

The Universal Language

The power of music: its impact on the intellectual, social and personal development of children and young people

Professor Susan Hallam, Institute of Education, University of London

Introduction

Recent advances in the study of the brain have enhanced our understanding of the way that active engagement with music may influence other activities. The cerebral cortex self-organises as we engage with different musical activities, skills in these areas may then transfer to other activities if the processes involved are similar. Some skills transfer automatically without our conscious awareness, others require reflection on how they might be utilised in a new situation.

Perceptual, language and literacy skills

Speech and music have a number of shared processing systems. Musical experiences which enhance processing can therefore impact on the perception of language which in turn impacts on learning to read. Active engagement with music sharpens the brain's early encoding of linguistic sound. Eight year old children with just 8 weeks of musical training showed improvement in perceptual cognition compared with controls.

Speech makes extensive use of structural auditory patterns based on timbre differences between phonemes. Musical training develops skills which enhance perception of these patterns. This is critical in developing phonological awareness which in turn contributes to learning to read successfully.

Speech processing requires similar processing to melodic contour. Eight year old children with musical training outperformed controls on tests of music and language.

Learning to discriminate differences between tonal and rhythmic patterns and to associate these with visual symbols seems to transfer to improved phonemic awareness.

Learning to play an instrument enhances the ability to remember words through enlargement of the left cranial temporal regions. Musically trained participants remembered 17% more verbal information than those without musical training.

Children experiencing difficulties with reading comprehension have benefitted from training in rhythmical performance.

Numeracy

Research exploring the relationships between mathematics and active musical engagement has had mixed results, in part, because not all mathematics' tasks share underlying processes with those involved in music. Transfer is dependent on the extent of the match, for instance, children receiving instruction on rhythm instruments scored higher on part-whole maths problems than those receiving piano and singing instruction.

Intellectual development

Learning an instrument has an impact on intellectual development, particularly spatial reasoning. A review of 15 studies found a 'strong and reliable' relationship, the author likening the differences to one inch in height or about 84 points on standardised school tests. A study contrasting the impact of music lessons (standard keyboard, Kodaly voice) with drama or no lessons found that the music groups had reliably larger increases in IQ. Children in the control groups had average increases of 4.3 points while the music groups had increases of 7 points. On all but 2 of the 12 subtests the music group had larger increases than control groups.

General attainment and creativity

There is a consistent relationship between active engagement in music and general attainment but much research has been unable to partial out confounding factors. A recent study, adopting more sensitive statistical modelling overcame these difficulties. Two nationally representative data sources in the USA with data from over 45,000 children found that associations between music and achievement persisted even when prior attainment was taken into account.

Music participation enhances measured creativity, particularly when the musical activity itself is creative, for instance, improvisation.

Personal and social development

General attainment may be influenced by the impact that music has on personal and social development. Playing an instrument can lead to a sense of achievement; an increase in self-esteem; increased confidence; persistence in overcoming frustrations when learning is

difficult; self-discipline; and provide a means of self-expression. These may increase motivation for learning in general thus supporting enhanced attainment.

Participating in musical groups promotes friendships with like-minded people; self-confidence; social skills; social networking; a sense of belonging; team work; self-discipline; a sense of accomplishment; co-operation; responsibility; commitment; mutual support; bonding to meet group goals; increased concentration and provides an outlet for relaxation.

Research in the USA on the benefits of band participation found that 95% of parents believed that participation in band provided educational benefits not found in other classrooms.

Working in small musical groups requires the development of trust and respect and skills of negotiation and compromise.

In adolescence music makes a major contribution to the development of self-identity and is seen as a source of support when young people are feeling troubled or lonely.

Music has been linked to the capacity to increase emotional sensitivity. The recognition of emotions in music is related to emotional intelligence.

Increasing the amount of classroom music within the curriculum can increase social cohesion within class, greater self-reliance, better social adjustment and more positive attitudes, particularly in low ability, disaffected pupils.

