical Sequential Memory for Music (HSMM) and discuss preliminary results. The HSMM is an extension of the Hierarchical Temporal Memory framework (HTM) of Dileep George and Jeff Hawkins, intended to make that model better suited to musical applications. The HSMM is a machine-learning framework, designed to learn hierarchies of sequences, and to make inferences on those hierarchies in a cognitively-inspired process of "bottom-up" and "top-down" information propagation.

Extension of the SRNN Melody Recognition Modeling Framework

Naresh N. Vempala, Anthony S. Maida; University of Louisiana at Lafayette, USA

PO055, Poster

This paper describes the extension of our previously designed melody recognition framework and relevant simulations. In a previous study, we designed a framework and simulated results of the Dalla Bella et al. study. Dalla Bella et al. compared melody recognition between musicians and nonmusicians and identified three events: the familiarity emergence point (FEP), the isolation point (IP), and the recognition point (RP). Our framework illustrated the hypothesized cognitive processes underlying these three events by simulating their qualitative rank ordering using sequence recognition neural networks (SRNNs) augmented with meta-level processes. We extended this framework to illustrate melody frequency effects by using trace strengths within the network, and tested for robustness using two additional corpora. We introduced a method for modeling acquisition of new melodies. Preliminary studies incorporating hierarchy into the existing framework are also presented.

The Perception of Implicit vs. Explicit Harmony: Evidence from Sing-Back Reaction Times

Jung Nyo Kim, Richard Ashley; Northwestern University, USA

PO058, Poster

This study investigated the influence of harmonic expectations on the perception of explicit harmony in chord sequences. Building on a previous study in the perception of implicit harmony in single-voice melodies, this study aims to show commonalities and differences between implicit and explicit harmony perception. Musically trained participants heard tonal melodies with chordal accompaniment in one condition and only chord sequences in the other condition. After hearing each of the musical examples, they sang the last tone of the top-voice melody as quickly as possible. The last tone was either a tonic-chord tone (expected) or a subdominant-chord tone (unexpected) presented at the expected moment or one beat early or late. Sing-back RTs for the tonic-chord tones were faster than those for the subdominant-chord tones, as found in the study of implicit harmony perception. However, this RT difference was statistically significant only in the implicit harmony study. In the implicit harmony study, there were two types of indeterminacy for the subdominant-chord tones: (a) unexpectedness and (b) harmonic ambiguity. However, in the explicit harmony study, harmonic ambiguity was not present due

to the explicit chord context and this seems to explain why the RT difference between the tonic-chord tones and subdominant-chord tones was smaller. The temporal position of the last tone was always statistically significant. Adding the explicit chord context did not alter the effect of temporal position, which suggests that temporal expectation operates differently from harmonic expectation.

Musical Expertise and the Ability to Imagine Expressive Timing and Dynamics

Laura Bishop, Roger T. Dean, Freya Bailes; University of Western Sydney, Australia

PO062, Poster

Expert musicians display exceptional control over performance expression. This may result from an enhanced ability to plan, or imagine, such parameters as expressive timing and dynamics. Little research, however, addresses the extent to which these parameters are imagined. This study investigates the relationship between musical expertise and the ability to imagine expressive timing and dynamics. Experts seem to imagine pitch and duration more vividly than novices, and it is hypothesized that imagery for expressive timing and dynamics improves with increasing expertise as well. Experts, novices and non-musicians are asked to imagine short passages of well-known Classical music under two counterbalanced conditions: 1) while adjusting a slider to indicate the imagined loudness of the music and 2) while tapping out the rhythm to indicate imagined timing. Two subtests assess perceptual abilities and working memory span to ensure that these factors, also hypothesized to improve with increasing expertise, cannot account for performance on the imagery task. Time series and Procrustes analyses are used to determine the goodness of fit between each participant's imagined dynamic and timing profiles and expressive profiles generated from professional recordings. It is expected that similarity between participant and professional recorded expressive profiles will increase as a function of expertise; this will indicate that the ability to recall from long-term memory and generate imagined expressive parameters improves with increasing musical skill. An absence of correlation between imagined and professional expressive profiles at any level of expertise would indicate that expressive timing and dynamics are not readily imagined.

The Role of Gazing Behaviour During a Piano Duo Performance

Satoshi Kawase; Osaka University, Japan

PO066, Poster

The purpose of this study was to explore the gazing behaviour between performers and to examine how such behaviour affects musical performance. We investigated the influence of gazing behaviour and eye contact on performers' timing coordination in a piano duet. Two proficient pianists played the same tune under four different visual-contact conditions: non-face-to-face, able to see body alone, able to see head (face) alone, and face-to-face. The timing of gazing behaviour and gaps between each performer's sounds at the point of tempo change were measured and analyzed via a behaviour-coding system. The following results were obtained. (1) Gazing behaviour frequently occurred at the timing points. (2) Under the head alone and face-to-face conditions, the frequency of gaze became the highest just before the timing points. In contrast, under the body alone condition, the frequency of gaze was the highest just at the timing points as compared with the head alone and face-to-face conditions. (3) Under the body alone and face-to-face conditions, the gaps between each performer's sounds decreased when the performers looked toward each other just before the timing points. (4) For some performers, the amount of eye contact seemed to affect their satisfaction with their own performance.

A Periodicity-Based Approach on Harmony Perception Including Non-Western Scales

Frieder Stolzenburg; Harz University of Applied Sciences, Germany

PO070, Poster

Empirical results demonstrate that human subjects rate harmonies, e.g. major and minor triads, differently with respect to their sonority. These judgements of listeners have a strong psychophysical basis. Therefore, harmony perception often is explained by the notions of dissonance and tension, focussing on the sonority of intervals and triads, i.e. chords only.

In this paper, we introduce an approach based on the notion of periodicity, providing a unified view on the perception of chords and scales. The method is psychophysically motivated: It applies the fact, that the just noticeable difference of human pitch perception is about 1% for the musically important low frequency range and that periodicities of complex chords can be detected in the human brain, as recent results from neuro-science prove. Mathematically, periodicity can be derived from the frequency ratios of the tones in the harmony with respect to its lowest tone, employing e.g. the so-called Stern-Brocot tree.

The theoretical results presented here correlate very well to experimental results on the perception of common triads. Applying the periodicity-based approach to harmonies consisting of more than three tones also yields interesting and plausible results: Standard chords in jazz and also the diatonic and blues scales have low, i.e. good harmonic values according to the approach presented here, ranking among the top 5% in their respective tone multiplicity category. Furthermore, according to their average harmonic value, all church modes rank among the top 11 of 462 theoretically possible scales with 7 tones. Therefore, the periodicity-based approach can contribute to the discussion about the origin of chords and scales, especially in western music. It adopts equal temperament as reference system.

Non-western scales, e.g. in Turkish classical music with makam melody types or octave reduced tone scales of recordings of traditional Central African music, do not seem to be based on equal temperament tunings. Nevertheless, they can be successfully analyzed by the periodicity-based approach, predicting also relatively good values of sonority for these scales. Thus in summary it seems that both the perception of chords and scales in any music obey similar principles, namely that simpler patterns with short period lengths are preferred by humans. They correspond to higher sonority.

Music to My Eyes: Cross-Modal Interactions in the Perception of Emotions in Musical Performance

Bradley W. Vines¹, Carol Lynne Krumhansl², Marcelo M. Wanderley³, Ioana M. Dalca³, Daniel J. Levitin³;

¹University of British Columbia, Canada; ²Cornell University, USA; ³McGill University, Canada

PO074, Poster

We investigate non-verbal communication through expressive body movement and musical sound, to reveal higher cognitive processes involved in the integration of emotion from multiple sensory modalities. Participants heard, saw, or both heard and saw recordings of a Stravinsky solo clarinet piece, performed with three distinct performance styles: Restrained, Standard, and Exaggerated intention. Participants used a 5-point Likert scale to rate each performance on 19 different emotional qualities. The data analysis revealed that variations in performance intention had their greatest impact when the performances could be seen; the ratings from participants who could only hear the performances were the same across the three expressive styles. We also found evidence for an interaction effect leading to an emergent property, intensity of positive emotion, when participants both heard and saw the musical performances. An exploratory factor analysis revealed orthogonal dimensions for positive and negative emotions, which may account for the subjective experience that many listeners report of having ambivalent or complex reactions to music, such as "bittersweet."

Name That Tune: Decoding Music from the Listening Brain

Rebecca S. Schaefer, Jason Farquhar, Makiko Sadakata, Peter Desain; Radboud University Nijmegen, The Netherlands

PO079, Poster

Recent advances in neuroscience show an increasing ability to decode from single trial brain measurements what someone is seeing or hearing. In the current study we use electroencephalography (EEG) to detect heard music from the brain signal, hypothesizing that the time structure in music makes it especially suitable for detection with EEG signals. We used linear discriminant classification to detect the perception of seven different musical phrases, both individually and cross-participants, using the event-related potential (ERP). The ERP was compared to different aspects of the music stimuli, as well as with the audio envelope of the stimulus. The best individual results are 70% correct in a seven-class problem while using single 3s trials, and when using multiple trials we achieve 100% correct after 8 presentations of the stimulus. When classifying across participants, a maximum rate of 53% was reached. The correlation with the audio envelope varied over stimulus (from -.07 to .48), and several musical aspects, both rhythm and pitch-based, reached a correlation up to .4. We conclude that it is possible to detect perceived music from the single-trial ERP, as well as across participants, supporting the notion of a universal representation for each stimulus. Comparison of the ERP with the audio envelope shows great variability, which also holds for the musical aspect comparison. This implies that different processes are salient for perception of different musical phrases.

Examining the Role of Training and Movement on Rhythm Perception in Disc Jockeys Using EEG and Behavioural Thresholds

Blake E. Butler, Laurel J. Trainor; McMaster University, Canada

PO082, Poster

Professional disc jockeys (DJs) engage in beatmixing and beat-sampling to preserve energy on the dance floor; central to these tasks is the maintenance of a consistent beat, achieved by altering the rhythm of one or more tracks. Studies have shown that average listeners find it difficult to maintain a steady rhythm in the absence of an external acoustic stimulus, but that trained musicians are significantly better. This project aimed to determine (1) whether DJs show an advantage in the ability to maintain a steady imagined beat and (2) whether head movements are advantageous in such a task. In Part I, participants heard a beat sequence, were asked to imagine the beat continuing through a period of silence, and to determine if a target beat that followed was on-time or early. In one condition, they were allowed to make head movements and in another they remained still. Psychometric functions were created for both movement and non-movement conditions. Part II used electroencephalography (EEG) to examine brain responses with similar stimuli. In the behavioural task, accuracy was significantly impaired when subjects were asked to perform in the absence of movement ($p < 0.05$). The EEG data indicate that the response to the first beat of a sequence that started early differed significantly from that of a sequence that occurred on-time. We conclude that (1) the experience of DJs appears to enhance their ability to maintain an imagined beat and (2) movement helps maintain a steady imagined beat without an external auditory stimulus.

Tonal Stability as an Emergent Property in Low-Level Perceptual Organization

Ji Chul Kim; Northwestern University, USA

PO085, Poster

The prevalent view in music psychology has been that perception of relative tonal stability comes in part from our sensitivity to the frequency of occurrence of pitch-classes. According to this view, the tonic is perceived as more stable than other scale-degrees because it occurs more frequently and for longer durations. I propose that the perceived sense of tonal stability emerges in low-level

perceptual organization — the mental processes of grouping and integrating individual pitch events into larger units according to the segmentation structure in sensory information. To construct a stable representation of musical structure, the musical surface must be segmented and integrated into coherent perceptual units. Individual pitches, when integrated into a low-level perceptual unit, are assigned differing strengths of pitch salience according to their positions within perceptual grouping structure. The pitch with the highest salience tends to be perceived as the tonal center of the unit or the point of tonal stability. Thus, I argue that perceived tonal stability can be inferred from the low-level perceptual grouping structure of musical surface rather than pitch-class distributions or temporal ordering *per se*. These perceptual processes that lead to the emergence of tonal stability represent the “bottom-up” side of the mental processing of tonal music, whereas tonal expectations induced from activated schemata represent the “top-down” side of the processing. The perception of tonal structure is the perceptual interpretation of musical surface shaped by the constant interaction between these bottom-up and top-down factors.

Sounds of Intent Phase 3: Exploring Music Engagement in Children and Young People with Complex Needs

Angela Vogiatzoglou¹, Adam Ockelford¹, Evangelos Himonides², G.F. Welch²; ¹Roehampton University, UK; ²IOE University of London, UK

PO090, Poster

This poster demonstrates research in the third phase of the *Sounds of Intent* project, which explores musical behaviour and development in children and young people with complex needs. This is being undertaken through systematic observation and analysis using an expanded and revised ‘Sounds of Intent’ developmental protocol. The protocol was designed through amassing many hundreds of observations of children’s engagement in musical activities, fused with the findings of mainstream developmental music psychology and zygonic theory. The ‘Sounds of Intent’ protocol outlines three domains of musical engagement; reactive, proactive and interactive. Each domain is expressed over six levels within a developmental model, further refined into four elements. The aim of the project is to embed the framework into practice through the utilization of a web-based interactive software package, in which partner practitioners will be able to assess their pupils/clients, record their attainment and progress and download appropriate curriculum materials. The result is a tool, which enables specialists and non-specialists to map the engagement of children and young people in music, supported by an evidence-based model of musical development.

International Semantic Meanings of Popular Music Genre: A comparison of the Extra-Musical Associations with German Folksy Music, Country, Hip-Hop, and Punk in German versus American Listeners

Mark Shevy; Northern Michigan University, USA

PO095, Poster

In mass communication, music is often called an international language because without lyrics, it can cross barriers of spoken language. This study tests this presumption in regard to the meanings communicated by popular music genre. A between-subjects online experiment presented listeners (n=106) in Germany and the United States with a brief recording of one of the four genres. Participants then rated the music they heard along eight extra-musical conceptual dimensions. Results showed significant differences between the genres in their associations with ethnicity, rural-urban culture, age, trustworthiness, expertise, attractiveness, friendliness, and political ideology. The pattern of relative genre ratings was fairly similar between the Germans and Americans for all the variables except ethnicity and expertise. In-group vs. out-group theory predictions were fairly strong for the German listeners, particularly with German folksy music, but they were weak for American listeners.

