Does Music Really Make You Smarter?

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"Music makes you smarter and "the Mozart effect" have become increasingly visible buzz woods in the last few years. The possibility that music instruction might enhance learning In others areas has captured the Imagination of many. Many record stores carry "Music Makes You Smarter" CDs and the governor of Georgia has even proposed giving a CD to each newborn baby In the hopes of raising a generation of children who will do better when they reach school age. The purpose of this article is to examine this issue more closely. Following some background material, answers to the question are given in "no." "maybe," and "yes" sections.

BREIF BACKGOUND

The study that started this phenomenon first appeared as a letter to Nature (Rauscher, Shaw, and Ky, 1993). In this brief report, the authors described an experiment in which 36 college students completed spatial reasoning tasks following three different conditions: (I) after listening to 10 minutes of Mozart's Sonata for TWO Pianos in D major, K448; (2) after listening to 10 minutes of a relaxation tape: and (3) after 10 minutes of silence. Scores were translated Into spatial IQ scores of 119 (Mozart), 111 (relaxation tape), and 110 (silence); enhanced performance of the Motet condition did not extend beyond the 10-15 minutes it took for subjects to complete the spatial reasoning tasks.

Although there have been a number of other studies, one other example will suffice to set the stage for the subsequent discussions. The same research group (Rauscher, Shaw et al. , 1997) conducted an experiment in which 34 children received Private piano keyboard lessons, 20 children received private computer lessons, and 24 children provided other controls. All subjects took four spatial reasoning tasks before and after training. No significant-11provement was found on three of the four tests for any of the groups; the keyboard group did show significant improvement on a test of spatial-temporal reasoning. This effect lasted for at least 24 hours.

FURTHER BACKGROUND

Before answering the question posed in the title, there are three points to consider that will help place this issue in context. The first concerns the difference between magic and mystery. There are certainly many mysterious aspects to music. Probably everyone reading this article has felt the power of music and is aware of the profound affects. It can have. Music therapists can provide eloquent testimony to the power of music in dealing with handicapped individuals. Any music educator can describe incidents where students' lives were changed through music. How and why music has this power is not fully known; there are, in other words, many aspects of music that are mysterious and as yet unexplained. Music's power, however, is not magical. That is, music must obey the laws and principles of the universe that govern all human behaviors. We demean and diminish our profession when we make statements that seem to make it more like magic.

Another point concerns the tendency of our profession to jump on a bandwagon before we know if it has wheels or where it's going. A prime example of this occurred in the 1970s with exaggerated statements such as "music is in the right side of the brain." Twenty years later we know that music is not only in the right side, but in the left, the top and bottom, front and back: It’s all over the brain. Making a misstatement such as this by itself wouldn't be such a problem except that it led to further claims such as "if our children don't get music in the schools, the right sides of their brains will atrophy and then we have a generation of brain damaged kids."

Finally, the connection between musical experiences and SAT scores needs to be explored. As is commonly reported, students enrolled in music classes have higher SAT scores than state and national averages. What is not clear to everyone, however, Is the fact that one does not necessarily cause the other. If we wanted to explain why mu sic students achieve higher scores, we might look to such factors as home environments where education is supported, where parents are actively involved in their children's education, where skills such as time management are applied to everyday living, and so on. Showing a linkage is no proof by itself that these higher scores are the result of participation in music. In fact, some research (Holmes 1997) indicates that students who elect to participate in music ensembles tend to be brighter before they start music.

NO

One answer to the question - "Does music really make you smarter? - should be a resounding "NO." That is, certainly music does not make one smarter in any superficial sense. Here is a quick, informal test of logic that might help. Imagine going to any university campus and organizing the faculty into disciplines. Would it be reasonable to assume that the music faculty is smarter than the astrophysicists, the biochemists, the philosophers, or any other faculty group simply because they had heard more Mozart?

Once again, it demeans and diminishes our profession when we make extravagant, unsubstantiated claims. 1f we push this notion too strongly we are building a house of cards that may very well come down around us. Suppose we gain administrative and community support for music based on this idea and suppose that, like the "music is in the right side of the brain" fiasco, we later discover that, in fact, music does not make our students smarter. What will happen then?

MAYBE

There are two ways In which we may find some connections between music and other ways of thinking (e.g., spatial-temporal reasoning). One involves continued research and the other involves meta-analysis of that research. A growing number of studies concerned with this Issue are beginning to appear in the literature. Some tend to support the contention (Gardiner et al.. 1996: Sarnthein, et al., 1997), while other studies provide contradictory data (Carstens, Ruskin, and Hounshell, 1995; Newman et aL, 1995; Steele, Ball, and Runk, 1997). This is exactly the way research ought to proceed. That is, as many researchers continue to study this phenomenon over time we will gain an increasingly clearer comprehension. Until that time, however, we should be cautious in making extravagant claims that go beyond the available data.