The positive effects of engagement with music on personal and social development will only occur if, overall, it is an enjoyable and rewarding experience. The quality of the teaching, the extent to which individuals perceive that they are successful, and whether in the long term it is a positive experience will all contribute to the nature of any personal or social benefits.

Physical development, health and wellbeing

Rhythmic accompaniment to physical education enhances the development of physical skills.

Learning to play an instrument enhances fine motor co-ordination.

There may be particular health benefits for singing in relation to the immune system, breathing, adopting good posture, improved mood, and stress reduction. The research has been carried out with adults but these benefits could equally apply to children.

Appendices: research utilised in drawing up the briefing document

Altenmuller, E.O., Gruhn, W., Parlitz, D. et al. (1997) 'Music learning produces changes in brain activation patterns: a longitudinal DC-EEG-study unit'. *International Journal of Arts Medicine*, 5, 28-34.

Altenmuller, E.O. (2003). How many music centres are in the brain? In I. Peretz & R. Zatorre (Eds.), *The Cognitive Neuroscience of Music* (pp 346-356). Oxford: Oxford University Press.

Anvari S.H., Trainor L.J., Woodside J. and Levy B.Z. (2002). Relations among musical skills, phonological processing, and early reading ability in preschool children. *Journal of Experimental Child Psychology*, 83, 111-130.

Anshel, M. and Marisi, D. (1978) Effect of music and rhythm on physical performance, *Research Quarterly*, 49, 109-13.

Arnett-Gary, D. (1998) The effects of the arts on academic achievement. *Masters Abstracts International*, 42(01), 22.

Ashley, M. (2002) Singing, gender and health: perspectives from boys singing in a church choir, *Health Education*, 102(4), 180-186.

Atterbury, B. (1985) Musical differences in learning-disabled and normal achieving readers, age eight and nine. *Psychology of Music*, 13(2), 114-123.

Barr, L., Dittmar, M., Roberts, E., and Sheraden, M (2002) *Enhancing student achievement through the improvement of listening skills* (ERIC document Reproduction Service No ED465999)

Barwick, J., Valentine, E., West, R. And Wilding, J. (1989). Relations between reading and musical abilities, *The British Journal of Educational Psychology*, 59, 253-257.

Beisman, G. (1967) Effect of rhythmic accompaniment upon learning of fundamental motor skills, *Research Quarterly*, 38, 172-6.

Beck, R., Cesario, T., Yousefi, S. & Enamoto, H. (2000) 'Choral singing, performance perception and immune system changes in salivary immunoglobulin and cortisol'. *Music Perception*, 18(1), 87-106.

Beck, R.J., Gottfried, T.L., Hall, D.J., Cisler, C.A. and Bozeman, K.W. (2006) Supporting the health of college solo singers: the relationship of positive emotions and stress to changes in the salivary IgA and cortisol during singing. *Journal of Learning through the Arts: A research Journal on Arts Integration in Schools and Communities*, 2(1), article 19.

Bilhartz, T.D, Bruhn, R.A., and Olson, J.E. (2000). The effect of early music training on child cognitive development. *Journal of Applied Developmental Psychology*, 20, 615-636.

Bigand, E. & Poulin-Carronnat, B. (2006). Are we 'experienced listeners'? A review of the musical capacities that do not depend on formal musical training, *Cognition*, 100, 100-130.

Blakemore, S.J. & Frith, U. (2000) *The implications of recent developments in neuroscience for research on teaching and learning*. London: Institute of Cognitive Neuroscience.

Bowers, J. (1998) 'Effects of an intergenerational choir for community-based seniors and college students on age-related attitudes'. *Journal of Music Therapy*, 35, 2-18.

Bowles, S.A. (2003) *Tune up the mind: The effect of orchestrating music as a reading intervention*. Doctoral Dissertation, Indiana University of Pennsylvania, Dissertation Abstracts International, 64(05), 1574A

Broh, B.A. (2002) Linking extracurricular programming to academic achievement: who benefits and why? *Sociology of Education*, 75, 69-95.

Brown, J., Sherrill, C. And Gench, B. (1981) Effects on an integrated physical education/music programme in changing early childhood perceptual-motor performance, *Perceptual and Motor Skills*, 53(1), 151-4.

