

BOOK REVIEWS

Music, motor control and the brain, edited by Eckart Altenmüller, Mario Wiesendanger and Jürg Kesselring, Oxford, Oxford University Press, 2006, 344 pp., £75 (hardback), ISBN 0-19-853000 5; £35 (paperback), ISBN 0-19-929872-6

In the past few decades, especially since the publication of Critchley and Henson's *Music and the Brain* (1977), neuroscience research has greatly expanded our knowledge of how the human brain works when listening to, performing, composing and improvising music. This has been aided by the development of neuropsychological and brain imaging techniques used for the diagnosis of different disorders that affect the limbic system of musicians.

Music, Motor Control and the Brain, an adeptly edited collection of 20 papers, mostly from the *Music, Motor Control and Brain Symposium* (Monte Verità, Switzerland, 2002), provides fresh insights into the relationship between performing music and the ways it elicits sensorimotor reactions and activates neural mechanisms in the performer's brain.

Part 1 (*History*) discusses the dramatic development in performance skills and virtuosity, training and specialisation, playing techniques, instrumental capabilities and complexity of the repertoires in the Western art music world (Lehmann). Lehmann notes that in former times variability in performance was acceptable, whereas nowadays elite performers have to spend more time in preparing for a concert, given that 'present-day audiences expect musicians to entertain them with performances of reproducible quality' (7).

As in sport, motor skills and technical mastery in music performance have increased over time. An interesting point is that nowadays highly skilled performers' professional specialisation on a single instrument starts earlier in life and they practise 'at the limit of what is possible (often beyond!)' (11). In addition, performance students are introduced to difficult playing techniques and complex pieces at earlier levels of music instruction, while empirical evidence shows that 'recent piano prodigies have been more advanced in their performance skills than prodigies of earlier times' (17).

Part 2 (*Psychology*) features three chapters on the relationship between performers' musical skills and non-musical cognitions, and the coordination of performers' rhythmic movements with the rhythmic structure of the music being performed. Jäncke reviews empirical evidence suggesting that musicians outperform non-musicians both in the perception of pitch, timbre, and timing, and the recognition of familiar melodies. Differences found between the eye-hand span (the distance between the note being looked at in the score and the note being played) of skilled pianists and less skilled pianists show that it would be worthwhile to study further the motor side of this sensorimotor process in order to understand the underpinnings of virtuosity in music performance. Furthermore, electrophysiological investigations of professional musicians indicate that skilled performers can control more complex movements with less effort. Jäncke's final suggestion that

‘active musical performance’ is more likely to enhance IQ than the ‘passive hearing of musical pieces’ (35) is worthy of careful examination and debate, especially among music education theorists and researchers.

Palmer reviews the literature about the nature of memory for motor aspects of piano performance, such as finger and hand movements. She asserts that performers appear to be flexible when applying motor movements encoded in memory to different performance situations. However, motor and melodic information transfer independently, while mental practice facilitates the learning of unfamiliar music. She also describes how recent technological advances in optoelectronic systems allow us to measure anticipatory behaviour in piano performance.

The final chapter (Repp) in this part reviews research on different issues of sensorimotor synchronisation (e.g. tapping to the beat of music and playing music in an ensemble). Here Repp distinguishes between ‘internal processes’ (60) available to the central nervous system of a subject (e.g. a flexible internal timekeeper) and externally observable variables (e.g. the inter-tap interval (ITI) and asymmetries between a tap and a metronome beat) which are affected by these internal processes. It should be noted, however, that the author does not include recent evidence with regard to the exact properties of the internal processing of temporal information in the brain for a better understanding of the physiological function of the alleged internal timekeeper while performing music.

Part 3 (*Movement Analysis*) reviews the current state of research on motor control of music performers, in general (Jerde et al.), and in pianists (Jabusch), violinists (Wiesendanger, Baader and Kazennikov) and drummers (Dahl), in particular. Co-articulation (or the way individual movements of a movement sequence that correspond to a specific note might be adjusted for stylistic effect, depending on which notes precede or follow) plays a significant role in motor control. Jerde et al. note: ‘In this sense, musical performance is very similar to speech: the low level selection of movements must become an automatic process so that it does not interfere with conveying the meaning’ (87). Nevertheless, this section is lacking on studies that investigate the expressiveness of musician’s body movements in performance by means of some more intrinsically musical performance tasks beyond tapping and/or playing rudimentary melodies, scales and rhythmic patterns.

Part 4 (*Representation in the Brain*) includes seven chapters that explore research approaches to brain plasticity elicited by motor skills in music performance studied by means of advanced brain imaging methods. Plasticity refers to the brain’s ability to adapt to external experiences by continuously creating new neural networks. Schlaug demonstrates that musical training is related to functional and structural alterations in the brain as a result of brain plasticity. Studies demonstrate that fine motor and auditory discrimination skills of five–seven-year-old children significantly improve after one year of musical instruction, while three or four years of instruction lead to the acquisition of larger brain volumes and better scores on vocabulary, phonemic awareness and maths tests. Jäncke, who investigates the specific structural and functional changes of the brain of pianists and string players, concludes that ‘early and/or intensive musical training are the main variables determining the strength and impact of the reorganization of the motor system’ (169).

