Ann. N.Y. Acad. Sci. ISSN 0077-8923

ANNALS OF THE NEW YORK ACADEMY OF SCIENCES
Issue: *The Neurosciences and Music IV: Learning and Memory*

Making music in a group: synchronization and shared experience

Katie Overy

Institute for Music in Human and Social Development, Reid School of Music, University of Edinburgh, Edinburgh, United Kingdom

Address for correspondence: Katie Overy, IMHSD, Reid School of Music, University of Edinburgh, Alison House, 12 Nicolson Square, Edinburgh EH8 9DF, United Kingdom. k.overy@ed.ac.uk

To consider the full impact of musical learning on the brain, it is important to study the nature of everyday, non-expert forms of musical behavior alongside expert instrumental training. Such informal forms of music making tend to include social interaction, synchronization, body movements, and positive shared experiences. Here, I propose that when designing music intervention programs for scientific purposes, such features may have advantages over instrumental training, depending on the specific research aims, contexts, and measures. With reference to a selection of classroom approaches to music education and to the shared affective motion experience (SAME) model of emotional responses to music, I conclude that group learning may be particularly valuable in music pedagogy.

Keywords: music; pedagogy; group learning; social; synchronization; shared experience

Musical behavior is a fundamental part of human experience and especially important during childhood, when lullabies, nursery rhymes, and action songs provide rich and enjoyable forms of social interaction and play.[1] Educators have often suggested that musical learning during childhood can have a positive impact in other learning domains, from the high academic performance found in Hungarian singing schools in the 1960s,[2] to Swanwick's influential description of "the incredible mind-making potential of music."[3] More recently, researchers have indicated the potential impact of musical training on neural function and neural structure, from motor,[4,5] auditory,[6] and language regions,[7] to brain stem responses.[8] Such research is contributing to the growing idea that musical learning can play an important role in child development and perhaps even throughout the life span.[9,10]

In this context of potentially "recommending" music training for children, it is particularly important to note that musical learning experiences are not always positive. In experimental research, musical learning is often equated with musical instrument training—a specialized and technologically challenging form of expert human musical behavior. Although some children excel at such training, many children actually have negative experiences of learning to play a musical instrument and discontinue their lessons,[11–13] with common reasons being that they are considered "boring" or the child "dislikes practice."[14] Meanwhile, overtraining on a musical instrument can lead to problems such as repetitive strain injury[15] or focal dystonia,[16] while many musicians, both amateur and professional, experience anxiety when performing,[17,18] often relying on medication.[19,20] Even informal singing in social situations can produce severe anxiety in adults,[21] which is often anecdotally related to memories of negative experiences of childhood music lessons.[22]

At the same time, it is well established that music listening plays a strong and positive role in the daily lives of a great many individuals who do not consider themselves to be "musical," from the phonograph, to the radio, to the advent of personal, portable sound systems, and extensive personal music collections.[23,24] Music seems to be especially important to adolescents and can play a strong role in identity formation and social independence.[25–28] In addition, music is employed and enjoyed in a wide range of formal and informal social situations, such

doi: 10.1111/j.1749-6632.2012.06530.x

as the pub, nightclubs, birthday parties, weddings, rock concerts, church services, and sports events. Such "real-world" musical experiences tend to involve small or large groups of untrained "nonmusicians," usually involved in some kind of interactive movement such as clapping, foot-tapping, singing, or dancing together. The case of football fans jumping up and down together, singing can be compared with music fans jumping up and down together singing at a rock concert or, indeed, with the young children jumping up and down together to music. All three cases involve exuberant, whole-body, synchronized movement with opportunities for variation, creativity, leadership, imitation, error, and humor (and little fear of individual performance exposure).