Brown, J.D. (1980) Identifying problems facing the school band movement. Elkhart: Gemeinhardt Co. Ltd

Brown, J.D. (1985) Strategic marketing for music educators. Elkhart: Gemeinhardt Co. Ltd

Butzlaff, R. (2000). Can music be used to teach reading? *Journal of Aesthetic Education*, 34, 167-178.

Byrgen, L.O. Konlaan, B.K. and Johansson, S-E (1996) Attendance at cultural events, reading books or periodicals and making music or singing in a choir as determinants for survival: Swedish interview survey of living conditions, *British Medical Journal*, 313, 1577-1580.

Cardarelli, D.M. (2003) *The effects of music instrumental training on performance on the reading and mathematics portions of the Florida Comprehensive Achievement Test for 3rd grade students*. Doctoral Dissertation, University of Central Florida. Dissertation Abstracts International, 64(10), 3624A.

Catterall, J., Chapleau, R. & Iwanga, J. (1999) *Involvement in that arts and human development: General involvement and Intensive Involvement in music and theatre arts*. In Champions of Change: The impact of the Arts on Learning. Washington DC: Arts Education Partnership.

Catterall J.S. and Rauscher F.H. (2008). Unpacking the impact of music on intelligence. In W Gruhn and FH Rauscher eds. Pp 171-201. *Neurosciences in music pedagogy*. Nova Science Publishers, New York.

Chamberlain, J.R. (2003) *The relationship between beat competency and reading abilities of third and fifth grade students*. Doctoral Dissertation, The University of North Carolina at Greensboro. Dissertation Abstracts International, 64(06), 2016A.

Chan A.S., Ho Y.C. and Cheung M.C (1998). Music training improves verbal memory, *Nature*, 396, 128.

Cheek J.M. and Smith L.R. (1999). Music training and mathematics achievement. *Adolescence*, 34, 759-761.

Clift, S. & Hancox, G. (2001) 'The perceived benefits of singing: Findings from preliminary surveys of a university college choral society'. *The Journal of the Royal Society for the Promotion of Health*, 121(4), 248-256.

Clift, S., Hancox, G., Staricoff, R. & Whitmore, C. (2008) *Singing and Health: A systematic mapping and review of non-clinical research*. Sidney de Haan Research Centre for Arts and Health: Canterbury Christ Church University.

Coffman, D.D. & Adamek, M. (1999) 'The contribution of wind band participation to quality of life of senior adult band members'. *Dialogue in Instrumental Music Education*, 20(1), 25-34.

Costa-Giomi, E. (1999) 'The effects of three years of piano instruction on children's cognitive development'. *Journal of Research in Music Education*, 47(5), 198-212.

Davidson, J.W. & Good, J.M.M. (2002) 'Social and musical co-ordination between members of a string quartet: an exploratory study'. *Psychology of Music*, 30, 186-201.

Davidson, J. & King, E.C. (2004) 'Strategies for ensemble practice'. In A. Williamon (ed.) *Musical Excellence*. (pp 105-122) (Oxford, Oxford University Press).

Deli, E., Bakle, I., Zachopoulou, E. (2006) Implementing intervention movement programmes for kindergartne children, *Journal of Early Childhood Research*, 4(1), 5-18.

Derri, V., Tsapakidou, A., Zachopoulou, E. & Kioumourtzoglou, E. (2001) Effect of a music and movement programme on development of locomotor skills by children 4 to 6 years of age, *European Journal of Physical Education*, 6, 16-25.

Douglas, S. and Willatts, P. (1994) 'The relationship between musical ability and literacy skill'. *Journal of Research in Reading*, 17, 99-107.

Dowling, W.J. (1993) 'Procedural and declarative knowledge in music cognition and education'. In T. J. Tighe & W.J. Wilding (Eds) *Psychology and Music: The understanding of melody and rhythm* (pp5-18) Hillsdale, N.J.: Erlbaum.

