Abstracts from the Literature

William J. Dawson, M.D.

Andrade PE, Bhattacharya J: Brain tuned to music. *J Roy Soc Med* 2003;96:284–287.

The authors present a concise and thoroughly documented review of the mechanisms by which music is processed by the brain. Beginning with the suggestion that human auditory pathways are hard-wired to deal with music-related stimuli, they describe potential benefits of studying music perception, including obtaining insights into the functional organization of the auditory cortex and leading to greater understanding of higher brain function. The first studies of cortical localization of music were based on people with congenital or acquired amusia, or tone deafness. Melodic and temporal perception require local and global auditory information processing, with temporal music structures primarily processed in the left hemisphere. Electrophysiologic and imaging studies have proved rewarding in revealing functions in normal subjects. From imaging, we have learned of the right hemisphere specialization for perception and working memory for pitch and the left hemisphere specialization for rhythm and processing of melody recognition and identification. On the debated topic of possible difference in cerebral asymmetry between musicians and nonmusicians, the authors review many of the seminal findings and studies that confirm the presence of such a difference. The extensive bibliography, consisting of 55 references that serve as the core of neurobiologic studies in music, may be the most useful part of the entire article.

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Nolan L, Kerrigan DC: Keep on your toes: gait initiation from toe-standing. *J Biomech* 2003;36:393–401.

Gait initiation from the toe-standing position is common in able-bodied subjects during certain dance (demi-pointe) and athletic situations and in patients with upper motor neuron pathology. The aim of this study was to compare the biomechanics of gait initiation from toe-standing to that from heel-toe (flat foot) standing in healthy, able-bodied subjects. Data were collected from 3 seconds before, and 3 seconds after a visual signal to initiate gait. Ground reaction force and center of pressure (COP) data were collected with a force platform, whereas electromyographic and kinematic data were collected from each limb with a Vicon motion analysis system. When initiating gait from toe-standing, there was a smaller backward displacement of COP compared with heel-toe standing. In addition, greater forward momentum was generated, and there was an increase in muscle activity in the gastrocnemius, rectus femoris, and biceps femoris. There were no differences in COP displacement or momentum generated in the mediolateral direction for the two conditions. Initiating gait from toe-standing allows one to generate greater amounts of forward momentum, but not at the expense of generating excessive side-stance momentum. This may be an advantageous technique for initiating movement in dancers and certain athletes in certain situations. This work also suggests that balance problems in patients with upper motor neuron pathology are likely due to the underlying pathology and not from initiating gait from toe-standing.

Heijink H, Meulenbroek RGJ: On the complexity of classical guitar playing: functional adaptations to task constraints. *J Motor Behav* 2002;34:339–351.

The authors performed a behavioral study of the complexity of left-hand finger movements in classical guitar playing. Six professional guitarists played movement sequences (scales) in a fixed tempo. Left-hand finger movements were recorded in three dimensions, and the guitar sound was recorded synchronously. Assuming that skilled performers prefer to avoid extreme joint angles when moving, the authors hypothesized three biomechanical complexity factors: (1) the position of the left hand on the guitar neck, with positions at either extreme of the neck presumed to be the most complex; (2) finger span, where a large span is assumed to be complex; and (3) hand repositioning with note sequences. The results showed differential effects of the complexity factors on the performance measures and on the participants' judgments of complexity by means of a posttest. Neither the hand-repositioning factor nor the finger-span factor had any effect on left-hand asynchrony during the playing test or on the variability of left-hand timing. Left-hand finger placement was affected significantly by hand repositioning and in finger span variation. The results showed that keeping the finger joints in the middle of their range is an important principle in guitar playing, and players exploit the available tolerance in timing and placement of the left-hand fingers to control the variability of acoustic output. Controlling and exploiting redundancy are important parts of classical guitar playing, and it is not surprising that players take many years of diligent study to attain a technical level that allows them to do so.

Heman-Ackah YD, Sataloff RT: Who takes care of voice problems? s guide to voice care providers. *J Singing* 2002;59:139–146.

Voice care has evolved into a sophisticated, well-organized medical science. Patients with voice disorders are served best by a comprehensive voice team that coordinates the skills of professionals trained in various disciplines. It is important for health care professionals to assemble interdisciplinary teams and to affiliate with arts medicine specialists and other disciplines to provide comprehensive care for voice patients. It also is important for patients to be educated about the kind of health care that is now available for voice disorders and how to evaluate and select health care providers. This article addresses the latter concern and provides the vocal musician and the vocal teacher with details of definitions, training, and scope of practice for all members of this comprehensive voice team. There is even a separation of voice specialists into two groups: those who work with singers and those who deal with the acting voice. Expectedly, otolaryngologists are described in greatest detail, but a wide range of other medical specialties are discussed, in addition to other practitioners of traditional and nontraditional forms of medical care. The authors conclude with a list of common questions and their answers, providing further usefulness to individuals with voice problems. This article should be required reading for all serious voice students, performers, teachers, and artistic administrators.