Emotion Classification of Western Contemporary Music: Identifying a Representative Feature Set

Scott Beveridge, Don Knox, Raymond MacDonald; Glasgow Caledonian University, UK

PO099, Poster

Emotion classification algorithms rely on an extraction process to create numerical representations of raw music information. The result is a feature vector which is used to characterise the audio signal within a specific context or application. Frequency domain analysis is the primary method of creating these features which range from low-level acoustical parameters to high-level structural representations. This paper describes the creation of a feature set which can be used to identify the expressed emotional qualities of western contemporary music. A corpus of novel music tracks was assessed by participants using a time-continuous emotion measurement methodology. Based on the 2-dimensional circumplex model this approach provided participant responses based on factors of arousal and valence. The stimuli were selected by a panel of expert listeners to represent a popular music style. Signal analysis techniques were used to extract an initial vector of 586 features: acoustical and psychoacoustical features were extracted using signal analysis techniques, and a symbolic MIDI representation for structural characteristics. Through a series of statistical analyses a subset of features was selected which are most highly correlated with participant responses. The corpus showed strong correlation with a number acoustical and structural features. Timbral features correlated highly with overall measures of both valence and arousal. Tonal measures also showed a strong relationship with arousal. This study provides evidence of a relationship between musical features and expressed emotion in Western contemporary music. In particular it highlights the need to combine acoustical, psychoacoustical and structural features to establish an optimum feature set.

How We Hear Chords: Assessing the Perceptual Integrality of Musical Chords

Mark Yeary; University of Chicago, USA

PO102, Poster

Though the musical chord, a simultaneity of three or more tones, is common to many genres of Western music, the manner in which a listener experiences a musical chord — either holistically, as an integrated object, or analytically, as a collection of tones — is an underexplored facet of harmony perception. In particular, the difficulty of analytically perceiving a typical chord may complicate cognitive models of harmonic tonality that assume the perceptual availability of all of a chord’s component tones. Two experiments were conducted to examine listeners’ ability to analytically perceive the middle tone of a three-tone chord. The first study involved a speeded classification task, in which a learned tone is combined with a two-tone “frame” to form a chord; a Garner interference test was used to measure the integrality or separability of tone and chord frame. The second study was a discrimination task, measuring the ability to detect a tone within a previously heard chord; signal detection results are compared among three distinct pre-chord contexts to examine the effects of musical context on tone detection. The results suggest that both chord familiarity and musical context may be factors in the listener’s ability to analytically perceive a chord, and these results are used to suggest further approaches to the study of chord perception.

Effect of Transposition on Pitch Memory Production

Christopher Bartlette, Michele L. Henry, Jordan Moore; Baylor University, USA

PO107, Poster

Many people who do not possess absolute pitch have a strong pitch memory. Previous studies have investigated pitch memory through perception or performance tasks for single songs; the current study included both a list of multiple songs and a performance task. It sought to determine what effect altering the key of one song up or down one semitone had on the pitch memory and performance of the song that followed. This study also sought to determine any

differences in performance when participants sang or did not sing with the stimulus song. Further, this study sought to determine any differences in performance between music majors and non-music majors.

Results indicated that participants were more likely to sing a song at the original pitch overall, regardless of any alteration to the stimulus song, mirroring results of previous studies conducted without any stimulus material. For stimulus songs presented at original pitch, participants sang the succeeding song at the original pitch even more frequently than in prior studies. For stimulus songs raised one semitone, participants sang the succeeding song at the original pitch most often but had more instances of singing up one semitone (maintaining the relative relationship between songs). For stimulus songs lowered one semitone, results were less predictable, but favored singing up one semitone or more. The condition of singing versus not singing along with the stimulus song resulted in variation among the stimulus conditions, and there was a significant difference between the performances of music majors and non-music majors.

Investigations of Japanese Mothers' Musical Involvement at Home, Feeling Toward Childrearing, and Expectations Toward 1-Year-Olds' Music Programs

Mayumi Adachi¹, Kumi Matsuda¹, Kaori Iwai², Yoshinori Terada²; ¹Hokkaido University, Japan; ²ELM Music School, Japan

PO111, Poster

According to our early study with Japanese mothers with young infants, few mothers are interested in having their child take music lessons when they grow up. Even though all mothers sing to their infants, only few expressed interests in joining a formal music instruction for toddlers. Thus, Japanese mothers who send their young children to a formal music program are minorities. What motivates Japanese mothers to join a particular music program for toddlers? Do they expect early music lessons to facilitate their children's general skills more than musical skills? How critical are they with the content and the environment of music lessons? The purpose of this study was to explore answers to these questions. We conducted structured interviews with 15 Japanese mothers 26-40 years of age who were taking group music instructions for toddlers. Their children were first-born, with 3 boys and 12 girls. Each interview consisted of questions about the mother's own involvement in music, her feelings toward childrearing, her expectations toward the music program, and her impressions about the child's lessons. Data for the mothers' own musical involvement and their feelings toward childrearing were compared with those obtained from a matched sample of mothers who were not taking a music program for toddlers. The findings will reveal characteristics of a sub-population of Japanese mothers who send their children to early music instructions.

Musical Ear Training with Cochlear Implantees — A Study of Cortical Plasticity

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PO116, Poster

Cochlear implantation (CI) helps deaf people to regain hearing abilities. Successful rehabilitation depends on the brain's ability to adjust to the CI stimulation and on the postoperative efforts initiated. Many CI users achieve good speech understanding but fail in perceiving music and speech prosody. Sixteen adult newly operated CI users were matched in a music and a control group. Shortly after switch-on subjects in the music group began weekly one-to-one musical ear training lessons that contained a variety of musical activities and listening exercises. In addition specially adapted audio-visual training material was provided for home practice. To register the progress in discrimination of pitch, rhythm and timbre we created a battery of music tests. Speech perception was tested with the Hagerman test and a vocal emotion test. We used PET-scanning to detect possible

changes in auditory brain activity. Four water scans were run at each of three milestones with contrasting stimuli. The music and the control group on average increased their speech perception scores by 160% and 94% respectively. Subjects in the music group significantly improved their discrimination of timbre and melodic contour compared to the controls. Our results indicate that one-to-one musical ear training has a great potential as a complementary method to improve fine grained auditory skills in CI users. The deafened adult brain possesses the potential to make big changes at incredible speed. The observed progress in auditory capabilities correlated with the cortical changes in the brain, may represent a unique insight into neuroplasticity.

Investigating Relationships Between Melodic Intervals, Body Movement and Heart Rate Variability

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PO124, Poster

Previous work has shown that listening to isolated musical sounds may evoke differential psycho-physiological response patterns. Here we investigate responses to two contrasting ascending melodic intervals, namely the major third and the major seventh interval in a listening experiment. In addition, the influence of movement in psycho-physiological responses to listening to the intervals was examined. Twenty adult listeners were instructed not to move (first condition) or to move freely (second condition) while their heart rate was continuously recorded during presentations of the two intervals in random order. Heart rate (HR) as well as the standard deviation (SD-NN-RR) of heart rate variability (HRV) within each study interval was computed. SD-NN-RR is an indicator mainly of parasympathetic activity. A multivariate analysis of variance (ANOVA) for repeated observations in which SD-NN-RR is entered as dependent measure reveals a significant interaction between interval and condition. When the subjects did not move SD-NN-RR values were significantly higher during listening to the major seventh than during the major third interval. Accordingly, passive listening to the disharmonic interval appears to evoke a parasympathetic activation that mirrors a physiological "disgust" response. On the other hand, when the listeners are allowed to move, these associations are not observed. Heart rate does not differ between the two intervals in the passive condition. When the listeners are allowed to move, heart rate is significantly higher during the major seventh. The study extends previous findings indicating complex interactions between physical stimulus aspects and task demands, which can influence responses to isolated musical materials.

Development of Singing: A Critical Review and Directions for Future Research

Rayna H. Friendly, Laurel J. Trainor; McMaster University, Canada

PO127, Poster

Singing, like speech, is a universal human behaviour. Yet we know little about its development. In this paper, we review literature about singing development and begin to define a direction for future research. A thorough literature review has revealed many inconsistent findings and limitations to our current understanding of children's singing abilities, such as the developmental trajectory of singing in terms of how accuracy and precision improve with age; the factors that influence the development of singing ability; the type and timing of vocal training that would be most effective for teaching children how to sing; the best ways to go about measuring singing ability in children; and the relationship between vocal perception and production in children's ability to sing. The aim of this review is to highlight some of the limitations and possible reasons for opposing findings in the singing development literature. Factors that will be considered include methodological limitations, conflicting ideas as to what should be measured, how recorded singing samples should be analyzed, and whether or not there might be sensitive periods during

development when vocal training is critical to singing development in children. This review will be useful for pinpointing the methods that will be the most useful in assessing children's singing abilities. Future studies can then use these methods to effectively determine the type and timing of vocal instruction that will lead to optimal singing development later in life.

Beyond *Miyajima*: Messiaen's Synaesthesia in *Sept Haïkai* and Beyond

Yutaka Jono; University of Washington, USA

PO130, Poster

Olivier Messiaen's synaesthesia influenced his compositions, and its effect can be seen in *Sept Haïki*. While the influence of his synaesthesia in the *Miyajima* movement of *Sept Haïki* is often mentioned, the use of color chords in two other movements is little known. This presentation will visually show how the harmonies used in two other movements of *Sept Haïki* correspond to the scenery in Japan. The second half of this study investigates what sound combinations created what colors in his mind.

Messiaen provided the colors associated with the harmonies used in *Sept Haïki* in his posthumously published treatise. By using the treatise and the score, the colors that Messiaen "saw" can be listed. In *Gagaku*, the predominantly used color is red, in accordance with the red Shintoist shrine beams. In contrast, the colors in the harmonies in *Le parc de Nara et les lanternes de pierre* tend to be darker, dominated by brown and grey, in accordance with the scenery of the park in Nara.

The system of Messiaen's synaesthesia is yet to be clearly explained. Jonathan W. Bernard mentions in his article "Colours" that Messiaen was consistent in his synaesthetic sound-color relations, and that Messiaen mentioned associating major triads with specific colors. Vincent P. Benitez focuses on the triadic subsections of one type of Messiaen's chords, successfully matching the colors of the triads with the subsections.

This study applies Benitez's methodology to a wider group of chords. The lowest three notes of "the chords of the total chromatic" form a second inversion triad. While many of these colors agree with Benitez's assertion, further explanation is needed for the C major triad subsection, because the first color mentioned for this chord is yellow, the color of G major. This study asserts that the overtones of the lowest note G is creating the color yellow. Similar phenomenon is observed for the major triad subsections of the type-C voicing of "the turning chords."

Clearly Messiaen used his synaesthesia as a means to organize his characteristic harmonic vocabulary. Further investigation is necessary to clarify how the sounds matched specific colors. While Bernard mentions that synaesthesia is an individual experience that not even other synaesthetes can experience in the same manner, further research into Messiaen's synaesthesia is necessary in order to better understand his music. This study is a step toward this goal.

Interaction Between the Body and the Environment While Expressing Samba Rhythm

Kohei Matsumura, Tsutomu Fujinami; JAIST, Japan

PO135, Poster

Physical skills such as playing musical instruments or performing arts are acquired over years of dedicated practice. Through our previous studies, we have been led to believe that rhythm is important for mastering a skill. However, few studies address how our body expresses the rhythm. When a player expresses a rhythm, he may interact with the environment through his body. This paper discusses the effect of interaction between the body and the environment while expressing a rhythm. We employed samba rhythm as an example to study the expression of a rhythm and we conducted an experiment. Four healthy male persons who had 3 to 5 years experience to samba rhythm participated in the experiment. We asked the participants to keep rhythm patterns with their index-fingers and measured its accelerations. We controlled the presence of interaction by asking the participants to move his finger touching a stick. We also measured finger movements to non-accented rhythms for comparison. We collected 48 trial data in the experiment. The auto-correlation

function for the data showed that the rhythmic expression of the samba rhythm could not arise without the interaction between the finger and the stick. The result suggests that the interaction between the body and the environment is required to express the rhythm such as samba.

Perception of Tension in Contemporary Post-Tonal Orchestral Music: A Case Study

Gerhard Lock; Estonian Academy of Music & Theatre, Estonia

PO138, Poster

The following study deals with tension which can be considered as equally influential for composing, performing, listening, and analysis. Analysis of tension has been essential (albeit often hidden) part of different analytical approaches developed in 20th century music theory and analysis. It can be found especially in Kurth's theory of (musical) energetics, in different gestalt and phenomenologically oriented approaches, and, finally, in the analysis of highpoints. Lerdahl and Jackendoff (GTTM, 1983) treat tension and relaxation systematically in the pitch domain, for post-tonal music see Lerdahl (2001). More embracing approaches to tension are provided by Hutcheson (1972) and Kirschbaum (2001). This paper synthesizes the principles of tension design analysis developed earlier by Lock and Valk-Falk (2008, 2009), and more recently by Lock (2010) [submitted]. The latter focuses on analysis of form, the results of which are later paralleled with a perception test. Tension design analysis in general aims to combine the analysis of form, harmony, counterpoint, timbre, etc. with the approaches applied in music psychology. The current study focuses on "Oxymoron" (2003) for large ensemble by Estonian composer Erkki-Sven Tüür (*1959). The basic question is how the main culmination areas are related to the musical material and form of the piece. The results confirm the main hypotheses of the study: that results of the perception test can be related to those from analysis of the form, and that listeners perceive the tension at the overall level and at important points of the formal structure rather similarly. On the other hand, there are individual differences in perception of musical tension on more detailed levels, which shows the subjectivity of the perception.

A Formal Framework for Representing and Classifying Theme-Variation Relationships

Yuzuru Hiraga, Yuri Shimozaki; University of Tsukuba, Japan

PO141, Poster

In a theme and its variation, some properties of the theme are retained in the variation, while others are altered or transformed in an intentionally planned manner. Such relationships, collectively called *theme-variation relationships*, define the character of the variation. Our research takes a computational approach to studying such relationships, with the aim of building computer implementations for analysis and classification, as well as modeling human listening behavior. In this presentation, we describe the outline of the formal framework for representing, analyzing and classifying theme-variation relationships, which serves as the basis for computer implementation.

The framework deals with relationships that are structure-oriented. Music is decomposed into structural components, derived from operations that can be classified into five categories: *segmentation/partition*, *attribute decomposition*, *abstraction*, *reduction*, and *pattern extraction*. Structural components are represented in functional form as a combination of these operations. Theme-variation relationship is formalized as the correspondence between the structural components of the theme and its variation. The central requirement is that some of the structural components are shared in common (*Variation Principle*). Based on this common structure, structural correspondence between other structural components is characterized as a mapping between their functional representations. The use of functional form provides a suitable way of representing structural components at various levels of abstraction, thus enabling extraction and classification of commonly used variation techniques.

The basic ideas of the framework will be explained intuitively using examples from real variations. Some preliminary implementations for testing part of the framework will also be reported.

Acting Out the Collaborative Role — New Paradigm for Practice-Led Research in Chamber Music Performance

Regiane Yamaguchi; Cleveland Institute of Music, USA

PO144, Poster

The opportunity to prepare a chamber music work for performance concurrently with two different ensembles is rather rare. Nevertheless, it is an enriching experience that reveals subtleties of interpretation and interaction among performers that may otherwise not be noticeable. The process also highlights differences in individual practicing strategies of each ensemble player, as well as in collective approaches to rehearsal techniques.