Dowling, W.J., Kwak, S. & Andrews, M.W. (1995) The time course of recognition of novel melodies, *Perception and Psychophysics*, 57, 136-149.

Fields, R.D. (2005) Making memories stick, *Scientific American*, February, 75-81

Flohr, J.W., Miller, D.C., deBeus, R. (2000) EEG studies with young children, *Music Educators Journal*, 87(2), 28-32.

Gaab, N, Gaser, C & Zaehle, T. et al (2005) Neural correlates of rapid spectrotemporal processing in musicians and nonmusicians, *Annals of the New York Academy of Sciences*, 1069, 82-88.

Gardiner, M.E., Fox, A., Knowles, F. & Jeffrey, D. (1996) 'Learning improved by arts training'. *Nature*, 381 (6580), 284.

Geoghegan, N. and Mitchelmore, M. (1996) Possible effects of early childhood music on mathematical achievement, *Journal for Australian Research in Early Childhood Education*, 1, 57-64.

Goldstein, A. (1980) 'Thrills in response to music and other stimuli'. *Physiological Psychology*, 8(1), 126-129.

Goodman, E. (2000) '*Analysing the ensemble in Music Rehearsal and Performance: The Nature and Effects of Interaction in Cello-Piano Duos*'. Unpublished Doctoral Dissertation, University of London.

Graziano, A.B., Peterson, M. and Shaw, G.L. (1999). Enhanced learning of proportional math through music training and spatial-temporal training. *Neurological Research*, 21, 139-152.

Gromko, J., and Poorman, A. (1998). The effect of music training on preschoolers' spatial-temporal task performance. *Journal of Research in Music Education*, 46, 173-181.

Gromko, J. (2005) The effect of music instruction on phonemic awareness in beginning readers, *Journal of College Reading and Learning*, 53(3), 199-209.

Haley, J.A. (2001) *The relationship between instrumental music instruction and academic achievement in fourth grade students*. Doctoral Dissertation, Pace University. Dissertation Abstracts International, 62(09), 2969A.

Hallam, S. (2005) *Enhancing learning and motivation through the life span*. Institute of Education, University of London

Hallam, S., & Prince, V. (2000). *Research into instrumental music services*. (London, DfEE).

- Hamann, D. Bourassa, R., Aderman, M (1990) Creativity and the Arts, *Dialogue in Instrumental Music Education*, 14, 59-68.
- Hamann, D. Bourassa, R., Aderman, M (1991) Arts experiences and creativity scores of high school students, *Contribution to Music Education*, 14, 35-47.
- Harland, J., Kinder, K., Lord, P., Stott, A., Schagen, I., & Haynes, J. (2000). *Arts education in secondary schools: Effects and effectiveness*. (London, NFER/The Arts Council of England, RSA).
- Hetland, L. (2000) Learning to make music enhances spatial reasoning, *Journal of Aesthetic Education*, 34(3/4), Special Issue, The Arts and Academic Achievement: What the evidence shows (Autumn – Winter, 2000), 179-238.
- Hines, S.W. (2000) *The effects of motoric and non-motoric music instruction on reading and mathematics achievements of learning disabled students in kindergarten through ninth grade*. Doctoral Dissertation, The University of North Carolina at Greensboro, Dissertation Abstracts International, 61(05), 1777A.
- Hirt-Mannheimer, J. (1995) Music big for little folks. *Teaching Music*, 3(2), 38-39.
- Ho, Y.C., Cheung, M.C. and Chan, A.S. (2003). Music training improves verbal but not visual memory: Cross sectional and longitudinal explorations in children. *Neuropsychology*, 17, 439-450.
- Hodges, D.A. & O'Connell, D.S. (2007) The impact of music education on academic achievement. Chapter 2 in *Sounds of Learning Report: NAMM Foundation Sounds of Learning*.
- Hodges, D.A. & Haack, P.A. (1996) 'The influence of music on behaviour'. In D.A. Hodges (ed) *Handbook of Music Psychology*, San Antonia: IMR press.
- Hoffman, D.S. (1995) *Relationships between Academic Achievement and Participation in a comprehensive and sequential keyboard-based public school music education programme*. Doctoral Dissertation, University of South Carolina. Dissertation Abstracts International, 56(06), 2161A
- Humpal, M.E. and Wolf, J. (2007) Music in the Inclusive Classroom, *Young Children*, 58(2), 103-107.
- Hurwitz, I., Wolff, P.H., Bortnick, B.D. & Kokas, K. (1975) 'Non-musical effects of the Kodaly music curriculum in primary grade children'. *Journal of Learning Disabilities*, 8, 45-52.
- Hyppa, M.T. and Maki, J. (2001) Individual-level relationships between social capital and self-rated health in a bilingual community, *Preventative medicine*, 32, 148-155.

