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Conference Report: 9th Annual NeuroMusic Conference, Modeling the Musical Experience

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Abstract

The 9th Annual NeuroMusic Conference, *Modeling the Musical Experience*, was held at McMaster University (Hamilton, Ontario) on 23rd November 2013. The workshop was sponsored by the McMaster Institute for Music and the Mind (MIMM), a multi-disciplinary group comprised of scientists, musicians, composers, educators, and community members. The event was organized by Dr. Laurel Trainor and Dr. Steven Brown and coordinated by Dr. Rayna Friendly and Elaine Whiskin. David Gerry organized the music for the evening's keynote concert.

Over 130 attendees registered for this year's conference. The day included three lectures covering a broad range of topics in music cognition and perception. A *panel discussion* gave audience members the opportunity to pose their questions to the speakers as well as to the evening's keynote lecturer. The *poster session* offered a snapshot of 20 undergraduate and graduate students' ongoing work. Interested attendees took a tour of the new Large Interactive Virtual Environment (LIVE) Lab at McMaster University. The day concluded with an integrative keynote lecture and concert.

Dr. Edward Large, University of Connecticut

Neurodynamics of music perception

Dr. Edward Large started the day by proposing a neurological origin for systems of musical tonality based in nonlinear oscillatory neurodynamics. Large pointed out that though tonal systems differ somewhat across cultures, many (such as conventional Western tonality and North Indian *Raga* tonality) overlap considerably in their pitch structures. Large suggested that universal aspects of the “qualia” associated with musical intervals can be captured in a dynamical systems analysis of mode locking, and that such a model is biologically plausible. Large noted that perceived musical stability is often thought to emerge as a result of experiential statistical learning, but suggested that the opposite may be true – that the inherent stability of certain intervals leads to their statistical frequency in the musical literature. His goal is to develop a theory of universal grammatical structure in music.

Dr. Stephen McAdams, McGill University

Towards a psychological foundation for a theory of orchestration

While there are many *treatises* on orchestration, Dr. Stephen McAdams noted that, as of yet, there exists no true *theory* of orchestration and that timbre remains largely unstudied, despite its crucial role in orchestration. Traditional music theorists often reject the possibility of rigorous academic study of timbre, but McAdams' lecture defied this perspective. He presented data from a number of experiments on timbre perception, often utilizing a multi-dimensional approach. He argued that an understanding of orchestration will rest on basic principles of auditory scene analysis, including event perception, sound identification, stream formation, and large unit perception. Through data presentations and audience demonstrations, McAdams showed that timbre plays a number of roles in the musical experience. For example, combining different instruments can lead to new blended timbres. Perhaps most interestingly, McAdams clearly showed how timbres can imply musical structure and indicate musical gesture. He also demonstrated the Digital Orchestra Simulator (DOSIM), a computer-aided orchestral rendering system that can be used to manipulate specific variables in orchestral performance. This tool will greatly enhance the ability to conduct tests of timbre perception and orchestration to generate a true theory of orchestration.

Dr. Peter Keller, University of Western Sydney

Interpersonal coordination in musical ensembles: Psychological processes and brain mechanisms

Dr. Peter Keller's talk departed from consideration of the listener's experience and focused instead on synchrony between co-performers. Musical synchronization requires that performers

predict the timing of the next beat in a musical composition, as well as that they predict and adjust to the timing of their co-performers. Keller tested synchronization abilities with live co-performers and computer simulations in both musical and non-musical contexts to determine how synchrony is achieved. He presented evidence that synchronization strategies vary across individuals, and that some are poorer coordinators than others. He further showed that differences in synchronization strategies could be linked to differences in general personality traits like locus of control. Combined evidence from Keller's perceptual studies, EEG, and TMS suggests that performers must be adaptive to synchronize well. Being too adaptive, however, can actually impede performers' synchronization. Keller's points were highlighted by interesting and sometimes contradictory quotations from members of the Chicago Symphony Brass. His presentation suggested that many factors, from auditory and motor imagery to experience with co-performers to personality traits, affect interpersonal synchrony.

Dr. Peter Pfordresher, University at Buffalo

A mind for singing

Why is it that some of us are natural songbirds while others of us can't seem to carry a tune? Dr. Peter Pfordresher shared some of his and his colleagues' work, which explores the origins of poor-pitch singers' difficulties. One possibility is that poor-pitch singing is a result of errors in auditory representations. Pfordresher provided evidence that the clarity of one's auditory representations, even those that are non-musical, may be associated with their ability to vocally match pitch. Even those with strong auditory imagery, however, may have difficulty generating those pitches themselves. For some people, singing problems may lie in the motor system or in coordinating the auditory and motor systems. After investigating problems that potential singers

might encounter, Pfordresher looked to the question of how a person's singing might be improved. He suggested that the vast improvement in singing ability that is seen over one year in kindergarteners suggests that experience plays a large role in becoming a good singer. Although there is clearly social stigma attached to unpleasant singing, Pfordresher believes that, given the enormous perceptual and motor challenges in singing, we should be in awe that we can sing as well as we can!

Pfordresher's talk was illustrated by a variety of impressive musical interludes. Dr. Andrea Halpern performed Mozart's *Dove Sono* (from "*The Marriage of Figaro*"). The McMaster University Chamber Choir, directed by Rachel Rensink-Hoff, exemplified interpersonal synchrony with pieces like Jeff Enns' composition *O Magnum Mysterium*, as well as leading the audience in an interactive synchronization activity. Guest performer Leslie Fagan, accompanied by pianist Larisa Gulenco, demonstrated with apparent ease many of the aspects of singing that would be challenging for the majority of us. Among her performances were Saint-Saëns' *The Nightingale and the Rose* and an explosive rendition of Verdi's *Sempre Libera* (from "*La Traviata*"). The combination lecture-concert was a unique and impactful experience for all who attended.

Tour of the LIVE Lab

Attendees had the additional opportunity to tour the new Large Interactive Virtual Environment (LIVE) Lab, which will open officially in September 2014. The LIVE Lab is unique in the world, with the capability to record EEG, physiological responses (e.g., heart rate, breathing rate, skin

responses) and movements (using motion capture) of audience members and performers in real-time. Its dense array of speakers and microphones will allow researchers to manipulate the virtual acoustics of the room. The LIVE Lab will enable many of the research questions discussed throughout the day to be explored empirically.

Conclusions

The NeuroMusic Conference brought together over 100 researchers, many of whom are tackling similar questions from different viewpoints. Speakers and student presenters covered topics ranging from basic auditory processes to complex social interactions. Despite this variety of topics, several themes, such as the origins of tonality and interpersonal synchrony, emerged throughout the day. This conference served as a reminder that many of our research questions can be asked from multiple perspectives, and that researchers across disciplines have much to offer towards our understanding of music perception and cognition.