Thus, an important question when considering music intervention programs for scientific research is how to reconcile these two types of musical behavior: nonexpert, real-world, social experiences of music, compared with expert instrumental performance. In either case, genuine musical learning and skill development is important if potential transfer effects are to be examined. This requires specific pedagogical aims and methods in addition to controlled variables. Expert instrumental training has now been directly and substantially correlated with neural differences,[29,30] presenting a very strong candidate for future research. However, there are also many other approaches to music education, many of which have been developed specifically for group learning in the classroom.[31] These range from well-established music education approaches developed in the 20th century by Kodaly,[32] Orff,[33,34] Dalcroze,[35] and Gordon,[36] to national interpretations and developments of these approaches,[37–39] traditional, intercultural approaches,[40] and methods developed in the context of psychology research with specific transfer aims in mind.[41,42] Such methods involve group learning, shared musical experiences, synchronization, imitation, and a range of other socially interactive behaviors that are common to "real-world" social musical experiences, and could perhaps be used effectively and systematically in music intervention research.

The idea of music as a shared experience is central to the SAME (shared affective motion experience) model of emotional responses to music, which proposes that auditory musical signals are heard not simply as abstract patterns of sound, but rather as a series of intentional, expressive motor acts, recruiting similar neural networks in both agent and listener.[43–46] According to this model, the synchronization of such networks between actor and perceiver (or between multiple actors or multiple perceivers) can create a sense of empathy and social bonding, which is potentially of value in educational, therapeutic, and social contexts. Research into multibrain rather than single brain conceptions of human cognition has suggested that actors and perceivers show similar neural activations during language tasks,[47] and that closer coupling of such activations correlates with increased communication.[48] It has also been shown beautifully by Kirschner and Tomasello that group musical activity with children can lead to increased cooperative behavior,[49] a finding that is comparable to studies showing that synchronization activities in adults can lead to increased cooperative behaviors.[50] In addition, there is evidence that children and adults seem to perform better when synchronizing with a human agent than with a nonhuman agent,[51,52] indicating that an important aspect of human musicality may be its capacity as a medium for social interaction, probably from infancy.[53] Such synchronized, social interaction might bring specific benefits to musical learning paradigms, for example, by improving motivation or by providing immediate temporal feedback.

The temporal, pulse-based nature of such social interaction is clearly important. The ability of humans to synchronize with a steady pulse has been shown extensively in a range of complex conditions,[54,55] with temporal prediction abilities playing an important role in synchronization accuracy.[56] It has also been shown that the auditory perception of pulse and meter engage neural motor regions, including the cerebellum,[57] basal ganglia,[58] and premotor cortex,[59] as well as the vestibular system.[60] These research findings provide strong evidence in support of theories of the embodied nature of music cognition[61] and, indeed, embodied cognition in general.[62] Evidently, musical behavior is deeply rooted in motor behavior, from vibrating vocal chords and clapping hands to expert fine motor control of musical instruments at great speeds. Even young children tend to respond very physically to a steady beat, naturally moving their bodies in approximate synchronization.[1,63] It thus seems likely that encouraging children in their natural

musical movement behaviors—through clapping, marching, dancing, and singing together—might provide advantages in a musical learning context.

In conclusion, the aim of this brief paper is not to set up one kind of musical training or music education program against another, but rather to emphasize the wide range of possible approaches to musical intervention programs. In certain contexts and under certain conditions, different musical intervention paradigms may be found to have greater or lesser effects, depending on the aims and selected outcome measures. We should not ask the question, *does* music have an impact, but rather *can* specific kinds of musical experience have an impact, and *how* and *when*.[64,65] Experimentally, it is important to isolate individual variables to establish mechanisms, correlations, and causes, but pedagogically it may be crucial to combine multiple facets of musical experience, such as motivational, affective, motor, and social behaviors. When we ask children to learn music, perhaps in some cases we should encourage them to engage their entire motor systems and to jump around in groups together, rather than to sit still and develop their fine motor control on a difficult instrument. There remains a wealth of knowledge from music pedagogy, therapy, psychology, and sociology that can help us to understand the full potential of music to affect the developing brain.