Johansson, S.E., Konlaan, B.B. and Bygren, L.O. (2001) Sustaining habits of attending cultural events and maintenance of health: a longitudinal study, *Health Promotion International*, 16(3), 229-234.

Johnson, C.M. and Memmott, J.E. (2006) Examination of relationships between music programmes of differing quality and standardised test results, *Journal of Research in Music Education*, Winter, 54(4), 293-307.

Kahn, A.P. (1998) 'Healthy aging: A study of self-perceptions of well-being'. *Dissertation abstracts International*, 58, 4740B. (UMI No. AAT98-10054)

Kalmar, M. (1982) The effects of music education based on Kodaly's directives in nursery school children, *Psychology of Music*, Special Issue, 63-68.

Kemmerer, K.P. (2003) *Relationship between the number of hours spent in general music class and reading skills in kindergarten through grade 3*. Doctoral Dissertation, Lehigh University. *Dissertation Abstracts International*, 64(12), 4400A.

Kokotsaki, D., & Hallam, S. (2007) Higher Education music students' perceptions of the benefits of participative music making, *Music Education Research*, 9(1), March, 93-109.

Kokotsaki, D., & Hallam, S. (in preparation) The perceived benefits of participative music making.

Konlaan, B.B., Bygren, L.O. and Johansson, S-E. (2000) Visiting the cinema, concerts, museums or art exhibitions as determinant of survival: a Swedish fourteen-year cohort follow-up study, *Scandinavian Journal of Public Health*, 28(3), 174-8.

Koutsoupidou, T., and Hargreaves, D. (2009) An experimental study of the effects of improvisation on the development of children's creative thinking in music, *Psychology of Music*, 37(3), 251-278.

Kreutz, G., Bongard, S, Rohrman, S., Grebe, D., Bastian, H.G. & Hodapp, V. (2004) Effects of choir singing or listening on secretory immunoglobulin A, cortisol and emotional state, *Journal of Behavioural Medicine*, 27(6), 623-635.

Kuhn, D. (2002) The effects of active and passive participation in musical activity on the immune system as measured by salivary immunoglobulin A (SigA), *Journal of Music Therapy*, 39(1), 30-39.

Lamb, S.J. and Gregory, A.H. (1993) The relationship between music and reading in beginning readers, *Educational Psychology: An International Journal of Experimental Educational Psychology*, 31(1), 19-27.

Legette, R.M. (1993) *The effect of a selected use of music instruction on the self-concept and academic achievement to the musical problem solving abilities of high school students*.

Doctoral Dissertation, Case Western Reserve University, Dissertation Abstracts International, 54(07), 2502A.

Lillemyr, O.F. (1983) Achievement motivation as a factor in self-perception, *Norwegian Research Council for Science and the Humanities*, 245-248.

Long, M (2007) *The effect of a music intervention on the temporal organisation of reading skills*. Unpublished PhD, Institute of Education, University of London.

Lu, D.T. (1986) *The effects of teaching music skills on the development of reading skills among first graders: an experimental study*. Doctoral Dissertation, University Washington, Dissertation Abstracts International, 47(12), 4344A.

Magne, C., Schon, D. & Besson, M. (2006) Musician children detect pitch violations in both music and language better than nonmusician children: behavioural and electrophysiological approaches, *Journal of Cognitive Neuroscience*, 18: 199-211.