Practice-led research may be the most appropriate approach to study the complex collective cognitive processes that underlie ensemble rehearsal and performance. Systematic studies of a performer's own observations and annotations from rehearsals with the two different groups reveals interpretative and technical elements that could lead to a higher level of awareness in interpretation and in ensemble performance.

This paper proposes a new paradigm for experimental research in chamber music performance and performance preparation. Multiple aspects of ensemble music making were observed. Issues of personal interaction and communicative ability were registered in post-recital reports. Audio recordings of the performances were also compared, and excerpts from recordings of performances and annotated scores will be available during the conference.

The interaction of a performer with different groups while working on the same musical piece reveals enriching subtleties involved in music making. This suggests that this experiment should be further explored for research and pedagogical purposes. It highlights the qualities of each individual performer, their approaches in preparing for performance, as well as nuances of interpretation.

Conductor-Talk as a Rehearsal Strategy

Patricia Hopper; University of Windsor, Canada

PO149, Poster

Music educators devote a significant amount of their day involved in conducting activities (Kruse, 2007, La Rosa, 1962, Ulrich, 2009). Communication, both verbal and non-verbal is an important aspect of the conductor's duties. Gesture, facial expression, and cues do not provide ensemble members with enough information. In order to effectively communicate with their ensembles, conductors must use spoken words.

Skadsem (1997) states that, "effective communication is an essential part of educating students" (p. 509). Verbal communication should be used sparingly, as it interrupts the flow of the rehearsal and students tend to spend more time involved in off task behaviours (Skadsem). Music educators must use the spoken word wisely and could use guidance in developing conductor-talk as a rehearsal tool.

Conducting textbooks provide music educators with strategies to develop their skill as a conductor. Most textbooks focus on beat patterns, baton techniques, score study, gestures and cueing, and the rehearsal process. Verbal communication is a secondary topic, giving the impression that it is less important in conducting training. Research indicates that rehearsals in an educational setting focus on teacher talk 45% of the time (Colprit, 2000).

In order to investigate the use of conductor-talk as a research strategy, rehearsals were recorded and analyzed. The conductor uses spoken language to give directives, explain conducting gestures, teach musical concepts, develop music literacy, and request specific alterations to the performance of the repertoire.

The 37th Jig

Christine Beckett¹, Doug Eck²; ¹Concordia University, Canada; ²BRAMS, Canada

PO145, Poster

Research on oral traditions has produced increasing work recently, yet Irish traditional music — wildly popular — has received minimal exploration. Beckett (2008) found only 8 articles, with little attention to how humans actually perceive Irish music. Is mere exposure to Irish jigs (statistical learning, Patel 2007) sufficient for listeners to understand and reproduce details and form?

Participants (8 non-musicians; and 9 musicians, not Irish music specialists) heard 6 jigs played once (6 exposures, sparse), twice (12 exposures, medium), or four times (24 exposures, intensive), over 30 min. They then tried to sing a "new" jig.

Variables analyzed were: novelty; AABB form, with contrast between A and B; 8-bar phrases, with the second phrase higher-pitched; compound metre; and appropriate tempo, rhythms, and ornamentation.

All participants sang novel tunes in six-eight time, with high success rates on tempi and rhythms (88-96%, no group differences). Musicians sang more AABB forms (70% compared to 27%, $p < .001$); 8 bar phrases (93% : 71%, $p < .05$), with clear AB contrast (93% : 58%, $p < .01$); B higher in pitch (78% : 58%, $p < .05$); and ornamentation (67% : 42%, $p < .01$). In a group by condition interaction, musicians sang accurate form in all conditions, non-musicians only after intensive exposure ($p < .01$).

This study is the first to ask participants to produce a new jig. We conclude that the task can be done, with surface details more reproducible than form, consistent with variables' differing exposure rates during listening.

Do Motion Control and Motor Coordination Interact with Musical Abilities in Young Children?

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PO162, Poster

It has been observed that singing in tune and motion control are mutually related. Therefore, the early development in both domains shall be investigated. Empirical data are collected for motor and musical abilities. The general hypothesis is that motor coordination is more pronounced in children who exhibit higher scores in music aptitude tests. 28 randomly selected 4 to 6 year old children from an early childhood music program underwent a standardized motor test (MOT 4-6 by Zimmer & Volkamer) which consists of 18 items that measure fine motor abilities, balance, motor reaction, and motion control. A split-half design is used for data analysis with regard to the variables gender, age, cognitive abilities, musical aptitude and music performance. Additionally, Gordon's *Primary Measures of Music Audiation* (PMMA), three nonverbal subtests of the *Kaufman Assessment Battery for Children* (K-ABC) are performed to relate the motor findings to musical and cognitive abilities. Additionally, ratings of children's musical performance during early childhood classes are also implemented. Results exhibit that mean ranks of intelligence and music aptitude differ significantly according to the upper and lower half of motor quotient scores. Significant correlation is found for age and motor abilities (coordination, fine motor skills, balance, and motion control) as well as for motor scores and music aptitude. In general, PMMA and motor quotients exhibit a strong linear correlation. A follow-up study shall investigate the neural mechanisms of motion control which develops from decreasing spinal to increasing cortical control.

Interrogating Statistical Models of Music Perception

Andrew R. Brown, Toby Gifford; Queensland University of Technology, Australia

PO166, Poster

We have developed a new experimental method for interrogating statistical theories of music perception by implementing these theories as generative music algorithms. We call this method *Generation in*

Context. This method differs from most experimental techniques in music perception in that it incorporates aesthetic judgements. *Generation In Context* is designed to measure percepts for which the musical context is suspected to play an important role. In particular the method is suitable for the study of perceptual parameters which are temporally dynamic.

We outline a use of this approach to investigate David Temperley's (2007) probabilistic melody model, and provide some provisional insights as to what is revealed about the model. We suggest that Temperley's model could be improved by dynamically modulating the probability distributions according to the changing musical context.

The Influence of Musical Training on the Phonological Loop and the Central Executive

Vijayachandra Ramachandra, Colleen Meighan, Jillian Gradzki; Marywood University, USA

PO169, Poster

Research studies indicate that musical training leads to cortical reorganization, which may extend to areas not directly concerned with music-related functions. More recently, Franklin et al. (2008) showed a positive effect of musical training on both long-term verbal memory and verbal working memory capacities. The current study compared the effects of musical training on the phonological loop and the central executive components of Baddeley's working memory model (Baddeley & Hitch, 1974). The phonological loop, which is constrained by phonological memory is important for learning novel linguistic information. The central executive, on the other hand, is responsible for the processing, storage, regulation, and retrieval of linguistic information. Thirty-nine healthy undergraduate students (30 musicians and 30 non-musicians) between the ages of 18 and 30 years were administered tasks of phonological memory (nonword repetition and digit span), and central executive (the reading span test and backward digit span). A one-way MANOVA revealed that musicians performed better than non-musicians on both phonological memory and central executive tasks ($p < 0.05$). The findings here indicate that musical training can have positive effects on not just domain-specific phonological memory tasks but also on more domain general cognitive tasks such as reading span and backward digit span, which require simultaneous storage and processing of information. This could suggest cortical reorganization of a more distributed neural network among musicians.

Rumination and the Effectiveness of Mood Induction with the Use of Music and Speech

Joanna Kantor-Martynuska, Magdalena Dąbrowska; Warsaw School of Social Sciences & Humanities, Poland

PO174, Poster

The present study examines the possibility of inducing happy or sad mood in high and low rumination individuals with the use of music and speech. Rumination as a thinking style focused on negative aspects of individual experience forms the basis of depressive tendencies. We aimed to find out whether rumination moderates responsiveness to mood induction procedures with music and speech. Mood induction with the use of happy or sad music and speech was expected to result in a change in participants' self-reported mood. We also expected that rumination would moderate the effectiveness of mood induction: high rumination participants would be more susceptible to sad mood induction and less susceptible to happy mood induction (with both types of auditory emotional stimuli used) than low rumination scorers. The emotional character of the mood induction material has been tested in a pilot study.

115 high-school students filled out a rumination questionnaire. Equal numbers of low and high rumination participants were randomly selected to either a happy or sad mood induction groups. In another session, happy or sad speech recordings were presented. Mood was measured with a questionnaire. Then, participants were subject to the same procedure, but now mood was induced with the use of music. Another mood measurement followed.

Happy music had a significant effect on mood, whereas sad music issued no depressive effect, irrespective of listener's rumination.

Rumination is positively associated with the salience of negative affect and negative emotions experienced both in response to speech and music.

Music as Space of Possibility

Christoph Seibert, Thomas A. Troge; University of Music Karlsruhe, Germany

PO177, Poster

Contemplating insights of musical research in relation to 'music' as concept and phenomenon brings fundamental problems to awareness. Even in interdisciplinary research each academic field inevitably has to follow its own paradigm. Occurring negative side-effects could be reduced by relating every paradigm or concept to a system that describes the object of research.

Based on the theory of autopoietic and operationally closed systems by Maturana and Varela and from the perspective of radical constructivism, some elements of a convenient system of music implying the psychological, physiological and sociocultural conditions of differentiation shall be established.

Following this we describe music as a space of possibility with certain characteristics. Related to this space of possibility an actor-observer gets introduced who builds instances by performing musical actions. The actor-observer is affected by constraints that confine his access to the space of possibility. In general constraints are society, culture or science, as well as concrete musical instances built by an actor-observer. So space of possibility, actor-observer and constraints are the constitutive elements of an aspired system of music.

Considering music as space of possibility presents a concept of music that includes all types of music and all types of musical activities. The associated system outlined in here offers a framework for a transdisciplinary approach which integrates several discourses of musical research. The formalization of such a system may lead to a basic model for implementations of musical artificial intelligence that contain psychological, physiological and sociocultural conditions of music.

Health Behaviours, Life-Style Choices and Mood States Amongst Music Students in the Department of Music at the University of Pretoria

Clorinda Panebianco-Warrens; University of Pretoria, South Africa

PO185, Poster

It is in the interest of any university to have healthy, well-balanced students. Music students have specific and associated health concerns and behaviours which manifest in various physical and psychosomatic ways. Based on similar studies in to health promoting behaviours on music students across a wide range of contexts, the aim of this study is to explore the association between healthy habits, lifestyle choices and mood states in all undergraduate music students at the University of Pretoria. First to fourth year students completed the Health-Promoting Lifestyle Inventory (HPLP-II) and the PANAS mood states inventory. The research explores differences between male and female students, instrumental versus vocalists, and looks at keyboard and violin students versus other instrumental players.

Female students report better nutrition habits than male students whereas male students score higher on the self-awareness/regulation scale. Keyboard and violin players spend less time doing physical activity. They also report lower scores in coping with stress and experience less positive mood states than other instrument players. This could be attributed to a history of long practicing hours considering that lessons in piano and violin are ideally started at a young age and require years to master. It is encouraging that music students of all four years report a higher positive than negative mood state. In general the findings indicate fairly low levels of healthy behaviour in music students.

The Role of Contrasting Musical Characteristics in the Appreciation of Music

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PO193, Poster

Previous theories about aesthetic appreciation suggest that the introduction of a contrasting stimulus can result in an increased emotional response and, consequently, an increased appreciation compared to a previously habituated stimulus. In this study we examined this theory by comparing the emotional responses as well as the liking of listeners for related contrasting and habituated stimuli. In particular, we focused on the emotional contrast between happy- and sad- sounding music, which was realized by using different combinations of the parameters mode (minor and major) and tempo (slow and fast). Music excerpts of 30 seconds that conveyed either happiness or sadness were presented to 46 undergraduate students. Fourteen excerpts conveying one emotion were chosen as habituated stimuli; two excerpts conveying the other emotion served as the contrasting stimuli. Each excerpt was judged in terms of the magnitude of emotional response as well as degree of liking. Listeners showed a stronger emotional response and greater liking to contrasting stimuli than to habituated stimuli. These findings provide support for the theory of heightening the appreciation of music by heightening emotional arousal.

Spatial Properties of Perceived Pitch

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 Canada; ²Brock University, Canada; ³McMaster
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PO198, Poster

Responses to sensory stimuli are often complex, and are influenced by many different factors, including the location and the nature of the stimulus. Previous work has shown that we have a natural tendency to impose order on certain visually presented stimuli, and that this ordering often also endows stimuli with inherent spatial properties. We suggest that this tendency might also be applied to stimuli presented in the auditory domain.

Data is presented from two experiments. The first experiment investigated whether the pitch of an auditory 'go' signal can influence response time. The second experiment investigated influences of the pitch of the signal on movements to auditory targets which were presented in the free-field. Our data suggest that a relationship exists between perceived pitch and movements to auditory targets. 'Lower' tones facilitated responses with the left hand and 'higher' tones facilitated responses with the right hand. 'Higher' tones biased movement upwards and 'lower' tones biased movements downwards when the tones were presented in free-field. These findings suggest that perceived pitch has inherent spatial properties and that competition may arise between spatial maps across perceptual systems, influencing movement planning and execution.

Transformative Experience Through Voice Lessons in Later Life

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 Transpersonal Psychology, USA

PO202, Poster

The research falls under a major collaborative research initiative focusing on Advancing Interdisciplinary Research in Singing (AIRS). The particular study explores singing as an avenue for personal growth and wellness in later life and also has implications for understanding musical perceptual-cognitive development across the lifespan. The "later life singer" is defined as one who started private voice lessons at or after age 40 and continued consistently for at least one year.

The study has two parts. The first entailed locating later life singers and determining their interest in sharing their experiences with the

researchers. Primarily through contact with the National Association of Teachers of Singing, 70 willing students of voice, between the ages of 40 and 80 years, responded. Many of them freely gave unsolicited information about their reasons for taking lessons and the impact that those lessons had on their lives. In addition to acquiring music performance ability, singing lessons seemed to lead to a transformative learning process that fostered greater self-knowledge, well-being, and agency.

To pursue this further, in the second and primary part of the study, which is on-going, an extensive on-line questionnaire — with both open-ended and short-answer components — was devised to provide specific information about experiences as older students of singing, including motivation, goals, the fit of singing into current and future endeavors, impact of participation in singing on their sense of health and general well-being, repertoire achievements, practice, lifestyle, and demographic information.

Qualitative analysis of open-ended questions will be carried out to reveal emerging themes of meaning that may show how singing lessons enhance the quality of life for older adults and contribute to individual well-being and development, both physically and psychologically. Quantitative analyses will be conducted to reveal the extent to which variables of age and gender, for example, influence the significance of lessons, extent of practice, and sense of improved competence. The research potentially opens doors to the idea that singing lessons are for every age, and that there are surprising rewards for those who may have thought it was too late to sing or learn to sing. Typically in music psychology research, the influence of music training focuses on children or younger adults. The present research adds balance by focusing attention on the ability of older persons to acquire skills by beginning training and practice in later life. [Acknowledgment to the SSHRC MCRI program].

