Practical Teaching Ideas for Today's Music Educator
CHORTEACH

A Cognitive Crescendo - How Music Affects the Brain

by

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In the summer of 2007, I completed a sequence of three levels of coursework on Brain Compatible Teaching offered through my school and Indiana University Southeast. While the class itself did not focus specifically on music, two of the four instructors are practicing musicians. They brought to light recent research on how the brain reacts to music and how musicians of all ages benefit from participating in musical activities. This is a huge subject for current neuroscience research, and much information is published on the topic.

In this article, I offer interesting findings in the area of brain research as it relates to music. Though this will merely scratch the surface of the topic, I hope you find that science supports the notion that our passion for music is beneficial to our mental capacities.

There are a few basic principles regarding brain function that are necessary for understanding music's role in shaping the brain.

- First, learning takes place when neurons are activated. The more activation, the greater the capacity for learning. Musical activity engages millions of neurons.

- Second, the principle of "use it or lose it" is especially true of the brain. Learning becomes permanent when neurons make connections to other neurons. This occurs when new learning is employed. There are windows of opportunity for many intellectual functions, including learning to play a musical instrument, learning a foreign language, building vocabulary, developing spatial skills, etc. That is, there are optimal times in human growth and development (mostly from birth to puberty) in which the brain is equipped with a greater capacity to learn in these areas with ease; however, it is never too late to learn anything. The brain is malleable and can learn at any age.

- Third, there is no musical center in the brain. Musical involvement activates more areas of the brain than any other activity. The right brain is involved in the experiential aspects; the left brain is involved with the analytical, structural elements of music; the limbic system controls the emotional response to music.

Music is innate. Music has been a part of human life throughout all cultures in all times and is more foundational to our species than language. Identified by Howard Gardner as one of the eight multiple intelligences, Musical/Rhythmic Intelligence is present in every human at birth. Of all the intellectual capacities, none develops earlier than music. Even individuals with physical, mental and emotional disabilities possess musical abilities and can have meaningful musical experiences (Lazear 105-106).

Music strengthens the brain. Numerous studies in the past decade have confirmed that participation in music has definite benefits for the brain. Even listening to music has a positive effect on the brain, though not nearly as great as with music making.

- Listening to music stimulates the brain, increasing the neural connections.

- Participating in music enhances brain development and increases the brain's efficiency.

- Participating in music helps strengthen and maintain brain cells and connections that deteriorate with age—under normal circumstances.

Because music involves many different areas of the brain, growth resulting from active music participation is evident in several places. The brain's capacity increases during musical activity because synapses are strengthened and connections are built between neurons. Music making is thought by some researchers to be the most extensive exercise for brain cells and for strengthening synapses. Brain scans of musicians reveal that nearly all of the cerebral cortex is active during performance (Weinberger).

In studies of professional musicians versus non-musicians, researchers have found that professional musicians have up to 130% more gray matter (cell bodies, axons and dendrites responsible for processing information) in multiple areas of the brain than non-musicians.

- Broca's Area, the part of the brain associated with language, is one of those areas. Musical sight-reading is rooted here.

- The cerebellum, long thought to control only motor skills, is also larger in size in musicians. We now know that it is the seat of tempo and rhythmic synchronization, extremely important elements to musicians.

- Musicians who learned to play a keyboard or string instrument prior to adolescence reportedly have larger than normal areas of the brain dedicated to touch perception.

- The thick bundle of neurons connecting the left and right hemispheres of the brain, the corpus callosum, is significantly (5–15%) thicker in musicians than non-musicians, proportionate to the age at which musical training began. This is due to increased inter-hemispheric traffic resulting from music processing. This strengthening of the communication system makes the brain more effective and efficient (Harvey).

Music enhances cognition in general and specific ways. There are strong connections between music and the development of language. Multiple researchers have examined the relationship of musical training to verbal skills, finding that many language processing areas in the brain are also involved in musical processing.

Physically, the areas of processing for both music and speech (the frontal and temporal lobes) are very close together and actually have overlapping connections (Levitin 125-127). It is evident that children with musical training exhibit better verbal memory skills than children without musical training. The degree of verbal memory improvement appears to increase proportionally to the length of musical training, and the effects are long-term, as the benefits to verbal memory gained from the musical training are maintained even after instruction has been discontinued (Ho).

A 2005 study at Stanford University showed that musical training increases the brain's capacity to process subtle differences in word syllables. Since these fine distinctions are often the source of a child's reading or speech difficulty, incorporating musical training may help overcome those obstacles (Sturrock).