Marshall, A.T. (1978) An analysis of music curricula and its relationship to the self image of urban black middle school age children: *Dissertation Abstracts International*, A 38, 6594A-5A

Moreno, S. and Besson, M. (2006) Musical training and language-related brain electrical activity in children. *Psychophysiology*, 43, 287-291.

Montgomery, A.J. (1997) *The influence of movement activities on achievement in melodic pitch discrimination and language arts reading readiness skills of selected kindergarten music classes*. Doctoral Dissertation, University of Southern Mississippi. Dissertation Abstracts International, 58(09), 3453A.

Morrison, S.J. (1994) Music students and academic growth. *Music Educators Journal*, 81(2), 33-36.

Movsesian, E. (1967) *The influence of primary teaching music reading skills on the development of basic reading skills in the primary grades*. Doctoral Dissertation, University of Southern California. Dissertation Abstracts International, 28(08), 3078A.

Munte, T.F., Nager, W., Beiss, T. Schroeder, C. & Erne, S.N. (2003). 'Specialization of the Specialised electrophysiological Investigations in Professional Musicians'. In G. Avanzini, C. Faienza, D. Minciocchi, L. Lopez, & M. & Majno (Eds) *The Neurosciences and Music*. (pp. 112-117) New York: New York Academy of Sciences.

Murningham, J.K. & Conlan, D.E. (1991) 'The dynamics of intense work groups: A study of British string quartets'. *Administrative Science Quarterly*, 36, 165-186.

Musacchia, G., Sams, M., Skoe, E., & Kraus, N. (2007) Musicians have enhanced subcortical auditory and audiovisual processing of speech and music, *Proceedings of the National Academy of Sciences of the USA*, 104(40), 15894-15898.

National Advisory Committee on Creative and Cultural Education (NACCCE) (1999). *All our futures: Creativity culture and education*. (London, Department for Culture, Media and Sport/Department for Education and Employment).

Nicholson, D. (1972) *Music as an aid to learning*. Doctoral Dissertation, New York University, Dissertation Abstracts International, 33(01), 0352A.

North, A.C., Hargreaves, D.J. and O'Neill, S.A. (2000) 'The importance of music to adolescents'. *British Journal of Educational Psychology*, 70, 255-272.

Norton, A., Winner, E., Cronin, K., Overy, K., Lee, D.J. and Schlaug, G. (2005) Are there pre-existing neural, cognitive, or motoric markers for musical ability? *Brain and Cognition*, 59, 124-134.

Orsmond, G.I. and Miller, L.K. (1999). Cognitive, musical, and environmental correlates of early music instruction. *Psychology of Music*, 27, 18-37.

Overy, K. (2000). Dyslexia, temporal processing, and music: The potential of music as an early learning aid for dyslexic children. *Psychology of Music*, 28, 218-229.

Overy, K. (2003). Dyslexia and music: From timing deficits to musical intervention. *Annals of the New York Academy of Science*, 999, 497-505.

Painter, G. (1966) The effects of a rhythmic and sensory motor activity program on perceptual motor spatial abilities of kindergarten, *Exceptional Children*, 33, 113-116.

Pantev, C., Engelien, A., Candia, V. & Elbert, T. (2003) 'Representational cortex in Musicians'. In I. Peretz and R. Zatorre, *The Cognitive Neuroscience of Music*, Oxford: Oxford University Press (pp. 382-395).

Parr, S.M. (1985) The effects of graduated exercise at the piano on the pianist's cardiac output, forearm blood flow, heart rate, and blood pressure. *Dissertation Abstracts International*, 46(6), 1436A. (UMI No. AAT85-18673)

Patel, A.D. and Iverson, J.R. (2007) The linguistic benefits of musical abilities. *Trends in cognitive sciences*, 11, 369-372.

Patel, I. (2009) *Music and the Brain*. In Hallam, S., Cross, I & Thaut, M. (eds) *The Oxford Handbook of Psychology of Music*, pp 208-216. Oxford: Oxford University Press.