For a Grammar of Vocal Gestures

Alessia Rita Vitale; Université de la Sorbonne - Paris IV,
 France

PO208, Poster

In what manner are gestures a support for the dynamics of the learning processes *of* and *with* the voice (including the acquisition of verbal language) and how do they complete and/or replace verbal language? An observer watching singers studying and rehearsing (alone or with others) sees a whole silent alphabet of non-verbal signals which interweave to make up a silent "language" of gestures, which I call vocal gestures, for they generate the voice, replace or "dub" it, to enrich it. I have defined two types of vocal gestures: internal and external. *Internal vocal gestures* are not visible from the outside; physiological, they generate the voice. External vocal gestures turn out to be — among other functions — very important to didactics. What determines that at "such a particular instant" in time there must be precisely "such a gesture" and why? Which gestures support the voice of a singer, how are they organised and what do they signify? Can we set up a grammar for that language? What interests me is to investigate whether within voice training classes the language of gestures set up by each teacher has important similarities to those of other teachers; this would imply that behind that «spontaneity» may lie behaviour attributable to a common root, at the basis of human communication of an instinctual type.

If gestures appear to be a "language", can we set up a grammar for that language? These are some of the questions that we will refer here.

Personality and Preferences for Musical Instruments

Marek Franek; University of Hradec Králové, Czech
 Republic

PO217, Poster

There are many popular beliefs about temperament and personalities of orchestral players. Recently, it was demonstrated that there were associations between preferences of music genres and certain personality traits. The aim of the study was to investigate associations between personality traits of Big-Five personality model and preferences for particular musical instruments. Non-musicians, undergraduate students (n=120) were asked to express their desires

and choices to play a particular instrument. They received a list of 18 instruments and were required to rate their preferences. Further, they were asked to complete the Big-Five test of personality. Exploratory factors analysis revealed five categories of musical instruments, which were labeled Brass, Romantic, Pop, Accompaniment, Home, and Classical instruments. Positive correlation between Neuroticism and desires to play Brass instruments (French horn, trumpet, trombone, tuba, and saxophone) in males and a negative correlation between Neuroticism and desires to play Home instruments (recorder, flute, piano, and keyboard) in females were found. Both in males and females desires to play Romantic instruments (organ and harp) were negatively correlated with Extraversion. Openness was positively correlated with desires to play Home instruments (recorder, flute, piano, and keyboard). Finally, Conscientiousness was positively correlated with desires to play Classical instruments (violin, double bass, flute, and clarinet) and negatively correlated with desires to play Pop music instruments (percussion and electric guitar) in females. The results are discussed in terms of social stereotypes associated with particular musical instruments.

The Relationship Between Instrumental Experience and Social Cognition — A Study on Transfer Effects

Reinhard Kopiez, Marco Lehmann, Luisa Rodehorst;
Hanover University of Music & Drama, Germany

PO219, Poster

We investigated whether a positive transfer of emotional codes/skills acquired in instrumental training can facilitate similar ones in the domain of social and affective cognition. We hypothesize that year-long training in a non-language-related communication system (music) can also have a positive effect on the socio-affective cognition that is present in the language-related domain. Four groups of students (20 students each of music, drama, art and electric engineering) participated. Social cognition was measured by the film-based MASC test (Movie Assessment of Social Cognition; Dziobek et al., 2006). This test measures competence in situation-dependent inter-human understanding (empathy), using the assessment of complex conversation settings presented in 45 short film sequences. As the main result, music students outperformed electric engineering students (effect size: Cohen's $d = 1.22$). No statistical differences were found between music students and those of drama and art (results of statistical contrast analyses). The direct relationship between the duration of instrumental training and the MASC score revealed a correlation of $r = .37$ ($p = .01$). Although our results confirm previous findings on effects of long-term instrumental training on other domains of language-related communication, such as speech perception, we are cautious of drawing causal conclusions about the influence of instrumental training on social cognition. The more general problem of using dependent variables with a "built-in advantage" for musicians is discussed. We argue for a cautious interpretation of "inferiority" of other groups in the population.

How Do the Adult's Interaction Style Affect Infant's Vocal Activity? — Observation During the Diaper Change Routine

Anna Rita Addessi; University of Bologna, Italy

PO222, Poster

This poster deals with the observation of infant/adult vocal interaction during the diaper change routine, at home and at the nursery. In our previous exploratory study we found that the vocal activity/passivity of infant during the routine of diaper change is affected by some adult's vocal interaction modes (Addessi 2009). A systematic observational study has been therefore carried out with more participants, in order to verify some hypotheses concerning the adults' interaction styles affecting the infant vocal activity/passivity. Furthermore we aim to observe if significant differences exist between home and nursery routines and between 3 different kinds of dyad (mother/infant, father/infant and practitioner/infant). Several observational protocols were carried out in naturalistic contexts during diaper change, at home and at the nursery. Participants: At home: $n = 4$ dyads mother/infant, $n = 3$ dyads father/infant; At the nursery: $n = 4$ dyads practitioner(girl)/infant. The infants were 36/39 weeks old.

The observation took place for two consecutive weeks, one per day. To observe the variables a grid was elaborated. We measured the frequency and the full duration of 3 types of vocal activity (speech, singing, vocalization), turn-taking, imitation/variation, repetition, at-tunement, in both the subjects (adult and infant). The data have been registered by several independent observers watching the video (by the Observer software). Afterwards an accord index will be applied to the each registered score, for each variable. We then calculated the correlation between the adults' and child vocal behaviors. The results analyzing so far show that the child's increased vocal passivity (that is low frequency of vocal activity and self-initiated vocal play) could be caused by the greater frequency of the adult's vocal productions, the limited presence of turn-taking and imitation by the adult, and the intervention of the adult during the turn-taking that disrupted the child's vocalization. From a pedagogical point of view, these results suggest that in order to enhance the vocal activity of the child, adults/educators should not vocalize too much, but rather find a balance with the vocalizations of the child, imitating the child rather than trying to be imitated, respecting the turn-taking and following the nuances of the child's voice, giving preference to the pleasure of musical interaction.

A Qualitative Investigation of a Collaborative Music Project Involving Individuals with Mental Health Problems and Professional Musicians

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

PO231, Poster

There is a growing body of work which provides evidence for the efficacy of music as a therapeutic intervention (Hayashi et al 2002; Hargreaves et al 2005). This project focuses on the work of *Polyphony*, a charity which provides access to musical activities in a large psychiatric hospital in the west of Glasgow, Scotland. This paper investigates 'Inreach' a novel project delivered by Polyphony which involved professional musicians, a composer and amateur musicians who have mental health problems composing a large scale work together and performing the finished piece in public.

This qualitative study explores the subjective experiences of individuals with mental health problems and professional musicians who participated in 'Inreach'. Two individuals with mental health problems, one professional musician, a composer and a member of Polyphony staff took part in this study. Interviews were transcribed and analysed using thematic analysis. Super-ordinate themes will be presented. These include the role of music in the participants' lives, the benefits participants' gained from the project and the participants' experience of 'Inreach'. This project highlights the centrality of music in the lives of all the musicians involved in this project and the importance such projects can have in the lives of those with mental health problems.

Sound Gestures: Exploring the Effect of Conducting on Music Listening

Harry E. Price¹, Steven J. Morrison²; ¹Kennesaw State
University, USA; ²University of Washington, USA

PO234, Poster

Conducting presents an opportunity to examine the relationship between sound and movement since it is an entirely physical task, one with which sound is associated but not produced. Through a continuing series of studies we explore the contribution of conducting to the experience of music listening. For each of two studies participants were presented with varied visual information coupled with identical aural information. Listeners rated ensemble expressivity significantly higher for high-expressivity conductors; this result was further evidenced by significant correlations ($r = .56$ and $r = .68$) between conductor and ensemble ratings. There was no significant difference in ensemble evaluations between performances viewed from behind or in front of the conductor. These data prompt several key questions. (1) While varied approaches to conducting might be assessed as more or less expressive or of greater or lesser quality, it is not clear whether commensurate variation in ensemble evaluations are attributable to simple bias or to a perceptual difference prompted by the integration of aural and visual information. (2) It remains un-

clear how the visual component of conducting enhances or detracts from performance judgments, whether “good” conducting elevates the evaluation of a performance or whether “poor” conducting undermines what might have been an otherwise positive evaluation. (3) Acknowledging that conducting encompasses the visual expression of numerous musical characteristics (e.g., tempo, articulation), it would be useful to examine each of these in isolation to determine whether the impact of such a broad construct as “expressivity” is attributable to particular constituent components.

Poster Session 3

KANE HALL - WALKER AMES ROOM
17:30 - 18:30, Thursday 26 Aug 2010

The Influence of Distortion and Thirds on the Perception and Restoration of Power Chords

Jay Juchniewicz¹, Michael J. Silverman²; ¹East Carolina University, USA; ²University of Minnesota, USA

PO003, Poster

The purpose of this study was to investigate the influence of distortion on the tonal perception and restoration of thirds within power chords. Sixteen chord progressions, including sets of paired major and minor progressions, were recorded on electric guitar under both clean-tone and distortion effect conditions. Fifty ($N = 50$) undergraduate music majors listened to all sixteen chord progressions and rated the tonality of the final chord in each progression. Participants had completed a mean 3.82 ($SD = 0.66$) semesters of ear training and twenty-eight indicated they played the guitar. The researchers utilized a three-way repeated-measures ANOVA to analyze the perception of "majority" or "minority" of the last chord in each progression. Statistically significant interactions were found between progressions (1-4), distortion (clean versus distortion), and type of progression (whole chords versus power chords). Mean data indicated participants perceived the last chord to be more major if the progression was composed of power chords and if the progression used distortion. These results are congruent with previous findings that indicate the last chord of a chord progression is perceived as more major if progressions are composed of power chords as opposed to chords with thirds. Additionally, the use of distortion affected the perception of these power chords in a similar manner. Future research into the perception of power chords is warranted.

Joint Drumming in Brazilian and German Preschool Children: Synchronization Skills and Prosocial Effects

Sebastian Kirschner¹, Beatriz Ilari², Michael Tomasello¹; ¹MPI EVA, Germany; ²Federal University of Paraná, Brazil

PO007, Poster

AIM: The current study was designed to untangle two proposed mechanisms underlying spontaneous synchronization in preschool children, when drumming with a human partner (Kirschner & Tomasello, 2009): (A) a shared visual representation and thus better comprehension of the task, or (B) a specific human motivation to synchronize movements during joint rhythmic activity. Furthermore, we hypothesized that children who grow up in a culture with frequent access to live music played in relevant social settings would synchronize their movements with higher accuracy during joint drumming, compared to children from a culture, where most musical stimuli nowadays come from playback devices. **METHODS:** We invited 84 Brazilian and German three-year-old children to drum along (A) a drum sound coming from a "radio", (B) with the experimenter in front of them, and (C) with the experimenter while his body and drum were hidden behind a curtain. **RESULTS:** So far, we have analyzed the data from Salvador, showing that Brazilian children do spontaneously synchronize their taps and adopt for tempo changes better during joint drumming with a human partner compared to drumming along with a "radio". Importantly, hiding the stimulus drum from view does not decrease the synchronization accuracy in Brazilian children. **CONCLUSIONS:** Of the two cognitive mechanisms proposed above, our data suggests that Brazilian children feel a higher motivation to spontaneously synchronize if drumming in a social context, regardless of whether they see the partner drumming or just hear him. At the conference we will present the German data as well.

Unraveling Musical Training's Impact on Neural Mechanisms of Selective Auditory Attention

Dana L. Strait, Nina Kraus, Victor Abecassis, Richard Ashley; Northwestern University, USA

PO011, Poster

Musical expertise requires efficient processing of multiple simultaneously-occurring auditory streams, with particular attention devoted to melody lines and the line of one's own instrument. Accordingly, music listening and practice activates selective auditory attention networks. Although musicians demonstrate superior performance on tasks that require auditory attention, the neural manifestations of musicians' auditory attention expertise remain unclear.

To determine how musical training impacts neural mechanisms of selective auditory attention, we recorded cortical auditory-evoked potentials to attended and ignored auditory streams in adult musicians ($n=11$) and non-musicians ($n=11$), ages 18-32. Participants were asked to attend to one of two simultaneously-occurring stories, which differed in speaker voice, direction of presentation and story content, while ignoring the competing story. Neural responses were recorded by a 32-channel electrode cap to a speech stimulus that was embedded within the stories and presented in an alternating fashion to the attended and ignored sides. The paradigm yielded average *attend* and *ignore* cortical responses. Response variability in attend and ignore conditions was assessed by calculating the variance in individual responses over the course of a single recording session. Response amplitudes and response variability were compared both within (attend/ignore) and across (musician/non-musician) subjects.

Outcomes reveal that musical training shapes cortical mechanisms that underlie selective auditory attention performance, decreasing response variability during auditory attention. Musicians did not show response magnitude differences with auditory attention, although non-musicians demonstrated increased magnitudes in the attend, compared to the ignore, condition. Musicians' increased cortical response consistency with attention and lack of amplitude difference between conditions indicates increased neural processing efficiency during selective auditory attention. Such neural efficiency may account for musicians' enhanced performance on auditory perceptual tasks.

Supported by NSF 0921275, NIH T32 NS047987 and a grant from the Grammy Research Foundation.

Faster Decline of Pitch Memory Over Time in Congenital Amusia

Victoria J. Williamson¹, Claire McDonald¹, Diana Deutsch², Timothy D. Griffiths³, Lauren Stewart¹; ¹Goldsmiths University of London, UK; ²University of California at San Diego, USA; ³Newcastle University, UK

PO014, Poster

Congenital amusia is a developmental disorder that impacts negatively on the perception of music. Psychophysical testing suggests that amusic individuals have above average thresholds for detection of pitch change and pitch direction discrimination; however, a low-level auditory perceptual problem cannot completely explain the disorder, since discrimination of melodies is also impaired when the constituent intervals are suprathreshold for perception (Tillmann, Schulze & Foxton, 2009). The aim of the present study was to test pitch memory as a function of a) time and b) tonal interference, in order to determine whether pitch traces are inherently weaker in amusic individuals. Memory for pitch was examined using two versions of a paradigm developed by Deutsch (1970). In both tasks, participants compared the pitch of a standard (S) to a comparison (C) tone. In the time task, the S and C tones were presented, separated in time by 0s, 1s, 5s, 10s and 15s (blocked presentation). In the interference task, the S and C tones were presented with a fixed time interval (5s) but with a variable number of irrelevant tones in between: 0, 2, 4, 6 and 8 tones (blocked presentation). In the time task, control performance remained high for all time intervals, but amusics showed a performance decrement over time. In the interference task, both groups showed a similar performance decrement with increasing number of irrelevant tones. Overall, the results suggest

that the pitch representations of amusic individuals are more prone to decay than those of matched non-amusic individuals.

Animal Songs: Animal Music?

