ARTS AND COGNITION:

Can Arts Education Truly Improve Other Cognitive Skills?

by Michael S. Gazzaniga, Ph.D.

The idea that arts education can enhance learning in other areas is not new. Baby Einstein videotapes are advertised as "products to entertain and develop the little ones by exposing them to music, art, language, science and nature." American Express campaigns featuring Sheryl Crow and Sting tout the benefits of music lessons for math and science performance. The idea has permeated our popular culture.

But is it true? As it turns out, the specific way arts education may impact the brain, and whether that impact has implications for other domains of learning, is unknown. The existing data that suggest a link between arts training and other cognitive skills have been either unreplicable or purely correlative. But that's not to say definitively that there is not a causal link. Until now, researchers may have been looking at the wrong things.

One of the most common misconceptions about how the arts impact the brain has come through what is known as "the Mozart Effect"—the theory that a student exposed to a brief episode of listening to Mozart would show increased spatial-temporal ability. In other words, if you play Mozart records for

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Is there a link?

Practicing the cello will make you a better cello player, but a new study will examine whether arts education affects other cognitive processes as well. Five neuroscience laboratories will conduct the research.

your children, they will be better at algebra. While this initial finding by researchers at the University of California at Irvine, published in *Nature* in 1993, has yet to be replicated in spite of numerous attempts to do so, it has become the basis for claims that taking music lessons can improve math and science skills. These claims reach too far.

The assertion has, however, led to a refined approach to the study of arts and cognition, namely that we should be looking at how a long period of arts training (years) impacts the brain structure itself and how we think. We need to try to establish a causal relationship between musical training and other skill domains, rather than relying on correlative data. Very little is known about whether the effects of an arts education transfer to other task-domains, and nothing is known about the brain-based mechanisms that might serve this transfer from the arts to domains such as math, science, language, and social interactions.

The Dana Foundation has funded a $2 million study to try to delineate, for the first time, what (if any) specific effects an arts education has on basic cognitive processes and on the brain regions that are responsible for these processes. This is the largest study of its kind, with five leading neuroscience labs across the country taking part. John Jonides at the University of Michigan, Mark D'Esposito at the University of California,

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Berkeley, Brian Wandell at Stanford University, Laura-Ann Petitto and Kevin Dunbar at Dartmouth College, Michael Posner and Helen Neville at the University of Oregon, Elizabeth Spelke at Harvard University, and I will be looking at different aspects of the three major questions the study seeks to answer: whether education in the arts has a beneficial effect on learning in other academic areas, whether it stimulates development of particular cognitive processes that may have general effects across a wide array of tasks, and what brain mechanisms are influenced by training in the arts and how these brain mechanisms relate to learning in other areas.

The two major claims the study will investigate are that training in the arts changes the brain and that there is a critical period for arts learning. Many types of training—from sports to physics to, more recently, music—have been shown to change the brain. Thus training in cycling makes you faster at cycling, and piano lessons increase your ability to play a Bach sonata. This is all presumably due to increases in speed of processing. What remains to be examined is whether piano lessons can make you better at non-arts domains such as science, math, language, and social interactions.

A primary goal of the study is to identify brain regions that, if activated by arts training, could be used in other tasks. The specific cognitive skills the study will look at to determine whether arts training has an impact are attentional control, working memory, abstraction, the transfer of information between hemispheres, language and literacy/reading, social interaction, and mathematical ability.

Modern imaging technology makes it possible to see what areas of the brain are utilized during specific tasks. Using different methodologies (including standard behavioral measures of proficiency, transfer to other behavioral domains, and brain measurement technique) and the newest brain measurement techniques, including functional magnetic resonance imaging

(fMRI), event-related potentials (ERP), near-infrared spectroscopy (NIRS), and diffusion tensor imaging, the methods will be tailored to each specific issue being investigated. For example, whether drama students have increased capacity to switch from one task to another and an ability to take multiple perspectives on tasks that are unrelated to drama will be investigated using fMRI, ERP, and NIRS. Using these techniques and tasks, it will be possible to discern whether drama students have acquired a particular skill, what the brain-based mechanism underlying the skill is, and how well it generalizes to different domains.

The second major area of inquiry is sensitive periods—windows of time during which a skill can be learned most easily. It is known that there are sensitive periods for learning language; for example, until the age of 10 months, infants can distinguish phonetic differences in any language, an ability that rapidly weakens when children are between 10 and 12 months old. Are there specific periods for learning arts skills? If so, this could impact our educational system. The study will look at whether there is a key age period for learning arts, and whether the length of time for training has an impact. As an extension of this, researchers will examine whether students who have had extensive education in the arts at *different ages* in development show *differential mental gains* (while keeping constant the amount of training that they have had in the arts). Researchers will investigate sensitive periods in the area of dance, drama, painting, and music. The age at which children begin training and its effect on cognition and learning will be studied. The researchers will investigate whether different brain regions are activated by different tasks in children who have started training at different ages and have trained for different amounts of time. Such studies could allow researchers to tease apart the importance of the age at which training occurs vs. the length of training one receives.

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This study is particularly timely, because many school boards and educators are currently assessing the role of an arts education in the contemporary curriculum. For decades, educators, school boards, and parents have looked beyond the arts for their own sake and have asked whether an intensive arts education has effects on the mind beyond helping students becoming better at their chosen artistic field. The results of this research could impact future decisions about the place of the arts in the school curriculum as well as provide the first vigorous scientific attempt to create a comprehensive picture of the role of education in arts in changing the brain.