

How many of us have heard that playing Mozart for a fetus in utero will increase his or her math skills? Or that piano (or other instrument) training increases IQ? Listening to and making music has become a subject of significant interest to neuroscientists over the past decade as it has become clear that studying and playing an instrument has significant positive effect on the brain of the player. Listening to music impacts the brain in a special way as well, although listening alone is unlikely to enhance cognitive strength as much as playing it will. Nonetheless, there appear to be long term physical and mental health benefits for the serious listener, as well as for the player.

Neuroscientists have been studying the effects of music on cognition, brain function and anatomy in real time using Functional Magnetic Resonance Imaging (fMRI), Proton Emission Tomography (PET scan) and other sophisticated technologies. They have also been using various psychological tests to study the observable effects of music making and music listening. If you look at the fMRI while a person is engaged in some intellectual or physical work such as reading a book or hammering a nail, a part of the brain will light up on the scan. If you do an fMRI on someone listening to music, the brain image will light up all over. If you do the scan while someone is playing music, the brain image looks like a firework display on the 4th of July or Times Square on New Year's Eve.

Several years ago, a group of neuroscientists observed the results of MRIs of normally developing children that had been done at various points in their development, comparing the images and psychological test data of those who were studying and playing instruments to those who were not. They discovered that the rate and degree of cortical

maturation was significantly advanced in the music playing group. Importantly, the psychological test data revealed that the children who played music were better focused and had greater attention and processing speed than their peers. This correlated with greater overall academic achievement in the music group. These findings seemed not to be related to the children's parents' economic standing or to their base intelligence. Many studies here and in Europe support the findings that children with musical training are likely to have better language skills, better spelling ability, better grades, and better math skills and altogether make better students. Some go so far as to suggest that music training leads to a higher IQ although others don't necessarily corroborate this.

Playing an instrument utilizes many brain functions at the same time as it uses the senses of sight, sound and touch. It requires the modulation of attention, rapid processing speed, decoding ability (reading the notes with flats and sharps), motor planning, memorization, use of one's working memory, impulse regulation, emotional regulation and more. These functions aren't centralized in one area of the brain; rather they are located in numerous areas, with complex neural pathways keeping them in communication with each other. Playing music is for the brain like going to the gym is for the body. And, as with going to the gym, the longer and more intensely you exercise, the greater the value.

Sadly, music and arts education are disappearing from our schools. Children who play orchestral instruments most often come from the upper socioeconomic group and attend private schools. It obviously requires money as well as commitment to support a child's music education and the financially stressed public education system is



unwilling to take this on. Nationwide, only 26% of tenth graders participate in any kind of regular out of school music, dance or art program and only 14% percent of high school seniors participate in any such activity. However, there are many El Sistema-like programs in the U.S. and their outcome effects are significant. Kids 4 Harmony, for example, serves 70 inner city children in Pittsburgh, a small but meaningful number. Nationally, children who participate in similar programs are more likely to do better in school, to graduate, go to college and be gainfully employed than their peers who have not participated.

Playing music is good for kids. It's also good for adults. The cognitive enrichment documented for children has also been documented for adults, those who have continued to play from childhood on and those who began in adulthood. Senility is something we fear as we age and it is something that many of us will suffer. The cause and the cure for Alzheimer's disease are as of yet unknown. But there are important things we know that may influence cognitive decline and Alzheimer's. People who have less than an 8th grade education are 2.2 times as likely to develop Alzheimer's as those with greater educational attainment. Individuals with very high educational attainment, social success and who continue to have ongoing intellectual stimulation may have up to a 46% decreased likelihood of developing Alzheimer's. In the high attainment group, even if one does develop the disease, it's likely to become apparent much later in life and more likely to have a shorter course before death. We believe that this difference is due to something called "Cognitive Reserve."

Imagine planting two small garden plots, one next to the other. You fertilize, water and weed one, neglect the other. Both will grow. If there is blight or a drought, both plots will die. But the plot that had been well tended will remain healthier longer before it succumbs. The well-tended brain develops cognitive reserve in ways similar to the garden plot developing resilience to blight. As might be expected, playing an instrument and studying music leads to greater cognitive reserve, which, in turn, leads to a diminished or delayed likelihood of becoming clinically ill with

Alzheimer's. Obviously, playing an instrument is not the only activity that encourages cognitive reserve but it seems to be a powerful one.

There are more people in the audience than there are musicians on stage at a concert. Most members of the audience are consumers of and not makers of music. Beyond the pleasure of hearing good music, what else is in it for them? Music programs in Senior Citizen Centers have been shown to increase cognitive strength, decrease depression and increase social connectivity. An article in the July 2011 *Harvard Health Letter* summarized the medical literature on the benefits of actively listening to music: the health benefits of listening regularly included reduced blood pressure, increased survival after myocardial infarction, enhanced recovery after a stroke and diminished severity of symptoms in depressive disorder. Most dramatically, the *Health Letter* summarized a Swedish study of 13,000 adults. The data collected on this large population included health history, social network information and concert and theater attendance. Rather unexpectedly, during the time the study was in progress, people who did not attend concerts and theater regularly were 1.57 times MORE LIKELY TO DIE than were the active concert and theater goers. Of course, association is not necessarily causation. People who are able to attend concerts frequently are likely to have additional advantages over others as well, but even so this statistic is dramatic.

So enjoy doubly the music you are about to hear with the knowledge that it may contribute to your general good health and mental state—and could even extend your life.

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