Emily Doolittle; *Cornish College of the Arts, USA*

PO017, Poster

Musicians have long felt a connection between animal songs and human music on an intuitive level, as shown by the enormous, cross-cultural repertoire of music based on animal song. Current scientific research suggests that superficial resemblances between music and animal songs may, in some cases, point to deeper-level similarities. Human music and the songs of animals most commonly considered “musical” — oscine birds and cetaceans — are not homologous, but some traits shared between human music and the songs of these animals, such as the connection of sound with physical activity or emotional state, may have a common origin. Other important aspects of both human music and music-like animal song, such as the use of vocal learning, have evolved convergently.

In this poster I examine sonic similarities between human music and animal song and behavioral similarities surrounding song production. I present recent research (Doolittle, Endres and Fitch, ms. in prep.) which shows that hermit thrush song, like some human music, is based on the harmonic series. The poster concludes with a discussion of whether some animal songs can be considered “music” in the same sense as human music. I propose that music is best defined by a sort of Wittgensteinian “family resemblance,” and outline some of the traits widely considered characteristic. Some animal songs share as many of these traits with human music as some kinds of human music share with each other, suggesting that to draw a firm dividing line between human music and animal song does not make sense.

Strategy to Recruit Degrees of Freedom of Proximal Joints for Increasing Sound Pressure Level in Expert Drummers

Shinya Fujii, Masaya Hirashima, Kazutoshi Kudo, Yoshihiko Nakamura; *University of Tokyo, Japan*

PO020, Poster

Playing musical instruments such as drums requires precise mapping between body movement and sound. To investigate the accomplished mapping of the auditory-motor systems in humans, expert musicians are an excellent population. The aim of the present study is to clarify how expert drummers regulate kinematic parameters in multi-joint upper-limb movements to modulate the sound pressure level (SPL) of the snare drum. Professional drummers are instructed to strike the snare drum for about ten times and gradually increase the SPL from the smallest to the largest level. We analyzed the three-dimensional movement kinematics using a serially linked five-segment model of the trunk and the upper limb that has 16 degrees of freedom (DOF). The results showed that the drummers used a few number of DOFs at distal joints such as rotations of the stick and wrist flexion when producing relatively small SPL. As the SPL increased, the drummers gradually used the DOFs at elbow extension, forearm supination, shoulder depression, shoulder internal rotation, and leftward rotation of the trunk. That is, the drummers gradually recruited more proximal joint rotations in the course of increasing the SPL. We conclude that, through intensive musical training, the expert drummers have acquired the strategy to gradually recruit proximal body parts for utilizing the kinetic chain of the multi-joint system to effectively produce large sound.

Effects of Pitch Register, Loudness and Tempo on Children’s Use of Metaphors for Music

Zohar Eitan, Alexandra Katz, Yeshayahu Shen; *Tel Aviv University, Israel*

PO023, Poster

Studies using simple auditory stimuli have demonstrated consistent associations between auditory and non-auditory dimensions, including emotional attributes, aspects of space and motion, and dimensions of vision and touch. Yet, such cross-domain mappings

have rarely been investigated within complex musical contexts. Here we examine how auditory dimensions, systematically manipulated, affect cross-domain mappings in a musical context. Comparing different age groups, we also investigate the developmental course of these mappings. 167 participants, aged 8 to adult, rated how well 15 emotional, synaesthetic, and spatial/kinesthetic antonyms characterize each of 16 musical stimuli. Stimuli consisted of 2 phrases from Varese’s *Density 21.5* for flute, in each of which 2 levels of pitch, loudness, and tempo were factorially combined, generating 8 unique combinations. Repeated measures ANOVAs demonstrated highly significant main effects of pitch, loudness and tempo on metaphor ratings, with no interactions between the musical variables. Louder stimuli were associated with bitterness, hardness, sharpness, and roughness; anger, fear, and hate; large mass and size, higher elevation, and fast pace. Stimuli higher in pitch were associated with brightness, hardness, sharpness, and roughness; happiness, anger, and fear; *small* mass and size, higher elevation, and fast pace. Faster tempi were associated with happiness, faster pace, and jumpy motion. Age interacted mostly with pitch; most ratings, however, were consistent across age groups. Results suggest that metaphors are consistently mapped onto basic musical dimensions by children and adults alike, and that pitch, loudness and tempo convey distinct profiles of “extra-musical” connotations.

Effects of Auditory Feedback Disruption on Singing Remembered Tunes

Aysu Erdemir, Jeana Simpson, Gretchen Verheggen, John Rieser; *Vanderbilt University, USA*

PO026, Poster

Producing a succession of musical sounds with the voice is a multi-faceted motor action which requires a solid memory representation for the spectral-temporal characteristics of the melody, a precise control over the auditory and motor systems as well as an efficient use of auditory and kinesthetic/motor feedback. The purpose of this study was to assess the role played by auditory and motor systems in skillful control of singing, specifically by investigating how absence of auditory feedback influences the accuracy of singing. Moreover, we aimed to uncover the nature of memory for pitch and time by inquiring the extent to which they are dependent on auditory or motor modalities. Adults sang Happy Birthday under two different normal feedback and two different masking conditions; their *absolute & relative pitch, tempo and rhythmic accuracy* were measured. Results showed that when participants lacked auditory feedback, their intonation accuracy was significantly reduced. Moreover, participants were more able to produce correct intervals than correct individual tones, suggesting a more solid relative pitch representation for the song. Furthermore, compared to the absolute, relative pitch accuracy was less disrupted by the absence of auditory feedback; which indicated that relative pitch memory was less dependent on auditory feedback, thus more readily accessed by the motor system. Similarly, in regard to time, although there was a significant decrease in tempo when auditory feedback was blocked-out, no difference was observed for tempo-free rhythmic accuracy, suggesting that relative information, also associated with time (rhythm) was more dependent on a motor component.

Color Harmonies and Color Spaces Used by Olivier Messiaen in *Couleurs de la Cité Céleste*

Paul E. Dworak; *University of North Texas, USA*

PO029, Poster

This paper explores the color spaces used by Olivier Messiaen in his orchestral composition *Couleurs de la cité céleste*. Messiaen discussed with Claude Samuel his experience of synesthesia, which is the ability of some persons to perceive colors when they hear sounds. In this work Messiaen identifies in the score the highly evocative colors and brilliance characteristics of gemstones suggested by scenes in the *Book of Revelation*, and he associates them with the voicing and instrumentation of the chords played by selected instruments from the orchestra that he uses in this work. Messiaen’s colors exist in a color space that corresponds with the formant space of the sound of the chords that realize these colors. Just as color models such as CIE L*a*b* define hue, saturation and luminance in three dimensions,

the $F1 \times F2 \times F4$ formant space of Messiaen's chords also locates the same color attributes within the three dimensions defined by these formants, with hue and saturation represented in the $F1 \times F2$ plane, and luminance in the $F4$ dimension. The software application Speech Filing System is used to determine the formants of the digitized sound of the orchestral chords that are associated with the various colors that he specifies. The formant data are plotted in three dimensions with IDL Workbench visualization software, using three-dimensional polynomial regression. These plots identify the surfaces and their orientations within this space that correspond with colors and color combinations. These data confirm that Messiaen's colors are not merely symbolic associations, but represent his simultaneous perception of sound and color.

Comparative Perceptions of Lossy Audio Compression on Different Music Styles

Alastair C. Disley, Matthew R. Duck; University of Kent, UK

PO033, Poster

Lossy audio compression formats aim to deliver optimal performance at reduced bit-rates over multiple genres of music. This experiment examines listener quality ratings of three competing formats: MP3, Ogg Vorbis (OGG) and Windows Media Audio (WMA) across four musical genres (Rock, Dance, Folk and Classical) at commonly used consumer bit-rates (128, 96 and 64kbps), using the formal MUSHRA technique.

Results showed that the OGG and WMA files outperformed MP3, particularly at lower bit-rates. Genre had significant impact on performance, with the Dance and Rock tracks rated worse for lower bit-rates. Overall, listeners rated OGG files highest, with WMA a close second.

Auditory Perceptual Learning in Musicians and Non-Musicians: Neural Evidence

Miia Seppänen, Anu-Katriina Pesonen, Mari Tervaniemi; University of Helsinki, Finland

PO037, Poster

Neurocognitive studies show enhanced auditory processing in musicians when compared with non-musicians. EEG (electroencephalography) studies have demonstrated that musicians have either larger amplitudes or shorter latencies (or both) for automatic, preattentive and attention-sensitive event-related potentials (ERPs) 40-600 msec after sound onset. While these findings reflect the experience-dependent plastic effects in musicians' cortical functions after long musical training, less is known about the rapid plasticity in musicians. In this study, we compared rapid auditory perceptual learning between musicians and non-musicians by recording automatic and attention-modulated ERPs (P1-N1-P2, mismatch negativity 'MMN', P3a) during one hour session including both passive listening and active auditory discrimination tasks. Stimuli consisted of frequently ('standard') and infrequently ('deviant') presented sine tones. Deviant tones were differing either by pitch, duration or perceived sound location (with three difficulty levels, each). P1-N1-P2 was analysed for standard sounds, and MMN and P3a for deviant (targets in active task) sounds. The relationship between learning-related neural changes and discrimination accuracy during tasks was also examined. In addition to replicating the previous findings of stronger neural responses in musicians (P2, MMN, P3a), the rapid auditory perceptual learning differentiated musicians and non-musicians for N1, MMN and P3a. MMN latency became shorter in non-musicians during passive listening. MMN as well as P3a showed faster habituation (decrease) in musicians. We conclude that rapid auditory perceptual learning differs between musicians and non-musicians but only for N1, MMN and P3a. Musicians might have stronger attention switching during active listening which decreases the need for neural activation in frontal areas.

Music Training and Reading Readiness: Examining a Causal Link

Christine D. Tsang¹, Hailey Goldstein¹, Nicole J. Conrad²; ¹Huron University College at Western, Canada; ²Saint Mary's University, Canada

PO042, Poster

Musical aptitude is related to cognitive abilities, including reading skills. Studies examining this relationship often fail to account for formal music training, which can enhance performance on musical aptitude tests. In Experiment 1, we compared the relationship between specific music and reading skills in a broad age-range of 82 children with and without formal music training. The results showed that children with music training significantly outperformed children without music training on most tests of music perception and reading skill. Furthermore, the relationship between music and reading skills differed depending on the experience and the age of the children, such that pitch discrimination predicted variance in reading ability for children without formal music training, while rhythm discrimination predicted variance in reading ability for children with formal music training. In Experiment 2, we examined the causal effects of music training on a specific precursor to reading ability, phonological skill. Following baseline tests of music and phonology, half of a small classroom of junior kindergarten children received group music training embedded into their daily classroom routine for 15 minutes a day over 4 consecutive days, while the other half received no additional training. Following training, new tests of music and reading skill were administered to all children. The results of Experiment 2 found that children in the training group showed significant improvement on all music test scores, and also scored higher on some phonemic tests compared to children in the no-training group. Together, the results of both experiments provide a stepping stone to help develop empirically-based training studies to better understand the link between music skills and literacy skills.

The Effect of Tonal Context in Melodies on Memory for Single Tones

Dominique T. Vuvan, Mark A. Schmuckler; University of Toronto Scarborough, Canada

PO047, Poster

This study sought to investigate whether and how tonality might impact memory for single tones in a melodic context. Participants were presented with melodies that were controlled for tonality, time signature, and tempo. Each melody had a target note (#5, M6, P5) which was either present or absent. The three target notes were chosen because of their differential importance in the tonal hierarchy, which leads to different levels of expectancy for each target (#5 — low, M6 — medium, P5 — high). On each trial, participants heard a melody, followed by a probe tone (one of the three possible targets), and judged whether they had heard the probe tone in the preceding melody. Task performance was best and statistically equivalent for #5 and P5 targets, and worse for M6 targets. Therefore, tonality does affect listener memory for melodic tones. Specifically, both highly expected and highly unexpected tones are remembered well, whereas tones that fall in between these two extremes of tonal expectancy are remembered poorly. This study provides evidence for both a tonal schematic effect as well as a von Restorff (1933) novelty "pop-out" effect in memory for melodies.

Examining the Effects of Active Music Therapy on Post-Stroke Recovery

Esa Ala-Ruona¹, Harriet Bamberg², Jaakko Erkkilä¹, Jörg Fachner¹, Heidi Parantainen²; ¹University of Jyväskylä, Finland; ²Central Hospital of Central Finland, Finland

PO050, Poster

According to recent findings merely listening to music during the early post-stroke stage can enhance cognitive recovery. On the basis of clinical experiences and anecdotal evidence is presumed, that active music therapy may be beneficial in post-stroke recovery, too.

The aim of the research project is to develop a neuropsychologically informed clinical music therapy model to meet the needs of treatment of MCA stroke patients, and to examine the effects of this active music therapy in post-stroke recovery. The study is a randomised controlled trial with crossover design. 45 patients (< 75 years of age) with MCA stroke (an acute ischaemic stroke or ICH) in the right temporal, parietal frontal and/or subcortical brain region will be randomly assigned to early intervention group and delayed (4 months) intervention group. All participants will receive standard care, and in addition to this two weekly sessions of active music therapy over a period of 3 months. The study will give valuable information on possibilities of neuropsychologically informed active music therapy in post-stroke recovery. By studying the use of music and music-based exercises in rehabilitation we can produce new knowledge on this form of therapy which is becoming ever more common.

Prediction of Multidimensional Emotional Ratings in Music from Audio

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

PO053, Poster

The objective of this study was to offer a detailed characterization of the interdependencies between musical content and induced emotion. A corpus of 110 movie soundtrack excerpts that uniformly samples the five basic emotions and the three-dimensional activity/valence/tension space was emotionally rated by 116 subjects. The corpus has been computationally analyzed, using a large toolbox of music feature extractors, covering timbre, harmony, register, rhythm, articulation and structure. Linear dependencies between emotional ratings and musical content was estimated via regressions, using classical and advanced techniques, such as Partial Least Square regression. To select the optimal number of features, Bayesian Information Criterion (BIC) was used. Each non-normally distributed feature was transformed by means of Box-Cox power transform. High consensus on induced emotion was observed, as the Cronbach index exceeds .99 for each concept. Using a five-fold cross-validation, about 70% of the variance in emotional ratings could be predicted with features extracted from the audio. When mapping the dimensional ratings onto each of the five basic emotions, the regression models could explain 63 to 89% of the variance. When mapping basic emotions onto the emotion dimensions, explained variance ranged from 88 to 97%. A large part of the variance can be explained using dynamic, rhythmic and timbral dimensions. The remaining part of the explained variance is based on more subtle factors, but of high musical importance, based on tonality, modality, and their temporal variability.