Conflicts of interest

The author declares no conflicts of interest.

References

1. Campbell, P. 1998. *Songs in Their Heads*. Oxford University Press. Oxford.
2. Barkóczi, I. & C. Pléh. 1982. *Music Makes a Difference: The Effect of Kodály's Musical Training on the Psychological Development of Elementary School Children*. Kodály Institute. Kecskemét, Hungary.
3. Swanwick, K. 1998. *Music, Mind and Education*. Routledge. London.
4. Bangert, M, & G. Schlaug. 2006. Form follows function. Specialization within the specialized. *Eur. J. Neurosci.* **24:** 1832–1834.
5. Abdul-Kareem, I.A., A. Stancak, L.M. Parkes, *et al*. 2011. Plasticity of the superior and middle cerebellar peduncles in musicians revealed by quantitative analysis of volume and number of streamlines based on diffusion tensor tractography. *Cerebellum* **10:** 611–623.
6. Schneider, P., M. Scherg, H. Günter Dosch, *et al*. 2002. Morphology of Heschl's gyrus reflects enhanced activation in the auditory cortex of musicians. *Nat. Neurosci.* **5:** 688–694.
7. Sluming, V., T. Barrick, M. Howard, *et al*. 2002. Voxel-based morphometry reveals increased gray matter density in Broca's area in male symphony orchestra musicians. *NeuroImage* **17:** 1613–1622.
8. Kraus, N. & B. Chandrasekaran. 2010. Music training for the development of auditory skills. *Nat. Rev. Neurosci.* **11:** 599–605.
9. Samson, S., D. Dellacherie & H. Platel. 2009. Emotional power of music in patients with memory disorders: clinical implications of cognitive neuroscience. *Ann. N.Y. Acad. Sci.* **1169:** 245–255.
10. Parbery-Clarka, A., S. Andersona, E. Hittnera & N. Kraus. 2012. Musical experience offsets age-related delays in neural timing. *Neurobiol. Aging* [Epub ahead of print].
11. McCarthy, J.F. 1980. Individualized instruction, student achievement and dropout in an urban elementary instrumental music program. *J. Res. Music Educ.* **26:** 59–69.
12. Hallam, S. 1998. Predictors of achievement and drop out in musical instrument tuition. *Psychol. Music* **26:** 116–32.
13. Pitts, S.E., J.W. Davidson & G.E. McPherson. 2000. Models of success and failure in instrumental learning: case studies of young players in the first twenty months of learning. *Bull. Council Res. Music Educ*. **146:** 51–69.
14. Driscoll, J. 2009. 'If I play my sax my parents are nice to me': opportunity and motivation in musical instrument and singing tuition. *Music Educ. Res.* **11:** 37–55.
15. Rosety-Rodriguez, M., F.J. Ordonez, J. Farias, *et al*. 2003. The influence of the active range of movement of pianists' wrists on repetitive strain injury. *M. Eur. J. Anat.* **7:** 75–77.
16. Jabusch, H. & E. Altenmüller. 2006. Focal dystonia in musicians: from phenomenology to therapy. *Adv. Cogn. Psychol.* **2:** 207–220.
17. Hamman, D.L. 1982. An assessment of anxiety in vocal and instrumental performers. *J. Res. Music Educ.* **30:** 77.
18. Wesner, R.B., R. Noyes, Jr. & T.L. Davis. 1991. The occurrence of performance anxiety among musicians. *J. Affect. Disord*. **18:** 177–185.
19. Gates, G.A., J. Saegert, N. Wilson, *et al*. 1985. Effect of beta blockade on singing performance. *Ann. Otol. Rhinol. Laryngol*. **94**(Pt. 1): 570–4.
20. James, I. & I.B. Savage. 1984. Beneficial effect of nadolol on anxiety-induced disturbances of performance in musicians: A comparison with diazepam and placebo. Proceedings of a Symposium on the Increasing Clinical Value of Beta Blockers Focus on Nadolol. *Am. Heart J.* **108:** 1150–1155.
21. Chong, H.J. 2011. Do we all enjoy singing? A content analysis of non-vocalists' attitudes toward singing. *Arts Psychother*. **37:** 120–124.
22. Abrila, C.R. 2007. I have a voice but I just can't sing: a narrative investigation of singing and social anxiety. *Music Educ. Res.* **9:** 1–15.
23. Denora, T. 2000. *Music in Everyday Life*. Cambridge University Press. Cambridge & New York: 181.
24. Sloboda, J., A. O'Neill, A. Susan & A. Ivaldi. 2001. Functions of music in everyday life: an exploratory study using the experience sampling method. *Musicae Scientiae* **5:** 9–32.

