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WHY SHOULD I LEARN MUSIC? IT CAN BE GOOD FOR YOUR BRAIN!

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Imagine a world without music—no summer concerts, no holiday sing-alongs, no dramatic orchestra music in movies leading to epic battle scenes. Would not that be terrible? Musicians train for a long time to create and play music. Playing music brings us pleasure and connects us to one another. Research shows that playing music also contributes to our overall health and wellbeing and helps our thinking and planning skills. In this article, we will first talk about how various parts of the brain are engaged to make music playing possible. We will also discuss benefits of music learning for the brain, including our thinking abilities and social skills. We hope that this article provides examples and evidence that making music is not only fun, but it can also benefit our overall wellbeing.

YOUNG REVIEWERS:

ALEX
AGE: 11

NOVA
AGE: 10

COGNITIVE NEUROSCIENTISTS

Researchers who study how the brains performs activities like thinking, reading, speaking, or playing music.

HOW DO WE STUDY THE BRAIN?

Cognitive neuroscientists are researchers who study how our brains perform activities like thinking, reading, speaking, or playing music.

FUNCTIONAL MAGNETIC RESONANCE IMAGING (fMRI)

A method to visualize brain activity by measuring the amount of blood flow in each brain region during an activity or while resting.

NEURON

A type of a cell in the brain that among others is responsible for receiving sensory input and sending motor commands to our body. Neurons carry these messages using electrical communication.

Some cognitive neuroscientists are interested in finding out how the brain understands different kinds of sounds, like sounds in nature, or speech, or music. One way they study this is using a technique called **functional magnetic resonance imaging** (**fMRI**). fMRI shows how much blood flow there is in various parts of the brain. More blood flow means more oxygen is being used. The more oxygen a brain area consumes, the more active the **neurons** (brain cells) are in that area. Using fMRI, cognitive neuroscientists can see how active certain brain areas are while people are performing tasks like listening to music, reading, or looking at the emotions on other people's faces. When you play or sing music, many brain areas are involved (Figures 1, 2).

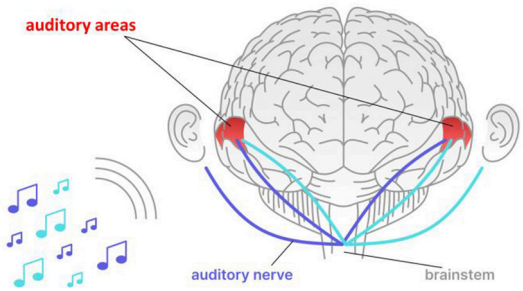

Figure 1

The auditory pathway. When you hear music, the sound travels through the air to your ear. Sound hits the eardrum, which vibrates. The vibration travels through the auditory nerve, up the brainstem, into a brain area called the auditory cortex. There are left and right auditory cortices (red). This brain image is shown as if you were looking at a person from the front and could see past the person's face into the brain.

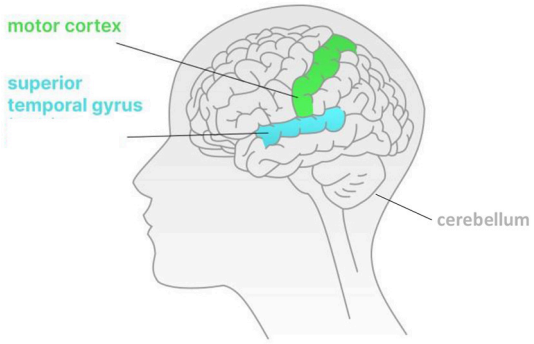

Figure 2

A side view of the left brain. The motor cortex (green) extends up and over the head from side to side, like a headband. The superior temporal gyrus (blue) is a brain region that is part of the auditory system. The primary auditory cortex is deep inside the brain, within the temporal lobe.

AUDITORY NERVE

The auditory nerve runs from the inner ear to the temporal lobe in the brain and carries sound information.

BRAIN REGIONS INVOLVED IN MUSIC

Let us begin by discussing what happens in the brain when we listen to and make music. First, how do you think sound travels from your ears to your brain? When you hear any type of sound, including sound of music, the sound first enters the ear and travels through the ear canal to the eardrum. The eardrum vibrates—just like a drum that has been struck. The eardrum then sends these vibrations through the middle and inner ear. Tiny hair cells in the inner ear move with the vibrations, sending a signal to the **auditory nerve**, which carries the signal to the brain (Figure 1).

AUDITORY CORTEX

AUDITORY CORTEX

The "hearing" region of the brain, located above the ears, that processes hearing information like pitch and loudness.

PITCH

The quality that makes music sound "higher" like a flute or violin, or "lower" like a tuba or bass.

One of the main brain areas that receives the signal from the auditory nerve is called the **auditory cortex** (Figure 1). The primary auditory cortex is deep inside the brain, right above the left and right ears, and it helps us decide how loud a sound is, or if it has a high or low **pitch**. Pitch is the quality that allows us to decide if musical sounds are "higher" or "lower." A higher-pitched sound could be made by a flute or violin, for example, while a tuba or bass could make a lower-pitched sound.

