Session 5aMU

Musical Acoustics and Psychological and Physiological Acoustics: Neurophysiology of Playing a Musical Instrument

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Chair's Introduction—9:00

Invited Papers

9:05

5aMU1. Movement amplitude and tempo change in piano performance. Caroline Palmer (Dept. of Psychol., McGill Univ., 1205 Dr. Penfield Ave., Montreal, QC H3A 1B1, Canada, caroline.palmer@mcgill.ca) and Simone Dalla Bella (Kazimierz Wielki Univ., Bydgoszcz, 85–867 Poland)

Music performance places stringent temporal and cognitive demands on individuals that should yield large speed/accuracy tradeoffs. Skilled piano performance, however, shows consistently high accuracy across a wide variety of rates. Movement amplitude may affect the speed/accuracy tradeoff, so that high accuracy can be obtained even at very fast tempi. The contribution of movement amplitude changes in rate (tempo) is investigated with motion capture. Cameras recorded pianists with passive markers on hands and fingers, who performed on an electronic (MIDI) keyboard. Pianists performed short melodies at faster and faster tempi until they made errors (altering the speed/accuracy function). Variability of finger movements in the three motion planes indicated most change in the plane perpendicular to the keyboard across tempi. Surprisingly, peak amplitudes of motion before striking the keys increased as tempo increased. Increased movement amplitudes at faster rates may reduce or compensate for speed/accuracy tradeoffs. [Work supported by Canada Research Chairs program, HIMH R01 45764.]

9:25

5aMU2. Physiology, anatomy, and plasticity of the cerebral cortex in relation to musical instrument performance. Mark Jude Tramo (Dept. of Neurol., Harvard Med. School and Massachusetts General Hospital and the Inst. for Music and Brain Sci., Boston, MA 02114-2696, mtramo@hms.harvard.edu)

The acquisition and maintenance of fine-motor skills underlying musical instrument performance rely on the development, integration, and plasticity of neural systems localized within specific subregions of the cerebral cortex. Cortical representations of a motor sequence, such as a sequence of finger movements along the keys of a saxophone, take shape before the figure sequence occurs. The temporal pattern and spatial coordinates are computed by networks of neurons before and during the movements. When a finger sequence is practiced over and over, performance gets faster and more accurate, probably because cortical neurons generating the sequence increase in spatial extent, their electrical discharges become more synchronous, or both. By combining experimental methods such as single- and multi-neuron recordings, focal stimulation, microanatomical tracers, gross morphometry, evoked potentials, and functional imaging in humans and nonhuman primates, neuroscientists are gaining insights into the cortical physiology, anatomy, and plasticity of musical instrument performance.

9:45

5aMU3. Speed, accuracy, and stability of laryngeal movement in singing. Ingo R. Titze (Dept. of Speech Pathol. and Audiol., Univ. of Iowa, Iowa City, IA 52242 and Natl. Ctr. for Voice and Speech, Denver Ctr. for the Performing Arts, Denver, CO 80204, ititze@dcpa.org)

Motor performance is often quantified in terms of speed, strength, accuracy, and stability of a target gesture, or maintaining a given posture. In the vocal system, this involves primarily the intrinsic laryngeal muscles and the respiratory muscles. Agonist–antagonist pairs of muscles are used to position the vocal folds for phonation (vocal onset), for pitch change, and for registration (as in yodeling). Maximum speed and accuracy are discussed for vocal embellishments such as trills, trillo, scales, arpeggios, yodel, and glissando. This speed and accuracy are interpreted in terms of muscle twitch and tetanic responses obtained *in vitro* on animal muscles, from electromyographic recordings on humans, and from muscles not easily tested on humans. The laryngeal reflex system is also described, particularly with regard to its ability to stabilize (or destabilize) neurologic tremor originating from the central nervous system.