Peynircioglu, Z., Durgunoglu, A.Y. & Uney-Kusefoglu, B. (2002) Phonological awareness and musical aptitude. *Journal of Research in Reading*, 25(1), 68-80.

Piro, J.M. & Ortiz, C. (2009) The effect of piano lessons on the vocabulary and verbal sequencing skills of primary grade students, *Psychology of Music*, 37(3), 325-347.

Pitts, S.E. (2007) Anything goes: A case study of extra-curricular musical participation in an English secondary school, *Music Education Research*, 9(1), 145-165.

Rafferty, K.N. (2003) *Will a music and spatial-temporal math program enhance test scores? An analysis of second-grade students' mathematics performance on the Stanford-9 Test and the Capistrano Unified School District CORE level test*. Doctoral Dissertation, University of Southern Carolina. *Dissertation Abstracts International*, 64(12), 4301A.

Rauscher, F.H. (2002). Mozart and the mind: Factual and fictional effects of musical enrichment. In J. Aronson, ed. *Improving academic achievement: Impact of psychological factors on education*, pp. 269-278. Academic Press, New York.

Rauscher, F.H. (2009) The impact of music instruction on other skills. In Hallam, S., Cross, I & Thaut, M. (eds) *The Oxford Handbook of Psychology of Music*, pp 244-252. Oxford: Oxford University Press.

Rauscher, F.H., Shaw, G.L., Levine, L.J., Wright, E.L., Dennis, W.R. and Newcomb, R. (1997). Music training causes long-term enhancement of preschool children's spatial-temporal reasoning abilities. *Neurological Research*, 19, 1-8.

Rauscher, F.H., LeMieux, M. & Hinton, S.C. (submitted) Lasting improvement of at-risk children's cognitive abilities following music instruction.

Rauscher, F.H. and Zupan, M. (2000). Classroom keyboard instruction improves kindergarten children's spatial-temporal performance: A field experiment. *Early Childhood Research Quarterly*, 15, 215-228.

Register, D. (2001) The effects of an early intervention music curriculum on prereading/writing, *Journal of Music Therapy*, 38(3), 239-248.

Resnicow, J.E., Salovey, P., & Repp, B.H. (2004) Is recognition of emotion in music performance an aspect of emotional intelligence, *Music Perception*, 22(1), 145-158.

Salamon, G. and Perkins, D.N. (1989) Rocky roads to transfer: rethinking mechanisms of a neglected phenomenon, *Educational Psychologist*, 24, 113-142.

Schlaug, G. Norton, A., Overy, K., and Winner, E. (2005) Effects of music training on the child's brain and cognitive development, *Annals New York Academy of Science*, 1060, 219-230.

Schellenberg, E.G. (2003) Does exposure to music have beneficial side effects? In Peretz, R., and Zatorre, R.J. (eds). *The cognitive neuroscience of music*, pp 430-448. Nova Science Press, New York.

Schellenberg, E.G. (2004) 'Music lessons enhance IQ'. *Psychological Science*, 15(8), 511-14.

Smith, J. A. (1995). Semi-Structured Interviewing and Qualitative Analysis. In J. A. Smith, R. Harré & L. V. Langenhove (Eds.), *Rethinking Methods in Psychology*. (London, Sage).

Schneider, T.W. and Klotz, J. (2000) *The impact of music education and athletic participation on academic achievement*. ERIC Document Reproduction Service No ED448186.

Shobo, Y. (2001) *Arts, Recreation and Children and Arkansas, 2001*. ERIC Document Reproduction Service No. ED463076.

Simpson, D.J. (1969) The effect of selected musical studies on growth in general creative potential. Doctoral Dissertation, University of Southern California, Dissertation Abstracts 30, 502A-503A.

Slevc, L.R. and Miyake, A. (2006) Individual differences in second language proficiency: does musical ability matter? *Psychological Science*, 17, 675-681.

Southgate, D.E., & Roscigno, V.J. (2009) The impact of music on childhood and adolescent achievement, *Social Science Quarterly*, 90(1), 4-21.