The next two chapters examine the network of the different brain areas activated during musical performance, performance imagery and preparation for performance

of pianists (Bangert) and string players (Nirkko and Kristeva). The authors highlight the importance of Broca's and Wernicke's areas of the brain, responsible not only for the production of speech and language but also for the production of music.

Ackermann, Wildgruber and Riecker relate the brain areas activated by singing to those activated by speech production, suggesting the dominance of the right hemisphere in singing and the left in speech production. Studies show that singing has weaker lateralisation effects in relation to speech production, with better possibilities for recovery of singing capabilities in the case of brain damage. Gordon, Racette and Schön investigate the relationship between musical and linguistic processing by focusing on their coupling in song, although findings of studies that examine whether language and music are processed interactively or independently are controversial. The last chapter of this section (Gerloff and Hummel) explores the neural correlates of motor inhibition or suppression of individual finger movements of a learned movement sequence using an MRI-compatible custom-made keyboard and visual stimuli to prompt subjects to make a movement (activation condition) or not to make it (inhibition condition). The authors strongly believe that further research on this aspect of motor control may lead to a better understanding of neurological diseases that exhibit loss of voluntary motor control of extensively trained movements, such as focal dystonia of music performers.

Part 5 (*Apollo's Curse – The Loss of Motor Control in Musicians*) is devoted to focal dystonia (four chapters) and to anxiety in music performance (one chapter). Based on new medical evidence, Altenmüller identifies the problem of Schumann's right hand that appears to have contributed to the ending of his career as a pianist, leading him to focus on composing.

Risk factors for developing focal dystonia include excessive practice, complexity of movements, high degree of spatial and temporal sensorimotor precision, personality traits of perfectionism and a tendency for anxiety, and heightened social expectations associated with musical performance (Jabusch and Altenmüller). Instrumental music students who encounter such medical problems are encouraged to abandon any performing career plans, since there is no cure for focal dystonia at present. It is also recommended that performers should check their possible predisposition to focal dystonia, in order to modify their training habits (Rosenkranz).

It is interesting to mention that studies on neural changes in inhibitory circuits or/and in sensorimotor integration that hinder the function of brain regulatory mechanisms were conducted on monkeys which developed focal hand dystonia (Byl and Priori). Rehabilitation methods, such as constraints with splints of the affected limb, rest or immobilization and tasks involving learning-based sensorimotor training, helped them show significant improvement.

With regard to music performance anxiety, a 'special form of emotional behaviour' (309) that affects a large part of amateur and professional performers, Kesselring acknowledges the musician's personal attitude towards his/her performance and the emerging emotions of shame, anger and distractibility resulting from lack of concentration as the basis of the problem. The treatment strategies he recommends incorporate positive self-talk and assignment of precise goals, as well as repeated mental practice and rehearsals.

On a more critical note concerning the volume's content, there is a lack of attention to the interaction of emotions, motor skills, musical structure and listener's

experience in music performance. More could also have been written about motor skills and music performance with other instruments (e.g. wind instruments) as well as in cultures besides that of the Western art music world. In addition, supplementary images depicting anatomical areas of the brain would help the unfamiliar reader to better comprehend neurophysiological terms. Notwithstanding these shortcomings, the volume encourages a broader understanding of the way the human body participates in acts of music performance and how the knowledge-acquiring system of the brain is involved in this process.

Reference

Critchley, M., and R.A. Henson, eds. 1977. *Music and the brain: Studies in the neurology of music*. London: Heinemann.

Eleni Lapidaki

*Department of Music Studies, Aristotle University of Thessaloniki,
Thessaloniki, Greece*

Email: lapidaki@mus.auth.gr

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Kyriaki Zacharopoulou

*Department of Music Studies, Aristotle University of Thessaloniki,
Thessaloniki, Greece*

Email: kyriakiz@mus.auth.gr

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Review 1

Music has a hallowed place in British culture. This is naturally reflected in the National Curriculum, where music is compulsory for all children up to the age of 14.

Yet schools are increasingly hearing negative messages about music from Muslim pupils and their parents, who believe that in Islam music is suspect.

Where does this belief stem from? Is it in fact true? What should schools do about it? Teachers, headteachers and school governors seeking answers to these questions will find this balanced and detailed study a great help. It is particularly valuable because it is presented largely in the words of Muslims themselves, including a strong representation of women's voices.

Many Muslims do in fact place a high value on music; indeed Islam has a rich tradition of both devotional and secular music. But some have always seen it as a threat. This stems from suspicion of the 'sensuous' aspects of life: enjoying music is seen as the first step on a path of indulgence that will lead inexorably to depravity and crime.