The second part of the "maybe" answer is that several groups of psychologists are working on meta-analysis of these studies. A meta-analysis gathers all the pertinent data and looks for consistent threads that emerge to inform our understanding. Because these reviews are not yet in print, they cannot be cited here. However, I can report informally that there is general skepticism in the same sense that the "no" answer was given above. Whether or not there are more subtle connections between music and other cognitive processing strategies remains to be seen.

YES

"No" and "Maybe" answers have already been given to the question "Does music make you smarter?" There is also a sense In which the answer is "Yes." Though this will be the longest portion of the article, this entire section can be summarized by the statement that musical experiences alter the brain's makeup, both in terms of morphology (brain structures) and in terms of information processing.

Throughout the discussion comparisons will be made between musicians and non- musicians. Two points must be made: (I) there is no such thing as a nonmusician, in the sense of a person being amusical All human beings are guaranteed to be musical: even those with massive brain damage can have meaningful, albeit limited, musical experiences. It would be more accurate to use phrases such as "trained or untrained musicians" or "sophisticated and naive musicians," but musicians and non- musicians are more commonly used. (2) It Is Important to note at the outset that in keeping with the prior discussion, there is nothing magical about music.

Nearly everything we do as human beings has the potential to alter the brain. If we were to compare chess players with non-chess players, or sophisticated mathematicians with naive ones, and so on, we would also likely find differences.

OF INFANTS AND ELDERS

With very minor exceptions we do not add brain cells as we grow older; in fact, we lose brain cells throughout the aging process. What is most important, then, is not so much how many brain cells one has but the number of interconnections among brain cells. Children raised in an impoverished sensory environment make a paucity of synaptic connections, while those raised in a rich sensory environment make many more. If we were to look at the brain of a child who had been stimulated with many different sights, sounds, smells, textures, and so on, we would see a dense thicket of neuronal interconnections. Note again that music is not the only, nor necessarily even the most important, sensory input. Nevertheless, early childhood musical experiences in the form of lullabies, musical crib mobiles, and other similar experiences can aid in the development of the neural networks necessary for later music processing (Olsho, 1984; Trehub, Bull, and Thorpe, 1984).

What we do early in life and throughout our lives bears implications for our later years. A group of retired nuns, many In their 80s and 90s, has volunteered to participate in an ongoing investigation of cognitive processing; in effect they have willed their brains to science (Golden, 1994). 10 major themes have come out of the study so far: (1) The more learning one engaged in while growing up, the less likely one is to suffer from Alzheimer's or other forms of cognitive dementia. This relates to the presence of many interconnections described In the previous paragraph. (2) Use it or lose it. These elderly women are encouraged to start playing a musical instrument, if they don't already (or learn to use a computer or play chess, etc.). Or, If they already play an instrument, they are encouraged to learn a new one. Continued mental and emotional activity is also an effective antidote against cognitive decline. Incidentally. it is also true that music therapy can be a very effective mode of treatment for those who do suffer from Alzheimer's (Lard and Garner,I993) and the elderly in general (Clair, 1997).

THE AUDITORY CORTEX

Information from SQUID (super quantum interference device) indicates that the auditory cortex (that part of the brain responsible for processing sounds, located just above and behind the ear,) is organized spatially for musical tones much like a piano keyboard, with equal distance between octaves (Williamson and Kaufman, 1988). Since musical scales are a human invention and thus would not be passed on genetically, this is another indication of the effect of musical experiences. Furthermore, this area of the brain on the left side is larger among those with absolute pitch and those who started serious musical studies before the age of seven (Schlaug et aL, 1994: 1995). While it is possible that some people may choose musical activities because their brains are naturally predisposed in that direction, it is perhaps more likely that this is more evidence of the effects of musical training.

VIOLIST’S BRAINS

This notion that musical training effects brain structures is demonstrated in an investigation of violinists (Elbert et aL , 1995). Violinists are one of the few groups of people who have refined motor skills in the fingers of the left hand and gross motor skills in the right hand When researchers looked at the right somatosensory cortex (the area of the brain that processes information from the left hand), it was seen that the earlier the training began, the larger and more sensitive the cortical representation. Violinists who started as teenagers or later showed little differences when compared to those who hadn't played the violin at all.

BRAIN IMAGINING

Another line of research involves looking at the electrical activity of the brain via an EEG (electroencephalograph) machine. In one study, EEG coherence values were used to demonstrate linkage or cooperation between various brain sites, both within and between hemispheres (Petsche et al, 1988). Data indicated that trained musicians had much higher coherence values than untrained musicians. Subsequent research (Petsche, 1992; Pefsche et al. , 1993) showed that general brain strategies for music listening could be revealed by EEC brain mapping. Likewise, EEG brain mapping experiments show differences between trained and untrained musicians (Petsche et al., 1985: Flohr, Persellln, and Miller, 1996).