Spychiger, M., Patry, J. Lauper, G., Zimmerman, E., & Weber, E. (1993). 'Does more music teaching lead to a better social climate'. In R. Olechowski & G. Svik (eds) *Experimental research in teaching and learning*. (Bern, Peter Lang).

Stacey, R., Brittain, K. & Kerr, S. (2002) Singing for health: an exploration of the issues, *Health Education*, 102(4), 156-162.

Standley, J.M. & Hughes, J.E. (1997) Evaluation of an early intervention music curriculum for enhancing prereading/writing skills, *Music Therapy Perspectives*, 15(2), 79-85.

Sward, R. (1989) Band is a family. *Today's Music Educator*, Winter, 26-7.

Tallal, P. And Gaab, N. (2006) Dynamic auditory processing, musical experience and language development. *Trends in neurosciences*, 29, 382-370.

Tarrant, M., North,, A.C., & Hargreaves, D.J. (2000) 'English and American adolescents' reasons for listening to music'. *Psychology of Music*, 28, 166-173.

Thomson, M. (1993) 'Teaching the dyslexic child: some evaluation studies'. In G. Hales (ed) *Meeting Points in Dyslexia: Proceedings of the first International Conference of the British Dyslexia Association*.

Thompson, W.F., Schellenberg, E.G. and Husain, G. (2004) Perceiving prosody in speech: Do music lessons help? *Emotion*, 4, 46-64.

Tolfree, E. & Hallam, S. (in preparation) Young people's uses of and responses to music in their everyday lives.

Trehub, S.E., Bull, D., and Thorpe, L.A. (1984) Infants' perception of melodies: The role of melodic contour, *Child Development*, 55, 821-830.

Trent, D.E. (1996) *The impact of instrumental education on academic achievement*. Doctoral Dissertation, East Texas State University. Dissertation Abstracts International, 57(07), 2933A.

Vanderark, S.D., Newman, I., & Bell, S. (1983) 'The effects of music participation on quality of life in the elderly'. *Music Therapy*, 3, 71-81.

Vaughn, K. (2000) Music and mathematics: Modest support for the oft-claimed relationship, *Journal of Aesthetic Education*, 34(3-4), 149-166.

Wong, P.C.M., Skoe, E., Russo, N.M., Dees, T., & Kraus, N. (2007) Musical experience shapes human brainstem encoding of linguistic pitch patterns, *Nature Neuroscience*, 10, 420-422.

Whitehead, B.J. (2001) *The effect of music-intensive intervention on mathematics scores of middle and high school students*. Doctoral Dissertation, Capella University, Dissertation Abstracts International, 62(08), 2710A

Whitwell, D. (1977) *Music learning through performance*. Texas: Texas Music Educators Association.

Wise, G.W., Hartmann, D.J., Fisher, B.J. (1992) 'Exploration of the relationship between choral singing and successful aging'. *Psychological Reports*, 70, 1175-1183.

Wolf, J. (1992) Let's sing it again: Creating music with young children. *Young children*, 47(2), 56-61.

Wolff, K. (1979) The non-musical outcomes of music education: A review of the literature. *Bulletin of the Council for Research in Music Education*, 55, 1-27.
Nature Neuroscience,

Yoon, J.N. (2000) *Music in the classroom: its influence on children's brain development, academic performance, and practical life skills*. ERIC Document Reproduction Service No. ED442707.

Young, V.M. & Coleman, A.M. (1979) 'Some psychological processes in string quartets'. *Psychology of Music*, 7, 12-16.

Wong, P.C.M., Skoe, E., Russo, N.M., Dees, T. & Kraus, N. (2007) Musical experience shapes human brainstem encoding of linguistic pitch patterns, 10, 420-422.

Zillman, D. & Gan, S. (1997) 'Musical taste in adolescence'. In D.J. Hargreaves & A.C. North *The Social Psychology of Music* Oxford: Oxford University Press

Zulauf, M. (1993) 'Three year experiment in extended music teaching in Switzerland: The different effects observed in a group of French speaking pupils'. *Bulletin of the Council for Research in Music Education*, 119, Winter, 111-21.