25. Laiho, S. 2004. The psychological functions of music in the everyday life of adolescents. In *Proceedings of the 8th International Conference on Music Perception and Cognition,* August 3–7, 2004, Evanston, IL.
26. Bleich, S., D. Zillmann & J.B. Weaver. 1991. Enjoyment and consumption of defiant rock music as a function of adolescent rebelliousness. *J. Electr. Broadcast. Media* **35:** 351–366.
27. Frith, S. 1996. *Performing Rites: On the Value of Popular Music*. Oxford University Press. Oxford.
28. North, A.C., D.J. Hargreaves & S.A. O'Neill. 2000. The importance of music to adolescents. *Br. J. Educ. Psychol*. **70:** 255–272.
29. Schlaug, G. 2001. The brain of musicians: A model for functional and structural adaptation. *Ann. N.Y. Acad. Sci.* **930:** 281–299.
30. Tervaniemi, M. 2009. Musicians—same or different? *Ann. N.Y. Acad. Sci.* **1169:** 151–156.
31. Pitts, S.E. 2000. *A Century of Change in Music Education: Historical Perspectives on Contemporary Practice in British Secondary School Music*. Ashgate. Aldershot, UK.
32. Choksy, L. 1981. *The Kodaly Context*. Prentice Hall. Englewood Cliffs, NJ.
33. Hall, D. & C. Orff. 1960. *Music for Children: Teacher's Manual*. Schott Music. New York.
34. Frazee, J. & K. Kreuter. 1987. *Discovering Orff: A Curriculum for Music Teachers*. Schott Music. New York.
35. Dalcroze, E.J. 1916. *The Technique of Moving Plastic*. Durand et Cie. Paris.
36. Gordon, Edwin E. 1997. *Learning Sequences in Music: Skill, Content and Patterns: A Music Learning Theory*. GIA Publications. Chicago.
37. Stocks, M. & A. Maddocks. 1999. *Growing with Music Teacher's Book Stage 1*. Longman. London.
38. Richards, M.H. 1984. *Aesthetic Foundations for Thinking: Rethought Part 1, Experience*. The Richards Institute of Education. Bellevue, WA.
39. Geoghegan, L. 2000. *Singing Games and Rhymes for Early Years*. National Youth Choir of Scotland. A&C Black Publishers. London.
40. Kirby, J. 2009. *Teaching Taiko: Principles and Practice*. Kagemusha Taiko. Exeter, UK.
41. Bogdanowicz, M. 1999. *Metoda Dobrego Startu*. WSIP. Warszawa, Poland.
42. Overy, K. 2008. Classroom rhythm games for literacy support. In *Music and Dyslexia: A Positive Approach*. J. Westcombe, T. Miles & D. Ditchfield, Eds.: 26–44. Wiley. London.
43. Molnar-Szakacs, I. & K. Overy. 2006. Music and mirror neurons: from motion to 'e' motion. *Soc. Cogn. Affect. Neurosci*. **1:** 235–241.
44. Overy, K. & I. Molar-Szakacs. 2009. Being together in time: musical experience and the mirror neuron system. *Music Percept.* **26:** 489–504.
45. Molnar-Szakacs, I., M. Wang, E.A. Laugeson, *et al*. 2009. Autism, emotion recognition and the mirror neuron system: the case of music. *McGill J. Med.* **12:** 87–98.
46. Molnar-Szakacs, I., V. Green & K. Overy. 2012. Shared affective motion experience (same) and creative, interactive music therapy. In *Musical Imaginations: Multidisciplinary Perspectives on Creativity, Performance and Perception*. D. Hargreaves, R. MacDonald & D. Miell, Eds.: 313–331. Oxford University Press. Oxford.