Musical training aids in the development of spatial-temporal reasoning, a foundation for mathematic success. The popular "Mozart Effect" research brought the neuro-musical subject into the public eye, but does not actually have the credibility to match the hype it received, due primarily to the fact that the achievement improvements were short lived. However, numerous studies have since established stronger correlations between instrumental music study and abstract reasoning skills.

According to Dr. Gordon Shaw of the M.I.N.D. Institute, which developed a research program using an integrated music and math curriculum with elementary children, "…music seems to tap into this internal neural structure we're born with, activating regions of the brain that are responsible for our ability to think in pictures." The effects are long-term (Armitage).

In his 2006 book, *This is Your Brain on Music,* Daniel J. Levitin explains that music training improves our ability to "discern structure and form in music" and confirms that even a small exposure to music lessons in childhood builds "neural circuits for music processing" that are more efficient and developed than for those without training (Levitin 190).

Music has lifelong benefits. While the "windows of opportunity" for optimal brain development end before or during adolescence, the ability to learn is always there. It may take more practice and desire to make the new learning stick, but the brain can continue learning until it dies. It is clear that some neural deterioration occurs through normal aging.

The brain continually prunes away what it is not using, trying to maintain efficiency. Musicians who continue practicing and performing through adulthood, show little reduction in gray matter and, in fact, often show growth through their thirties and forties as compared with non-musicians (Radford).

Right Brain, Left Brain or Whole Brain? For years, music has been thought to be a right brain activity, implying that there is a specific area in the right hemisphere of the brain that processes music. While

the right brain does process rhythm patterns, timbre, harmonic function and emotional responses to music, the left brain is also involved.

Analytical and formal structures are processed in the left brain, as well as stylistic and artistic elements. In fact, active musical participation, perhaps more than any other activity, engages more parts of the brain and encourages the two hemispheres to work together effectively and efficiently. Levitin puts it this way: "…musical operations become bilateral with increased training as musicians coordinate and recruit neural structures in both the left and right hemispheres." (Levitin 220). Clearly, music is a "whole brain" activity.

Most musicians would agree that their involvement in music has yielded benefits beyond the intrinsic rewards that need no explanation. It is refreshing to know that scientists not only acknowledge the physical and mental benefits of music, but that they have determined that music is so important to cognitive development and efficiency that it should be encouraged in every person.

Quotes

The functional architecture of the brain honors music as much as it honors language

— Norman M. Weinberger,
Center for the Neurobiology of Learning and Memory

Music will not only help us understand how we think, reason, and create, but it will enable us to learn how to bring each child's potential to its highest level

— Gordon Shaw,
Co-Founder and Chairman, M.I.N.D. Institute

The story of your brain on music is the story of an exquisite orchestration of brain regions, involving both the oldest and newest parts of the human brain, and regions as far apart as the cerebellum in the back of the head and the frontal lobes just behind your eyes.

— Daniel J. Levitin,
This is Your Brain on Music

Bibliography

Armitage, Lynn. "M.I.N.D. Games: How Mozart Fine Tunes the Brain." *OC Family,* April 2003, 158.

Harvey, Arthur. "An Intelligence View of Music Education." *Leka Nu Hou,* February 1997. Available from http://www.menc.org/publication/articles/academic/hawaii.htm; Internet.

Ho, Yim-Chi, Mei-Chun Cheung and Agnes S. Chan. "Music Training Improves Verbal but not Visual Memory: Cross Sectional and longitudinal Explorations in Children." *Neuropsychology,* Vol. 17, No. 3, 439-450.

Hodges, Donald A. "Implications of Music and Brain Research." *Music Educators Journal,* September 2000, 17-22.

Lazear, David. *Eight Ways of Knowing: Teaching for Multiple Intelligences,* 3rd ed. Arlington Heights: SkyLight Professional Development, 1999.

Levitin, Daniel J. *This is Your Brain on Music: The Science of a Human Obsession.* New York: Dutton, 2006.

MENC—The National Association for Music Education "Music Education Facts and Figures" 2002. Available from http://www.menc.org/information/advocate/facts.html; Internet.

Radford, Tim. "Music Improves Brain Power — In Some Performers." *The Guardian,* 12 September 2003. Available from http://www.guardian.co.uk/uk_news/story/0,3604, 1040324, 00.html#article-continue; Internet.

Sturrock, Carrie. "Playing Music Can Be Good for Your Brain." *San Francisco Chronicle,* 17 November 2005, sec. A, 1.

Weinberger, Norman. "The Music in Our Minds." *Educational Leadership,* Vol. 56, No. 3, November 1998, 36-40.

The greatest homage we can pay to truth is to use it.

— Ralph Waldo Emerson