Sluming V, Barrick T, Howard M, et al: Voxel-based morphometry reveals increased gray matter density in Broca's area in male symphony orchestra musicians. *Neuroimage* 2002;17:1613–1622.

Broca's area is a major neuroanatomic substrate for spoken language and various musically relevant abilities, including visuospatial and audiospatial localization. Sight-reading is a musician-specific visuospatial task, and spatial ability is known to be amenable to training effects. Musicians have been reported to perform significantly better than nonmusicians on spatial ability tests, which the authors' work supports. Using the hypothesis that use-dependent adaptation would lead to increased gray matter density in Broca's area in musicians, the authors examined 26 adult male symphony instrumentalists and 26 male nonmusician controls matched for IQ and handedness. Voxel-based morphometry (VBM) was applied to high-definition, three-dimensional magnetic resonance brain images. VBM with small volume correction revealed a significant region of increased gray matter in Broca's area in the left inferior frontal gyrus in musicians. Significant age-related volume reductions in cerebral hemispheres, left inferior frontal gyrus, and bilateral dorsolateral prefrontal cortex subfields were found in nonmusicians but not in musicians. There was a positive correlation between years of playing and the volume of gray matter in a significant region identified by VBM in musicians younger than 50 years old. The authors suggest that orchestral music performance promotes use-dependent retention, and possibly expansion, of gray matter involving Broca's area. They propose that musical performance is an environmentally enriching activity which, at least in part, mitigates age-related brain atrophy.

Harley YXR, Gibson AStC, Harley EH, et al: Quadriceps strength and jumping efficiency in dancers. *J Dance Med Sci* 2002;6:87–94.

To investigate quadriceps muscle strength and electromyographic (EMG) activity during isometric and stretch-shortening cycle activity in dancers, the authors measured body composition, flexibility, isometric quadriceps muscle force output, and EMG activity during isometric and stretch-shortening cycle activity. Eleven female dancers and 11 physically active controls were evaluated. The dancers had significantly less body fat and were significantly more flexible in the straight-leg raise, ankle plantar flexion and dorsiflexion, elbow flexion and extension, and sit-and-reach tests than the controls. The dancers also generated significantly greater quadriceps force output during a 5-second maximal voluntary isometric contraction, but they did not jump significantly higher than the controls. The dancers generated similar force output to the controls but with less relative EMG activity during the squat, counter-movement, and drop jumps. They used less of their maximum EMG during the jump tests and less of their maximal possible muscle recruitment when jumping than the controls. This may be due to the dancers subconsciously sacrificing their jump height for esthetics, to training-induced differences in whole-limb muscle recruitment patterns, or to training-induced or genetic differences in the elastic components of the dancers' lower limb musculotendinous tissues compared with those of the controls. A practical recommendation for dance teachers and dance conditioning specialists might be to address the issue of jump height versus esthetics. If dancers practiced exercises simply to increase jump height and gain greater understating in how to elevate themselves, they could bring correct dance technique back into the movements while trying to preserve as much jump height as possible.

Ebert D, Hefter H, Binkofski F, Freund H-J: Coordination between breathing and mental grouping of pianistic finger movements. *Percept Mot Skills* 2002;95:339–353.

Six pianists, age 22 to 43 years, performed a simple finger exercise at a spontaneously chosen most comfortable tempo. Five versions of the exercise, notated in quarter notes, were presented with different types of meters: 3/4, 4/4, 5/4, 6/4, and 7/4. The onsets of finger strokes were measured while respiration was recorded in parallel by means of a thermistor placed in front of a nostril. The chosen tempo or finger-beat rate was about 3 Hz on all trials, but not exactly constant. Correspondingly the meter-rate chosen was faster for 3/4 and 4/4 meter (around 1 Hz) and slower for 5/4, 6/4, and 7/4 meter (around 0.5 Hz). Mean breathing rate while playing the piano was higher than while resting. Individual data revealed integer ratios between instantaneous meter and breathing rates. Musicians playing the same piece of music with different meters grouped the finger movements according to the different meters and entrained their breathing with the movements. For individual pianists playing particular meters, clear coordination was observed between the first stroke in a meter and inspiration. The authors believe the mental effort necessary for timing the pattern of the rhythmical pianistic finger movements entrains the neuronal network, which generates the breathing rhythm. The mental process of grouping the same piece of music by various meters interacts and coordinates with unconscious breathing rhythm.