47. Hasson, U., A.A. Ghazanfar, B. Galantucci, *et al*. 2012. *Brain-to-Brain Coupling: A Mechanism for Creating and Sharing a Social World*. Neuroscience Institute. Princeton, NJ.
48. Stephens, G. *et al*. 2010. Speaker-listener neural coupling underlies successful communication. *Proc. Natl. Acad. Sci. USA* **107:** 14425–14430.
49. Kirschner, S. & M. Tomasello. 2010. Joint music making promotes prosocial behavior in 4-year-old children. *Evol. Hum. Behav.* **31:** 354–364.
50. Wiltermuth, S.S. & C. Heath. 2009. Synchrony and Cooperation. *Psychol. Sci.* **20:** 1–5.
51. Kirschner, S. & M. Tomasello. 2009. Joint drumming: social context facilitates synchronization in preschool children. *J. Exp. Child Psychol*. **102:** 299–314.
52. Himberg, T. 2006. Co-operative tapping and collective timekeeping – differences of timing accuracy in duet performance with human or computer partner. In *Proceedings of the 9th International Conference on Music Perception and Cognition.* Alma Mater Studiorum University of Bologna, Bologna, Italy.
53. Malloch, S. & C. Trevarthen. 2009. *Communicative Musicality: Exploring the Basis of Human Companionship*. Oxford University Press. Oxford.
54. Large, E.W., P. Fink & J.A.S. Kelso. 2002. Tracking simple and complex sequences. *Psychol. Res*. **66:** 3–17.
55. Repp, B.H. 2005. Sensorimotor synchronization: a review of the tapping literature. *Psychon. Bull. Rev*. **12:** 969–992.
56. Pecenka, N. & P.E. Keller. 2011. The role of temporal prediction abilities in interpersonal sensorimotor synchronization. *Exp. Brain Res*. **211:** 505–515.
57. Thaut, M.H., K.M. Stephan, G. Wunderlich, *et al*. 2009. Distinct cortico-cerebellar activations in rhythmic auditory motor synchronization. *Cortex* **45:** 44–53.
58. Grahn, J.A. & M. Brett. 2007. Rhythm perception in motor areas of the brain. *J. Cogn. Neurosci.* **19:** 893–906.
59. Bengtsson, S.L., H.H. Ehrsson, T. Hashimoto, *et al*. 2009. Listening to rhythms activates motor and pre-motor cortices. *Cortex* **45:** 62–71.
60. Phillips-Silver, J. & L.J. Trainor. 2008.Vestibular influence on auditory metrical interpretation. *Brain Cogn.* **67:** 94–102.
61. Leman, M. 2007. *Embodied Music Cognition and Mediation Technology*. MIT Press. Cambridge, MA.
62. Clark, A. 1997. *Being There: Putting Brain, Body and World Together Again*. MIT Press. Cambridge, MA.
63. Eurola, T., G. Luck & P. Toiviainen. 2006. An investigation of pre-schoolers' corporeal synchronization with music. In *Proceedings of the 9th International Conference on Music Perception and Cognition.* Alma Mater Studiorum University of Bologna, Bologna, Italy.
64. Mills, J. 1998. Responses to Katie Overy's paper, "Can Music Really 'Improve' the Mind?" *Psychol. Music* **26:** 204–205.
65. Lamont, A. 1998. Responses to Katie Overy's Paper, "Can Music Really 'Improve' the Mind?" *Psychol. Music* **26:** 201–204.