Self-Regulation, Music and Cognitive Performance: Participant Self-Selection of Music Varies as a Function of Task Requirements

Isba Husein, Samia R. Toukhsati, Simon Moss; Monash University, Australia

PO056, Poster

The aim of this study was to examine the capacity for individuals to regulate their emotional status to facilitate cognitive task performance. Affective self regulation was demonstrated by the differential selection of emotional music as a function of task requirements. Forty-eight participants (mean age = 23.96 ± 9.44) were recruited from Monash University, Australia to perform two cognitive tasks: the Stroop task and Raven's Progressive Matrices. Following a task familiarization phase, respondents were exposed to a series of brief excerpts (30sec) of three music conditions: "happy music" (*Chanson du Toreador* composed by Georges Bizet); "sad music" (*Adagio in G minor* composed by Albinoni) and "neutral music" (*Claire de lune* composed by Debussy) from which they chose the music stimulus they would prefer to listen to prior to completing either task. Following this, participants were exposed the three music conditions in counterbalanced order, irrespective of preference, prior to completing both cognitive tasks, which were also presented in counterbalanced order.

The findings revealed that "happy music" was selected with significantly greater frequency compared to the other two pieces prior to completion of the Stroop task, however the performance advantage was not significant in comparison to the other music conditions. A similar non-significant trend was evident in relation to the "sad music" condition such that "sad music" was more frequently selected prior to completion of Raven's task and participants performed best in this condition. These findings demonstrate a tendency for respondents to prefer music that will induce the appropriate mood for optimizing performance.

Beyond Happiness and Sadness: Modality and Dynamics and Their Association with the Affective Content of Lyrics

Laura Tiemann, David Huron; Ohio State University, USA

PO059, Poster

A study is reported investigating the relationship between modality (major/minor), dynamics (piano/forte), and the judged affective content of musical lyrics. Thirty-two solo vocal works by fourteen composers were sampled: 8 in the major mode with a loud dynamic level, 8 in the major mode with a quiet dynamic level, and 8 each in the minor mode (forte and piano). All sampled compositions were tonal Western works. Without hearing the music, independent native-speakers of English (n=44) and German (n=21), judged the lyrics according to four affects: happy (*fröhlich*), sad (*traurig*), tender (*zärtlich*), and passionate (*leidenschaftlich*).

Rhythmic Contrast in Historical Music Performances as Compared to Contemporary Ones

Marju Raju, Jaan Ross; Estonian Academy of Music & Theatre, Estonia

PO064, Poster

This work is aimed at studying the rhythmic contrast in music as measured with the normalized Pairwise Variability Index (nPVI) for the stylistically different performances of the same song. Our sample consisted popular national songs and art songs. Recordings analyzed were made by regular people, pop stars and professional singers. For art songs also the scores were analyzed to find whether there are differences in the nPVI values between calculations based on scores and recordings. As our results show, rhythmic contrast does not change as we compare the performances of the same song in some cases even over 90 years apart. The rhythmic contrast of the musical work do not seem to be (1) sensitive to differences between scores and recordings. As our results show, rhythmic contrast does not change as we compare the performances of the same song in some cases even over 90 years apart. The rhythmic contrast of the musical work do not seem to be (1) sensitive to differences between scores and recordings of the same musical works or (2) sensitive to style differences between performances of the same works.

Influence of Familiarity with a Co-Performer's Part on Synchronization in Musical Ensembles

Marie Uhlig, Peter E. Keller; MPI CBS, Germany

PO067, Poster

Precise temporal coordination in musical ensembles requires anticipation, which may involve action simulation via top-down controlled processes like musical imagery and bottom-up automatic expectancies about timing and pitch. To determine the importance of top-down musical imagery, this study investigates how interpersonal coordination in piano duos is affected by increasing familiarity with one's co-performer's part and his/her playing style. Synchrony is assessed in piano duos through the analysis of key strokes and body movements. In a first session pianists play duets on two pianos without visual contact. Each pianist plays two duets with two different partners. In one duet both parts are known to both players, while in the other piece only one's own part is known. The pieces are played and recorded six times in order to analyze the effects of increasing familiarity. During a second session the pianists play to a recording of four new pieces, two familiar and two unfamiliar, from both known and unknown partners. The introduction of randomly placed silent gaps is intended to necessitate familiarity-dependent top-down simulation to further assess the effect of implementing either a top-down or bottom-up strategy for maintaining synchrony. It is expected that pianists synchronize better when they are initially

familiar with both parts of the duet. Furthermore, synchrony should improve with increasing familiarity to a greater degree for pieces that are originally unfamiliar. To the extent that top-down processes are important, gaps in a familiar piece should have less detrimental effects than gaps in an unfamiliar piece.

The Musical Time Warp — Psychological Time and Elapsed Duration During Music Listening

Michelle Phillips; University of Cambridge, UK

PO071, Poster

The phenomenological experience of elapsed duration is dependent on multiple and complex factors. These include, but are not limited to, level of arousal, valence, familiarity, body temperature, memory, and division of attention. Moreover, estimates of duration differ according to experimental paradigm employed (retrospective or prospective), length estimated (i.e. the sub- or supra-second level) and means of testing (production, reproduction, verbal estimation, or comparison).

Whether musical time conforms to current models of psychological time — such as internal clock or contextual change models, or more recently proposed models of timing based on neural networks — or whether temporal production and estimation have special meanings in musical contexts, remains as yet unclear. However, studies demonstrate that musical features do appear to influence the experience of elapsed duration, and that the extent and nature of this influence varies depending on multiple factors, including the music's volume, tempo, modality, familiarity and harmonic variation.

The study aims to explore empirically the concept of musical time by examining the effects of varying structural factors within stimuli (e.g., increase / decrease in intensity or tempo), and affective 'set' of participants, on perceived duration. Results of two sets of empirical data will be discussed — a mobile phone ringtone experiment, and a waiting room scenario. The adequacy of existing models of temporal perception will be discussed in light of results, and possible new models proposed where appropriate.

Nostalgia-Inducing Music and Social Support Satisfaction

Brandon Paul; Ohio State University, USA

PO075, Poster

Recent empirical studies suggest that nostalgic emotions strengthen and extend a person's awareness of their own social bonds with friends, family, and loved ones. Often a reported emotion while listening to autobiographically-salient songs, nostalgia evoked by music may be able to demonstrate a similar social utility. A survey was conducted where participants identified songs that made them feel nostalgic. In addition, the ages of the participants were collected. From the information provided by the survey, the age of the participants at the date of release for the song was determined to be on average between 15 to 18 years. In a subsequent experiment, song stimuli were selected from this age range for participants 20-28 years of age. This experiment exposed a target group to nostalgia-inducing songs and then measured satisfaction with their present social support. A control group listened to songs that were not identified as nostalgic. Preliminary reports of social support satisfaction were shown to be inconclusive as research is still being conducted.

Musical Learning — Learning in the Choir: How Do the Singers in a Choir Cooperate and Learn Together and from Each Other?

Sverker Zadig; Örebro University, Sweden

PO080, Poster

My interest for this study is based on my experiences both as a choral singer and a conductor. I have noticed that in choirs and within the choral voices someone often functions as an informal leader — just by being the one in front musically — concerning attacks, intonation, phrasing and so on.

The thesis will consist of two separate studies.

The first part of the study is a series of interviews with long estab-

lished and internationally well known Swedish choral conductors about their experience of how singers in a choir cooperate and learn "together". Conductors are also chosen from Swedish gymnasium choirs.

I have found evidence or approval from the interviews of how choral conductors are convinced of the role of informal leaders in the voices. Many of the informants speak of leaders not only in attack and initiative but also how these singers, with their personal voice and timbre, gives color to the entire choral voice, or even to the whole choir.

The second study examines, by multi track recording of the individuals in choral voices, whether it is possible to graphically view differences in attacks and intonation and, also if it is possible to notice if someone is ahead and "pulling" others to follow.

A Computational Approach to the Modeling and Employment of Cognitive Units of Folk Song Melodies Using Audio Recordings

Peter van Kranenburg¹, George Tzanetakis²; ¹Meertens Institute, The Netherlands; ²University of Victoria, Canada

PO083, Poster

We present a method to classify audio recordings of folk songs into tune families. For this, we segment both the query recording and the recordings in the collection. The segments can be used to relate recordings to each other by evaluating the recurrence of similar melodic patterns. We compare a segmentation that results in what can be considered cognitive units to a segmentation into segments of fixed length. It appears that the use of 'cognitive' segments results in higher classification accuracy.

The MoMu Grid: Towards a Complementary Analysis of Movements and Music Elements During the Interactions Among Toddlers

Laura Ferrari¹, Anna Rita Addressi²; ¹Municipality of Bologna, Italy; ²University of Bologna, Italy

PO088, Poster

In recent years research on musical development underlines the presence of musicality in the vocal gestures especially, but not only, in the child/mother interactions (Stern 1985, Papoušek H. & Papoušek M. 1996, Trevarthen & Malloch 2000, Nakata & Trehub 2004, Imberty 2009). Instead the research on the movement analysis puts largely attention on the dance movements, the role of the body during the performance or on the rhythmic analysis, and the few studies on the movements of very young children are for therapeutic aims. The aim of the study, introduced in this paper, is to investigate the role of the body and voice in the early interactions among toddlers and the way used by them to communicate. A grid to analyze the correlation voice/movement was created using the Motor Laban theory: the MoMu Grid. To create the grid, we collected the video of the observations carried out with 15 children of 14 months old in two nursery schools in Bologna. The children were divided in 3 groups and they were free to move and play. All sessions were recorded with two cameras: one was steady, while the other was mobile. All data collected are analyzed using the MoMu grid: to observe the movements we used several elements of the Laban categories: energy, flow, spatial dimension, and especially the concept of "effort". To analyze the musical characteristics of vocal gestures (pitch, intensity, rhythm, etc) we used the grid created in our previous study to observe the used of the voice during the daily routine (Ferrari & Addressi 2009).

Listener Perceived Quality of Expensive and Inexpensive Cornets

Alastair C. Disley, Colin J. Batt; University of Kent, UK

PO093, Poster

Cornets are the lead instrument of the British brass band, but it is unclear whether the differences between expensive and inexpensive models can be perceived by trained listeners.

This experiment used seven cornets of different prices (\$350 to \$3250) in a listening test, where trained cornetists and musicians familiar with the cornet rated scales and short melodies in pairs. Results suggested that cheaper cornets were readily associated with a less preferred sound, but there was little perceptual difference between the more expensive models.

Multi-dimensional scaling suggests that the more expensive cornets have more in common than the inexpensive cornets. The difference between expensive and inexpensive cornets is likely to be greater than indicated here for less experienced performers, and other purchasing factors such as reliability have not been examined.

Effects of Visual Presentation on Aural Memory for Melodies

Nathan Buonviri; Temple University, USA

PO096, Poster

The purpose of this study was to determine how pitch and rhythm aspects of melodic memory are affected by aural distractions when melodic stimuli are presented both visually and aurally, as compared to aurally only. Participants were 41 undergraduate and graduate music majors. All participants completed experimental trials under each of four conditions, yielding 164 total observations. Trials consisted of target melodies, distraction melodies, and matched and unmatched answer choices. Target melodies were presented either aurally-only, or aurally with matching notation. The incorrect answer choice in each item contained either a pitch or rhythm discrepancy. A 2x2 ANOVA, by presentation format and answer discrepancy type, revealed no main effect of either variable or interaction between the variables. Results suggest that visual reinforcement of melodies, as presented in this study, does not improve aural memory for those melodies, in terms of either pitch or rhythm. Suggestions for further research include an aural-visual melodic memory test paired with a learning modalities survey, a longitudinal study of visual imagery applied to aural skills training, and a detailed survey of strategies used by successful and unsuccessful aural skills students.

The Effect of Melodic Contour on Infants' Auditory Attention

Lana J. Van Boven, Lynne A. Werner; University of Washington, USA

PO100, Poster

Psychophysical research suggests that infants' ability to attend selectively to sound is limited. However, infants' ability to attend selectively to music has not been examined. When listening to complex melodies, adults are known to attend selectively to accented notes. Contour accents occur on notes that highlight a shift in melodic contour, such as the pitch peak of a melody. The goal of this study was to determine whether infants and adults would attend selectively to the contour accent of a simple melody. Listeners heard a repeating 7-note melody with a distinct pitch peak, or contour accent, and detected pitch changes to a single note of the melody. The position of the changed note varied. Listeners also detected changes to singles notes of control melodies that did not feature a distinct contour accent. When listening to the melody with a contour accent, both adults and infants detected the change to the accent note more often than changes to other notes. When listening to the control melodies, both adults and infants detected changes similarly across note positions. These results suggest that both infants and adults attend selectively to the contour accent of simple melodies. The effects of melodic contour on infants' auditory attention are not surprising, given that the contour of speech is also known to influence infants' auditory attention. Thus, contour appears to be a prominent attention-directing cue from a young age. In addition, contour may facilitate the development of both language and music perception.

Altered Auditory Feedback, Self-Attribution, and the Experience of Agency in Sequence Production

Justin J. Couchman, Peter Q. Pfordresher; University at Buffalo, USA

PO103, Poster

Auditory feedback refers to the sounds one creates during sequence production. Alterations of auditory feedback (e.g., delayed auditory feedback) can disrupt production. However, it is not clear whether altered feedback actually functions as feedback. We addressed this issue by having participants rate the degree to which they experienced altered feedback as resulting from their actions (self-agency). In two experiments, participants performed short novel melodies from memory on a keyboard. Auditory feedback during performance could be manipulated with respect to its pitch contents and/or its synchrony with actions. Participants rated their experience of self-agency after each trial. In the first experiment, participants performed alone; in the second, the experimenter sometimes appeared to be playing. Altered feedback reduced the experience of agency, and was influenced by the relatedness of the feedback sequence to produced actions. Greatest disruption (error rate, slowing) occurred when feedback yielded an intermediate level of self-agency.

An Examination of Auditory Preferences and Aversions in Mice: Methods and Techniques

Matthew J. Davis¹, Trevor A. Bonsell², David A. Essig³; ¹Ohio State University, USA; ²Dayton Imaging Solutions, USA; ³Geneva College, USA

PO109, Poster

In the study of musical perception, human preferences are known to be influenced by a wide variety of phenomena, from aspects of the peripheral auditory system to a myriad of social and cultural factors. In order to extricate these factors it may be useful to find animal models, especially for untangling sociocultural aspects from physiological foundations. This study aims to determine the ability of mice to demonstrate preferences or aversions and so might serve as an inexpensive approach to understanding auditory preferences and aversions for higher mammals such as humans. To begin, we assembled a small sample of male and female mice of the C57BL/6 (C57) inbred strain. Several methods were tested in order to determine which system would be most useful. We assembled four different enclosures, each consisting of two different rooms using either infrared or vibration sensors to determine the location of the mouse. When the mouse moved to one side or the other, the sensors were triggered and information was sent to a computer that played the predetermined auditory stimuli and recorded how long and how often the mouse visited a particular side. Upon completion of our final test, we found that the mice spent 72% of the time listening to white noise, and only 28% of the time in silence. This preliminary data is consistent with the hypothesis that mice have the ability to behaviorally demonstrate auditory preferences and aversions.