MUSICIANS ELECTRIFIED

Neural systems underlying musical performance, a uniquely human activity, are minimally understood. By monitoring the brain during music making, researchers hoped to learn more about this fascinating process (Fox, Parsons, Hodges, Sergent, 1995). Eight right-handed professional pianists participated to three neuroimaging conditions of Bach, Scales, and Rest. Neuroimaging involved both PET (position emission tomography) to determine function (what is going on) and MRI (magnetic resonance imaging), to determine precisely where the activity. Is taking place. In the Bach trials, the third movement of the Italian Concerto was performed from memory. Scales were executed synchronously with both hands at a tempo approximating that of Bach. During the Rest condition, subjects were simply asked to lie quietly and put the brain in "neutral."

Data analysis Involved subtracting PET data of one task from another (e.g., Bach minus Rest). The resulting information about function was mapped onto the MRI data for more precision in determining location. The main conclusions to be drawn from this experiment are that brain activation during piano performance primarIly involves motor systems, and that focused attention is clearly demonstrated through strong, focal areas of deactivation.

In a second study, the same group of researchers was more interested in music cognition (Fox, Parsons. Hodges, 1998). Accordingly, PET was used to image the regional cerebral blood flow in the brain In order to localize mechanisms selectively supporting the comprehension of the principal components of music. Eight right-handed, university music faculty members (each with a Ph.D. in music) detected errors in a computer-generated Instrumental performance of an unfamiliar Bach Chorale as they read Its score. The performed errors on each trial were exclusively either melodic, harmonic, or rhythmic. The errors occurred unpredictably every 23 beats, varying unsystematically In how they deviated from the score.

In general, these data support the notion that music is represented in the brains of trained musicians by widely-distributed, but locally specialized neural networks. Music is not processed simplistically in a single "music center," nor is it only a "right- brained" activity; activations were found scattered throughout many brain regions. Melody, harmony. and rhythm are processed in complex neural pathways that are dissociated from each other and from other behavioral tasks (e.g., language). These variations in location of activation suggest that the different regions or subareas perform different functions for different tasks. Also, a region in the right hemisphere (the fusiform gyrus) was activated for music reading that paralleled an area in the left hemisphere that becomes activated during language reading.

In sum. brain research indicates that music learning experiences change brain organization and brain processing. Trained musicians, brains are organized differently and operate differently than untrained musicians, brains.

MUSIC AND MULTIPLE INTELLIGENCES

By now, most readers are probably familiar with Howard Gardner's theory of multiple intelligences (Gardner, 1983). Incidentally, he has now added one and a half intelligences to his original list of seven, so that these intelligences are now represented:

1. linguistic intelligence
2. musical intelligence
3. logical-mathematical intelligence
4. bodily-kinesthetic intelligence
5. spatial intelligence
6. intrapersonal intelligence (access to one's own feeling life)

7. interpersonal intelligence (sensitivity to other's moods, motivations, intentions, etc.)
8. naturalist Intelligence (sensitivity to flora and fauna)
9. spiritual or existential intelligence (this one only partially qualifies because it does not meet all of the criteria)

Each of these intelligences represents a unique, autonomous way of knowing. Gardner accepted each of these only after they met all eight criteria he established:

1. potential isolation by brain damage
2. the existence of savant syndrome, prodigies, and other exceptional individuals
3. an Identifiable core of operations or set of operations
4. a distinctive developmental history, along with a definable set of expert "end-state" performances
5. an evolutionary history and evolutionary plausibility
6. support from experimental psychological tasks
7. support from psychometric findings
8. susceptibility to encoding in a symbol system

(For a more complete discussion of how music satisfies these eight criteria see Hodges)

Each of these intelligences has developed because it provides a unique way of knowing about the world. Each type of intelligence may be better suited for providing information about different aspects of the inner and outer worlds of human beings. Music, no better and no worse than other types of Intelligence, provides its own type of information. Music is particularly useful in providing a medium for dealing with the complex emotional responses that are primary attributes of humanity.

From the information presented in this article, it is clear that music learning experiences do affect brain organization and can be demonstrated in the brain as higher order thinking skills. Whether or not it turns out that music instruction improves performance in other areas (e.g., mathematics), music has value in and of itself.

Systematic learning experiences are necessary to move children from a beginning use of language or mathematics to the most sophisticated uses of these knowledge systems (e.g.. from "See Spot Run" to Shakespeare's Hamlet and from 2+2 = 4 to E = MC2). Likewise, music education - in the guise of systematic learning experiences - is necessary to move children from singing preschool songs (e.g., the Barney Song) to experiencing fully a work such as Handel's Messiah or Beethoven's Ninth Symphony.

Music is a special means for providing unique and powerful insights into the human condition. When every child receives a thorough music education, they do become smarter.

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