

Music Makes You Smarter

by Frances H. Rauscher
Department of Psychology
University of Wisconsin

Music plays a role in the development of children from the strains of the first lullaby. It enters a child's life from experiences in the family, from the media, as part of religious worship, in the school curriculum, and in play. In addition to its enormous social value, recent research suggests that music also is important for intellectual development: Exposure to music from an early age appears to affect the organization of the central nervous system, making it a precious tool for early childhood educators.

Learning Starts Early—Even Before Birth

Studies from around the world show that early stimulation is important to brain development. An enriched environment can boost the number of neural connections that children form. Even animal studies have shown a significant relationship. For example, William Greenough of the University of Illinois exposed one group of rats to a stimulating environment. A second group was housed in standard drab cages. The animals housed in the enriched environments had 25% more connections among their brain cells.¹

The bottom line is that the brain is very pliable from the beginning of its development. This presents us with immense opportunities and weighty responsibilities, but timing is crucial. When there is a disruption of the normal development, neural connections are not made properly. In fact, a growing body of evidence confirms that brain development and learning are affected by experience, even before birth. Ultrasound recordings show that the neurons that develop in the womb begin driving an infant's limbs as early as the seventh week of pregnancy.² It appears that experience can act on the brain's development from the very beginning. Experimental data confirm that learning can take place in utero. Studies have shown, for example, that newborns will show a preference for sounds that mimic the mother's voice as it was heard in the womb.³

This evidence—and a great deal more that is beyond the scope of this brochure—leads to a single conclusion: how children develop and learn depends on both nature and nurture. It may be that nature sets the upper limits of development, but nurture determines whether an individual will reach this limit.

The Role of Music in Brain Development

What parent or teacher would choose to deny a child an experience that has been shown to help brain development? A new body of research suggests that music training at an early age can develop the neural connections that are necessary for understanding complex mathematical and scientific concepts. This research shows an important link between musical training and other cognitive abilities, particularly spatial abilities—the abstract reasoning that is used for understanding relationships between objects such as, for example, when calculating a proportion or playing chess.

Three-year-old children were given music instruction on the piano keyboard. Their spatial abilities were tested before they started lessons (pre-testing) and again six months later (post-testing). Their scores were compared to children who received lessons in the computer, children who participated in casual group singing sessions but who did not receive formal music instruction, and children who received no special training. Although the four groups of children's pre-test scores did not differ, the post-testing revealed that **the children who had received the keyboard instruction scored significantly higher** than the other children on a select, but very practical, domain of abstract intelligence—spatial-temporal reasoning.⁴

Supporting these data, Martin Gardiner and his colleagues have demonstrated that early training in music and the arts can influence kindergartner's test scores in reading and math.⁵ Other researchers have found similar effects. In fact, data demonstrating greater flexibility in mathematics and language skills for children enrolled in Hungarian music grade schools have been reported for decades.

What this means is that early music training may influence brain development, much in the same way that reading to a young child does. Specifically, it seems that music encourages the formation of neural connections essential for scientific endeavors. Many parents and educators have held this view for years, but it is only within the last decade or so that the scientific research in this area has come into its own. In fact, a recent study demonstrates the influence of music on cognitive development of animals. Rats who received extensive (12 hours a day for a period of months) exposure to complex music performed better in a spatial maze than rats exposed to repetitive music, white noise or silence. The researchers proposed that the area of the brain responsible for spatial learning was developmentally affected by the music exposure.⁶ Just imagine what kind of impact music training can have on our own children!

Music as an Educational Experience

Although research has shown that even listening to music affects human intelligence,⁷ the strongest effects of music are to be found from active participation in music making. Children who receive music training are likely to reap benefits far beyond those which can be found from passive listening. It is clear that cognitive stimulation reaches a high level during music training. Music training can hardly be called "dry and boring." It's fun, but is always a challenge to a student's cognitive abilities. After all, a child working on a mathematical problem can sit back and ponder it for as long as necessary before committing pencil to paper. The same child, playing with a band, must keep up with the group and at the same time think ahead to prepare for what is coming. In no other subject is a child called upon to make four or five decisions per second and to act on them continuously for long stretches of time.

During musical performance, children must constantly turn their thoughts into action. Thought structures continually have to be updated and adjusted. This combination of constant vigilance and forethought coupled with ever-changing physical responses is an educational experience of unique value. One can easily see why children with music training are able to deal more easily with material which cannot immediately be assimilated. In turn, these children may be able to learn more easily and store information

better than children who are not given the opportunity to participate in music making.

In addition to these benefits, the social climate of music instruction is marked by cooperation, whereas in most other subjects cooperation is either totally lacking or replaced by a climate of competition. Only by working together can students play a musical performance. They learn that cooperation is a means to an end which can be applied to other goals.

Music is not a solution to all the problems of education. The human brain is enormously complex, and our knowledge of how music affects us is far from complete. Nevertheless, music is a powerful instrument of education which should be used.

We must however be careful not to downplay the importance of music for the beauty and value it brings into the lives of our children. We should not engage our children in musical activities solely because they encourage brain development.

We don't make music out of duty, and nor should our children. Educating students in music puts them in touch with their feelings, and through their feelings, themselves. Being in touch with oneself, being capable of solitude and enjoying one's own company for a time, and being moved to feel what one would not otherwise feel are outcomes that are apparent to all who participate in music-making.

Music-making is fun and children love to make music. When you then consider the developmental benefits with the fun of music-making, this creates an even more compelling argument for your child to be involved making music.

References

1. Greenough, W.T., Black, J.E. & Wallace, C. (1987). Experience and brain development. *Child Development*, 58, 539-559.
2. Hofer, M.A. (1988). On the nature and function of prenatal behavior. In W. Smotherman and S. Robinson (Eds.), *Behavior of the fetus*. Caldwell, NJ: Telford Press.
3. Lock, J.L. (1993). *The child's path to spoken language*. Cambridge: Harvard University Press.
4. Rauscher, F.H., Shaw, G.L., Levine, L.J., Wright, E.L., Dennis, W.R. & Newcomb, R. (1997). Music training causes long-term enhancement of preschool children's spatial-temporal reasoning. *Neurological Research*, 19, 2-8.
5. Gardiner, M.F., Fox, A., Knowles, F. & Jeffrey, D. (1996). Learning improved by arts training. *Nature*, 381, 254.
6. Rauscher, F.H., Robinson, K.D., and Jens, J.J. (1997). Improved maze learning through early music exposure in rats. Manuscript submitted for publication.
7. Rauscher, F.H., Shaw, G.L. & Ky, K.N. (1993). Music and spatial task performance. *Nature*, 365, 611.

Copyright 1997 NAMM- International Music Products Association
Used by Permission