Influences of Musical Certainty on Perceived Emotions and, vice versa, Influences of Musical Emotions on Certainty in Decision-Making

Renee Timmers, Marianna Philippou; University of Sheffield, UK

PO114, Poster

Several characteristics of music contribute to the perception of emotion in music, such as intensity, pitch range, mode and tempo. Also more abstract characteristics may contribute, such as the music's predictability and tonal stability. Instability and violations of expectations enhance emotional tension, while predictability enhances the experience of positive affect. In addition, these attributes may give rise to a sense of certainty or uncertainty in listeners that may transfer to a secondary task like decision-making. An experiment was designed to explore interactions between musical predictability, subjective certainty, decision-making and emotion. This was done by 1) testing the effect of musical predictability on perceived emotion, and 2) testing the effects of musical predictability and emotion

on decision-making in a secondary task. In a subjective rating experiment, musically trained and untrained participants listened to excerpts of classical music that were predictable and stable (taken from the theme of the symphony or sonata) or unstable and unpredictably (taken from the development section). Participants judged the emotional valence and arousal of each excerpt and made online decisions related to visually presented letters. Participants judged whether the letters had the same or different size and indicated the certainty of response. The results confirm the relationship between certainty and emotion in two ways — less predictable music is evaluated as more negative and arousing than predictable music, and participants make more errors and are more uncertain in their decisions when the music is less predictable. This latter effect is the case only for musically untrained participants.

Music Circle: A Means for Developing Social-Emotional Skills in 2nd Grade Students

Scott D. Lipscomb¹, Jenifer Josephson², Sara Lapp², Dee Lundell³, Larry Scripp³, Fred Sienkiewicz⁴; ¹University of Minnesota, USA; ²Minneapolis Public Schools, USA; ³Learning Through Music Consulting Group, USA; ⁴New England Conservatory, USA

PO118, Poster

This investigation represents a three-year series of studies assessing the efficacy of an innovative music-plus-music integration program. The Music Circle curriculum was developed collaboratively by a music therapist, a 2nd grade classroom specialist, and a music integration consultant. Developed for implementation at the 2nd grade level, this program involves a 45-minute meeting once per week, co-led by the music therapist and classroom teacher, during which students are introduced to musical terms & concepts, internalizing their meaning through a series of teacher demonstrations and participatory activities. The primary form of data collected is a district-mandated behavior screener, completed for each student three times per academic year. As a result of the success of this program in reducing behavior problems during previous years, the principal insisted that all 2nd grade classes participate. During year three (the current academic year), 2nd graders at a matched K-8 school that does not offer the Music Circle program served as a comparative school. Should the comparison with the matched school reveal a significant positive difference in the behavior of those students who participate in Music Circle, the results of this study hold great potential for teachers and second grade students, because, if less classroom time and energy must be focused on addressing behavior problems, the amount of instructional time is increased. In a time of high stakes testing, this affords the opportunity for more learning to take place in a safer and more structured classroom environment.

Perception of Musical Tension Among Senior Adult Musicians

Jeremy S. Lane; University of South Carolina, USA

PO122, Poster

The current project is the first part of a replication of a study published by Fredrickson (1997). Senior adults who were members of a local community band (N = 22) listened to the first movement of Haydn's Symphony No. 104. Participants recorded perception of musical tension using a Continuous Response Digital Interface (CRDI) dial. The investigator used Pearson correlations to analyze similarities and differences among responses for each participant (i.e. Participant 1 correlated to Participant 2, and so on for all 22 participants). The investigator also correlated each individual response to an overall group mean.

Results suggest remarkable consistency among senior adults in relation to how they perceived tension in this piece of music. These findings suggest that musical tension may be an aesthetic construct that is perceived commonly; the second part of this study will compare perception of tension between senior adult musicians and undergraduate music majors. Future projects will continue to investigate differences between varying groups of participants (i.e. senior musicians compared to senior non-musicians), as well as among varying styles of music such as jazz or ethnic folk music.

The Pedagogical Utility of Psychoacoustic Precepts in the Teaching of First-Year Music Theory

Hubert Ho; Northeastern University, USA

PO125, Poster

The purpose of this paper / poster is to argue for the pedagogical utility of incorporating basic psychoacoustic precepts in the development of a music theory curriculum. A first-year university music theory typically consists of topics such as diatonic harmony, melody, basic aspects of rhythm, and phrase structure. This paper will focus on rhetoric-perceptive conceptual pairs: 1) Counterpoint/Auditory Streaming, 2) Chord Progressions/ Schema Development and 3) Melodic-Harmonic Prolongational Patterns or Schenkerian hearing/Hierarchical Structure. A MAX/MSP interface serves as a toolkit for classroom use. It demonstrates touch interactivity and adaptability to student levels and needs. This particular paper will be directed towards psychoacousticians curious about the utility of their research in classroom settings, and also music educators seeking new approaches to helping students acquire stronger theoretical and ear-training skills. The results of a psychoacoustic approach to music theory pedagogy show that such an approach can be widely and easily adopted in the music theory classroom.

Pitch/Time Diversity Effects on Perception and Production

Jon B. Prince, Peter Q. Pfordresher; University at Buffalo, USA

PO128, Poster

The perception and production of complex musical sequences was tested, while varying either the number of major diatonic pitches or inter-onset intervals (IOIs), but not both. One group of participants rated the complexity of each sequence (perception). A second group reproduced each sequence on a keyboard and rated the difficulty of production (perception and production). For both dimensions, increasing the number of unique elements in the sequences led to greater perceived complexity, rated difficulty, repetitions, and lower production accuracy. Paradoxically, increases in the number of unique IOIs had a smaller influence on perceived complexity than increases in unique pitches, whereas the opposite effect was found in production. Potential explanations include a perception-action mismatch, and an inferior ability to differentiate between IOIs with increasing temporal complexity.

Communication and Rehearsal Strategies in Chamber Ensembles

Mirjam James; University of Cambridge, UK

PO136, Poster

In the present paper communication and rehearsal strategies of a string quartet and a male vocal ensemble are compared. Individual and joint rehearsals for a world premiere are filmed and all non-verbal and verbal contributions are coded to show the different communicational processes and team roles. Both ensembles show stable team roles which leads to focused rehearsals.

However, the amount of non-verbal visual communication was much higher during the string quartet rehearsals and led to shorter rehearsal time (43:49 min, with 70% playing time and 30% talking). For the vocal group three individual rehearsals were needed before meeting the string quartet for the first joint rehearsal. The first rehearsal of the vocal group lasted 52:02 min, with only 45% of the time singing. In contrast, the second rehearsal lasted 43:59 min with 78% of the time singing.

The main difference between the rehearsals was the use of instruments for communicative gestures such as conducting movements to indicate the complicated rhythms. For the string quartet, conducting is a regular feature for performances of contemporary music whereas the vocal ensemble employs a different communication style during performance.

The vocal ensemble almost exclusively responds to audio information: breathing, articulation, and sound of the voice. The string quartet on the contrary responds to visual information: gestures for start, end, and caesura, tempo and rhythm, and articulation.

Performance Micro-Gestures Related to Musical Expressiveness

Jin Hyun Kim¹, Michiel Demey², Dirk Moelants², Marc Leman²; ¹Freie Universität Berlin, Germany; ²Ghent University, Belgium

PO139, Poster

In the recent framework of embodiment in music research, the mechanisms of the action-perception cycle are regarded as a basis for music cognition and aesthetic musical experience. Our case study aimed at investigating these mechanisms related to a high-level process of experience of musical expressiveness. Three professional musicians — gamba player, clarinetist, and singer — were instructed to play two pieces which they have never played yet, but the style of which they are familiar with. Each of these pieces was played sight-reading, then again after 20 minutes practice. A starting point of our study was the assumption that professional musicians would experience their sight-reading performances as less expressive, compared to their final performances due to the different performance conditions concerning the coordination of auditory and motor processes as well as the interplay between interpretative and performative expressiveness, and each performer's micro-gestures preparing and closing musical passages would correspond to musical expressiveness experienced by her or him.

Based on the annotation of the high-speed video, performance micro-gestures preparing and closing musical passages were identified and the corresponding motion capture data were analyzed. Additionally, timing and dynamic changes in the audio were quantified. The musicians' self-reports on bodily and/or visceral reactions noticed during the ongoing processes of music performance and on experienced musical expressiveness, which were collected through post-experimental oral interviews, were taken into account to interpret the results of analyses of the motion capture data and the audio data. The results imply that musically relevant preparatory and retrospective micro-gestures that might be conceived of as perceptually guided actions embody musical expressiveness emerging during the ongoing processes of music performance, which is monitored or/and pre-reflectively felt by the performer.

Changes in the Perception of Space and Time While Listening to Music

Thomas Schäfer, Mario Smukalla, Manuela Berger; Chemnitz University of Technology, Germany

PO150, Poster

How does music shape our perception of space and time? Intense musical experiences or simply listening to ones favorite music can alter our ordinary state of consciousness. People feel strong emotions, chills, and peaks; they get lost in the music and may enter states of trance or ecstasy. These kinds of states are thought to be characterized by altered perception of space (PS) and time (PT). Whereas subjective reports about strong experiences while music listening indeed covered changes in PS and PT, there is no systematic research on the qualities of these phenomena. To approach this issue, in a qualitative study, 20 people were interviewed while re-experiencing an intense musical event. Regarding changes in PS, three categories were extracted: *disappearance*, *room perspective*, and *private room*. Regarding changes in PT, two categories were extracted: *disappearance* and *acceleration*. In a quantitative study, 30 participants were shown a picture or a film while listening to either their favorite music or unknown music. While listening to favorite music, the picture was perceived as smaller and less dynamic. The road trip shown in the film was judged as longer and additional eye tracking analyses revealed longer and fewer glances. Results implicate that changes of space and time perception are central experiences when people are captivated by music. Such altered states of perception may be a useful tool for people to cope with their daily thoughts and feelings, to enter their own "space", which can also provide a fruitful framework for music therapy.

Creative Structures or Structured Creativity — Examining Algorithmic Composition as a Pedagogical Tool

Peter Falthin¹, Palle Dahlstedt²; ¹Royal College of Music, Sweden; ²University of Gothenburg, Sweden

PO153, Poster

This empirical study aims to depict how composers develop and structure creative resources, aided by algorithmic methods and other means of structuring material and processes. The project is not meant to be conclusive, but rather to form a point of departure and raise questions for further theoretical and empirical study in the field. Implications for teaching and learning composition and for designing interactive musical tools are expected.

In specific, this paper concerns concept development within learning of music composition: if, how and to what extent this is comparable to that of language-based learning. The research project in progress sets out to study cognitive processes of composers working to integrate the outcome of composition algorithms, with the subjective compositional aim and *modus operandi*. However, in most cases the composer is also designer of the algorithm or at least of its specific application to the compositional problem. Consequently the strategies involved in designing and applying compositional algorithms need to be considered and discussed insofar that they too are part of the integration process.

The study at hand draws from research conducted in cultural-historical psychology, cognitive psychology and linguistic theory, concerning internalization, development of concepts and syntactic and semantic aspects of musical structures.

Archetypal Musical Patterns: What They Are, How to Find Them, and What They Tell Us

Benjamin Anderson, Richard Ashley; Northwestern University, USA

PO158, Poster

Music scholars often use the words archetype and schema interchangeably: both words describe a musical pattern learned from the experience of listening. These words, however, have quite different epistemological underpinnings. In the context of style analysis, Leonard B. Meyer describes an archetype as a pattern that is "stable over time" and that "may help to illuminate the nature of the changes that have occurred in the history of ... music." Schema, on the other hand, comes from a cognitive bent and Robert O. Gjerdingen defines it simply as a "mental representation." There may be merit in keeping these terms separate, with "schema" operating within a style and "archetype" transcending styles. This paper will first compare two Galant schemata — the Prinner and the Romanesca — with two analogous schemata from the vastly different music of Elton John — schemata that we have termed the Levon and the Chameleon. Then the style-specific features of these two pairs of structurally similar schemata will be removed to approximate the two metastylistic archetypes: the 4-3-2-1 stepwise bass descent archetype and the stepwise octave bass descent archetype. Finally, we will briefly explain how archetypes might be superordinate schemata abstracted from listening to diverse styles of music.

Effects of the Musical Period on the Pianist's Body Movement: Its Time-Series Relationships with Temporal Expressions

Haruka Shoda, Mayumi Adachi; Hokkaido University, Japan

PO164, Poster

Musical performers move as a part of their expressions. We previously investigated the time-series relationship between a pianist's postural change and the temporal variation by using Rachmaninoff (Shoda & Adachi, 2009a) and Romantic pieces (Shoda & Adachi, 2009b). In playing a slower piece, the pianist moved "before" a long tone in slower sections and "after" a long tone in faster sections. For a faster piece, the pianist moved in synchronization with the temporal manipulation. The purpose of the present study was to

examine whether the pianist's movement strategies would differ as a function of musical period. Six female piano-major undergraduates ($M = 21.5$, $SD = 1.64$ years old) performed four short pieces, selected from each of the four musical periods: Baroque, Classical, Romantic, and Modern. From their audio- and video-recordings, we measured the duration of an appropriate temporal unit and the degree of postural change per temporal unit for each performance. As a result, the aforementioned time-series correlation was shown only for the Romantic pieces. In playing the Baroque and the Modern pieces, the overall and the section tempi also determined whether the time lag became positive, zero, or negative. However, there found no specific relationships between the time lag and the performed tempo for the Classical pieces. A further study is necessary to verify factors determining the time lag between the temporal and the movement manipulations.

Training New Listeners for Music

*Aintzane Camara*¹, *Mercedes Albaina*²; ¹University of the Basque Country, Spain; ²musikene, Spain

PO167, Poster

Today, musical activities with the aim of introducing young people and adults to the world of music are becoming more important. In the Basque Country, symphony orchestras and many musical groups are engaged to the diffusion of music organizing concerts for all audiences. In this context, the present project suggested activities including live music with explanations of some aspects of music that appeared in the pieces that were performed. A program of three concerts was performed with the participation of students from higher-level music. This initiative was mainly directed to adult people ($N = 40-50$), with the intention to provide more information and knowledge to the listener for a better listening. The main objective of this project is intended to facilitate the hearing of music in a more active and aware, and compare the changes in the level of aural perception before and after concerts. Likewise, it aims to develop the adult listener's hearing for a greater enjoyment of music ($N = 40-50$ adults). The research method used is based on the analysis of data collected from questionnaires made on different elements of music: timbre, texture, articulation and musical form. Furthermore, from observation we have analyzed the attitude of listening to the audience during the concert and the questions asked at the end of the performance. The study shows that this kind of activities to introduce listener who has not had a close relationship with the music, gives musical experiences and promotes active participation that allows to enjoy more music.

Violin Performance Achievement and Language Literacy in Five- to Eight-Year Olds in Two Contrasting Settings

Lissa F. May, *Brenda Brenner*; *Indiana University, USA*

PO171, Poster

Research suggests that early music study may impact the development of cognitive skills necessary for reading. Several studies have found a correlation between music skills, phonological awareness, and reading development. Some research in this area is criticized for examining literacy of students who self-select music performance, or whose musical training does not begin early enough to effect the development of literacy skills. Many studies have examined listening activities rather than musical performance. The purposes of this study were to develop a reliable and valid measure of violin performance achievement for beginning violinists, and to investigate the relationships among sex, violin performance achievement, and literacy in five- to eight-year olds in two contrasting settings. Three judges rated 33 subjects using the researcher-created Violin Performance Achievement Measure (VPAM) producing an inter-rater reliability of $\alpha = .94$. Reading assessments for subjects were obtained through the school district. A moderate but significant correlation between literacy scores and violin achievement ($p = .44$, $p < .01$) was revealed among all subjects. Results showed a significant difference ($< .001$) between the means on the VPAM of subjects in the two settings, with subjects enrolled in a university-based string academy (self-selected) outperforming first-graders in a local elementary school (all-inclusive). The standard deviation for the self-selected

group was 16, compared to a standard deviation of 29 for the all-inclusive group. There were no significance differences between means on violin performance achievement or literacy scores by sex.

Tracking the Beat in Carter

Ève Poudrier; *Yale University, USA*

PO175, Poster

In Elliott Carter's music, the association of structural polyrhythms with different musical characters implies that polymeter serves a primarily rhetorical function. However, the characteristically irregular musical surface that results from the interaction of structural polyrhythms with other procedures such as metric modulation and written-out rubato challenges listeners' ability to perceive a clear or enduring meters. This paper posits that complexity of texture and elusiveness of beat can be fruitfully understood as a solution to the paradoxical nature of polymetric perception. By activating competing beat structures, the composer invites the listener to engage in a form of perceptual "play" in which specific cues are used to communicate pulse sensations from which the listeners' attention is subsequently deflected in order to prevent integration of simultaneous and contrasting rhythmic layers into a single metric framework.

The results of a beat-tracking study using source materials from Carter's 90+ for piano suggest that while musically-trained listeners can track an underlying beat despite surface irregularities, effective synchronization requires a certain level of expertise with 20th-century music. The results also confirm the previous findings that musicians' lower threshold for detecting pulse irregularity had no effect on pulse attribution (Madison & Merker 2002) and that listeners' ability to detect simple ratios separating non-consecutive events depend on first-order relationships (Demany & Semal 2002; Carson 2007). Finally, the tapping patterns of participants with higher synchronization rates also provide valuable information on the perceptual cues used by musicians for beat-finding and specific strategies successfully used by Carter to manipulate beat induction.

Are Musical Chills Really Caused by Endogenous Opioids? Examining Goldstein's 1980 Results

Mark S. Riggle; *Causal Aspects, USA*

PO178, Poster

An often cited conclusion that musical chills are mediated by endogenous opioids (endorphins) is based on an experiment that showed the opioid antagonist naloxone reduced the chills rate of music in some subjects. However, we find some experimental problems with its methods, results and conclusion. Dr. Goldstein's experiment with musical chills and naloxone used 10 subjects, all music chill responders, and found that 3 had significant chill reduction related to naloxone. He did not provide the result showing if the other 7 had any reduction at all, and the assumption would be that they had no reduction in chills. Naloxone is a highly competitive opioid antagonist, thus this result is odd if music chills are from endorphins. An experimental confound, not known in 1980, is endogenous opioids are partly responsible for natural relief from chronic pain. If the three subjects who showed chill reduction had chronic pain relieved by endorphins, then Naloxone would have restored the pain. The pain increase, which need not be perceptible, could influence the ability to experience chills. If 7 of 10 subjects had no reduction in chills, then the opposite conclusion, that chills do not arise from endorphins, could be made. We conclude the results of the 1980 music chills and Naloxone experiment should not be used to claim that musical chills are mediated by endogenous opioids.

Applying the Three Factor Model of Adolescent Music Listening to Examine the Use and Importance of Music to Singaporean Adolescents

Winnie W.H. Ng, *Samia R. Toukhsati*; *Monash University, Australia*

PO182, Poster

The aim of this study was to explore the use and importance of music to Singaporean adolescents by extending the three-factor model of

adolescent music listening (social identity, mood modulation and self-actualisation) from Western cultures to that of an Eastern culture. Participants were 290 adolescents (157 males, and 133 females; mean age = 13.59 ± 0.61) recruited from a multi-denomination and multi-racial secondary school in the Northern Zone of Singapore. The findings revealed that adolescents listened to an average of 3.29 (SD = 2.53) hours of music per day and used music for the purposes of mood modulation, self-actualisation and, less so, for social identity. Multiple regression analyses revealed that adolescents who used music for social identity purposes tended to listen to less music, and that self-actualisation was related to listening to music as a sole activity. The findings support the universality of music use by adolescents and indicate a high level of similarity between Eastern and Western music listening practices in adolescents.

A Randomised Controlled Trial Evaluating the Effects of Music and Animal-Assisted Therapies on Depression in Cognitively Intact Elderly Individuals

Jenny Patterson¹, Samia R. Toukhsati¹, Bruce Barber², Daniel O'Connor¹; ¹Monash University, Australia; ²National Aging Research Institute, Australia

PO187, Poster

Music Therapy (MT) and Animal-Assisted Activities (AAA) are commonly used in conjunction with conventional medicines in a number of clinical populations. However, evidence-based research to support the utility of MT and AAA as treatments for depression in the elderly is limited and much of the evidence to support their use is derived from non-experimental studies. Although these studies suggest that MT and AAA may be effective in treating depression, in the absence of comparison treatments and randomisation procedures, care must be taken against the over-interpretation of findings. The primary aim of this randomised controlled trial was to evaluate the efficacy of MT and AAA to reduce self-reported depressive symptomatology in cognitively-intact elderly individuals residing in Aged Care facilities. A secondary aim of this paper was to explore the neurophysiological mechanisms that may underpin any such observed effects of the alternative therapy interventions. To this end, an independent groups, nested design was employed whereby 15 Aged Care facilities in Melbourne, Victoria were randomly assigned to one of the three conditions: MT; AAA, or; a wait-list control group. 99 cognitively-intact (Mini Mental State ≥ 24) residents were then selected from these facilities to participate in the project. Twice weekly 45-minute treatment sessions were conducted in small groups (≤ 5), by registered therapists for a total of 4 weeks. Data examining the effect of the treatment interventions on self-report and objective measures of cognition and depressive symptoms will be presented.

Consonance/Dissonance — A Historical Perspective

Ludger Hofmann-Engl; Croydon Family Groups, UK

PO199, Poster

This paper looks at the various approaches as taken in order to understand the phenomenon of consonance/dissonance. While an early understanding of consonance/dissonance was based upon number ratios (Pythagoras), it became a question of resonance for Descartes. Subsequently, Euler attempted to formalize the ratio approach by classifying intervals into consonance/dissonance classes according to prime factors producing impressive results. Helmholtz then somewhat picked up on where Descartes had left considering a physical/acoustical model based on roughness. Inevitable, the issue became a psychological one during the late 19th century with Stumpf which ultimately resulted in a cognitive model as produced by Hofmann-Engl in 1990. This model has remained unchallenged during the last 2 decades and has been found of good validity in a number of contexts.

Body Music: When Dancing Drums

Christine Beckett; Concordia University, Canada

PO204, Poster

Music and dance, linked since prehistory, involve separate training in “western” culture, yet may share certain common creative features.

This research explored undergraduate musicians' and contemporary dancers' improvisations done in response to “openers”, i.e., 2 contrasted time-periods (3 drum hits, 2 distinct dance movements) in four-four metre, slow, medium or fast, for a total of 6 openers in each art. Participants (N=24) improvised after openers (presented in randomized order), were videotaped, and journaled their strategies.

Two of the dance openers involved sounds — feet-on-floor, hand-against-body — which were salient to participants. Resulting dance improvisations (n=48) included 897 deliberate sounds distributed across 81.3% of improvisations. Non-deliberate sounds were not counted. Feet-on-floor spurred tap-like floor-foot-thumping. Hand-against-body provoked slapping body parts, clapping two hands together, or on the floor, and vocalizations. Dances turned into musical drumming by the body. Sound in these dance openers had a compelling quality for 11 contemporary dancers and for 13 musicians with little or no dance training — with the specific sound, not the beat or metre, driving responses. Metricality varied significantly, with musicians metrical 38%, dancers 18%, of the time ($p < .01$). There was an order effect for musicians, who used sounds in 17% of improvisations after silent openers presented subsequently to sounding ones, compared to 0% previously. Musicians' journals stated that they “wanted to keep on using sound” in all subsequent work. Dancers, by contrast, used sound in 4% of improvisations before, and only 2% after the sounding openers, thus reverting to their training.

Spectral Pitch Distance and Microtonal Melodies

Andrew J. Milne¹, Anthony Precht¹, Robin Laney¹, David B. Sharp¹; ¹Open University, UK; ²Independent Researcher, USA

PO214, Poster

We present an experiment designed to test the effectiveness of *spectral pitch distance* at modeling the degree of “affinity” or “fit” of pairs of successively played tones or chords (spectral pitch distance is the cosine distance between salience-weighted, Gaussian-smoothed, pitch domain embeddings of spectral pitches — typically the first eight to ten partials of a tone). The results of a previously conducted experiment, which collected ratings of the perceived similarity and fit of root-position major and minor triads, suggest the model works well for pairs of triads in standard 12-tone equal temperament tunings.

The new experiment has been designed to test the effectiveness of spectral pitch distance at modeling the affinity of tones in microtonal melodies where the partials of the tones can be variably tempered between being perfectly harmonic and perfectly matched to the underlying microtonal tuning. The use of microtonal tunings helps to disambiguate innate perceptual (psychoacoustical) responses from learned (cultural) responses.

Participants are presented with a software synthesizer containing two unlabeled controls: one adjusts the precise tuning of the tones; the other adjusts the extent to which the spectrum is tempered to match the tuning (as set by the first control). A selection of microtonal melodies are played in different tunings, and the participants adjust one, or both, controls until they find a “sweet spot” at which the music sounds most “in-tune” and the notes best “fit” together. The results of these experiments will be presented and discussed.

Musicians on Stage — Towards a Typology of Stage Entrance Behavior in Violinists

Friedrich Platz, Reinhard Kopiez; Hanover University of Music & Drama, Germany

PO220, Poster

Musical performance is an audio-visual and social-communicative process between performer and listener. Evaluations of the performance are influenced by musical and non-musical factors especially. The majority of these factors can be classified under the term “performer characteristics”. Our interest is in revealing the relationship between the performer characteristics as perceived by the listener and the listener's mental attitude towards the performer. In context of an international violin competition all competitors (N = 27) were

recorded from three perspectives (long shot, side view, close-up). Subsequently, a new video was produced taking into account the relevant visual aspects only of each competitor's stage entrance. Second we developed an evaluation tool to measure the listener's visual perception of performer characteristics. Exploratory data analysis reveals a typology of stage entrance behavior. These types of stage behavior can lead to certain mental reactions and attitudes on the part of the audience and influence the listeners' ratings of musical performances.

Noise and Fidelity — Poles Apart? Noise as an Active Medium for Communicating Physical Traces of Music Makers

Sean Williams; University of Edinburgh, UK

PO225, Poster

I introduce an archaeological approach to understanding the different ways in which information can be transmitted by noise in recorded music, and challenge the idea that noise is the enemy of fidelity.

My methods are derived from my own creative music practice and from an "ecological approach" to listening and the idea of the "performance ecosystem" which both deal with the experience of listening to and making music in phenomenological terms.

I define three main layers in which noise can enter the chain between the initial idea and the listener, and explore some mechanisms by which noise can communicate details to the listener that accentuate fidelity. These layers are the Listening Situation, the Reproduction Stage, and the Production Environment, which are not always easily distinguishable from one another, and I provide some examples of music which actively deals with this as its subject matter, and thereby interrogates the listener's preconceived ideas on this subject.

Cadenza as Music Projection of Rhyme in Serbian Romantic Lied

Milena Petrovic; University of Arts Belgrade, Serbia

PO226, Poster

The form of improvised, non-written cadenza could correspond to principle of oral poetry tradition. During the 19th century the improvised cadenza disappeared and the oral tradition and its propagation was over resulting with the predominance of rhyme. Cadenza as the end of phrase, movement or composition could correspond to rhyme principle of verse ending which helps in verse memorization. Such hierarchical structure of cadenza and rhyme reflected in visual notation and their audio perception influenced some authors to consider rhyme as graphic or music issue. At the epoch when rudiments of polyphony originated we can find rudiments of rhyme. But, in the Ancient Greek poetry we can not find rhymes, as well as in the Ancient Greek music we can not hear harmony.

Rhyme is equivalent to music tonal center and corresponds to the central principle at the same way the focus of tonal harmony is presented by a basic chord. In Serbian Romantic Lied rhyme produces music repetitions in cadenzas, while patriotic words require semantic and harmonic relationship. Composers sometimes digress from regular word accentuation and meaning due to rigid meter of rhyme. Frequently, rhyme is settled in "question-answer" music relation, sometimes highlighted by different harmonies. Composers of late Romanticism settled rhyme in a modern harmonic language and oftenly disturbed strict metric rhyme in order to respect word accent and word meaning.

Noise Levels in NASM Accredited Schools of Music — Who's Responsible?

Kris Chesky; University of North Texas, USA

PO233, Poster

Sound level data were collected from ensemble based instructional activities (N=660) offered at the University of North Texas. Data show that 40% of these educational activities exceeded 100% allowable daily dose as defined by the National Institutes of Occupational Safety and Health (NIOSH). The data also show high degrees of variability of risk over time and high levels of predictability of risk due to

pedagogic factors. Thus, in order to prevent music-induced hearing disorders from ensemble-based activities, music educators/directors must understand music as a potentially harming agent and have the competency to manage risk when working in an educational or community context.

Unfortunately, the National Association of Schools of Music (NASM) does not acknowledge the need to prevent irreversible hearing disorders caused by excessive exposures generated during ensemble-based instructional activities. The NASM accreditation Handbook does not mention hearing loss, hearing conservation, tinnitus, music as a sound source capable of harm, or any other related topic. Similarly, it does not declare that an educated music professional should know about music as a potentially harming agent, the role of the educated musician or teacher in the prevention of music-induced hearing disorders, or the role of NASM member institutions in the prevention of risk due to exposures generated during instructional activities.

In early efforts to remedy this dilemma, consensus-based recommendations from health care experts were sent to NASM in 2006 (www.unt.edu/hpsm). Subsequent academic discussions, policy considerations, and research activities related to this problem were recently recognized through the national 2010 Safe in Sound Award (www.safeinsound.us). This acknowledgment has led to elevated concerns by various stakeholder groups including the American Academy of Audiology, National Hearing Conservation Association, National Institutes of Occupational Safety and Health, Center for Disease Control, and the Performing Arts Medicine Association. This poster session will characterize these activities along with social, educational, and technical advances designed to empower musicians, music educators, conductors, institutions, and other stakeholders.

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