What other kinds of sounds are processed by the auditory cortex? How about listening to other people speak? Listening to language uses brain areas similar to those used when listening to music. This means that, when you are exercising your auditory system by playing music, you are also strengthening the connections you use to communicate with others. In fact, cognitive neuroscientists found that children who had 2 years of music training had better listening skills than children who did not have any music experience [1, 2].

MOTOR CORTEX

PRIMARY MOTOR CORTEX

The part of the brain that provides production of movement by sending signal to the muscles *via* long nerve fibers.

Another important brain area for playing music is the **primary motor cortex**. The primary motor cortex, located on the top of the brain, forms a shape that looks like a headband from ear to ear (Figure 2). It connects not only to other parts of the brain, but also down the spinal cord to the arms, legs, and singing muscles. It can actually travel through nerves that are a foot or more long! This is how a violinist's brain and fingers communicate when they play the violin, for example. There are also other regions in the brain that get involved when playing music; for example, there are areas for paying attention, or for feeling emotions like sadness or happiness.

CEREBELLUM

The area of the brain in the back of the head that allows people to coordinate and regular motor movements like moving to a beat or following a rhythm.

Beyond pitch, moving your muscles, attention, and emotion, can you think of anything else that playing music requires? Well, there is also rhythm. Rhythm refers to the timing and length of musical notes. Beat is the natural pulse in a song that helps us measure the rhythm. You can easily clap your hands, tap your foot, or move your body to a beat. The area of the brain that helps you move to a beat and follow a rhythm is called the **cerebellum** (Figure 2). It looks like a head of cauliflower and sits in the back part of the brain.

Finally, when you play music or sing with others, you must also listen to what you play or sing, to know whether it sounds beautiful or scratchy. Additionally, you must use your listening and movement skills to be in sync with other musicians. Research shows that synchronizing with other people's rhythmic beats leads to better social skills [3].

That is a lot of brain areas working together! Because playing music often requires many of these functions at once, the brain areas -work together. Interestingly, scientists have shown that children who have music training have stronger connections between the right and left sides of their brains, specifically between the left and right sensory and motor areas [4]. That means that continuous learning and regular music practice can change your brain.

If music training can change your brain cells, does that mean it can enhance your ability to learn other things? Yes! Researchers have shown that learning music can help with language development, improve mathematical abilities, and support memory and planning skills.

SOCIAL AND EMOTIONAL BENEFITS OF MAKING MUSIC

Music benefits you socially and emotionally, too! Drumming and moving with others can help you get along better with them [3]. Singing in choir every day also makes young musicians more generous and likely to share rewards with others [5]. We know this because researchers have done specific experiments on it. In one, researchers asked kids to decide whether to split a reward or keep it all but risk losing it. Kids who sang in a choir together every day shared the reward more often than kids in art and competitive-game groups [5]. Other studies with elementary school students showed that playing music in a group improves helping skills [6]. In another experiment, children felt more included after being involved in group music [7]. Participating in group music also significantly improved kids' ability to empathize with others [8]. This means that they could more easily tell if someone was sad and needed comfort. All of this is important because the world is built on community and connecting with other people. Playing music with others is not only fun—it also helps us share and connect.

Music is good for your brain in many ways. It can help your attention in school, improve your language skills, and help you connect better with other people. But do not be fooled— music for the sake of music itself is the greatest benefit of musical experiences. Again, imagine if the world had no music—it would be boring. Music connects us across cultures, is a lot of fun, and can help us to feel the most amazing emotions or cheer us up when we are sad. This is why every kid should have access to music training.

Unfortunately, not all kids are lucky enough to have access to music lessons. School budgets for music education—that is, money planned to pay for music teachers and instruments—are often small. What can you do to help? Keep participating in music! By attending music classes and playing music with your friends and family, you are showing your school and teachers that music classes are important to you. Now that

you know all about the benefits of learning and practicing music, share your knowledge with your friends, classmates, and family members, and tell them why you love music.

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YOUNG REVIEWERS

ALEX, AGE: 11

I like to play baseball and tennis. I like to go fishing anywhere, especially in FL. I also fly fish and like camping in the Rocky Mountains in CO. My favorite book series is the Spy School series and favorite colors are green and blue. Math and Science are my favorite subjects. I have one dog, one turtle, and 15 fish.

NOVA, AGE: 10

My name is Nova and I am in 5th grade. My favorite subjects are writing, science, social studies, and reading. When I grow up, I did like to be an architect, because I like art and I also like building. I think it is important for kids to be curious so they can learn. Albert Einstein said that he did not have a special brain, but he wondered how the universe worked, so he went out and learned, so he could figure it out.

AUTHORS

BRONTE FICEK-TANI

Bronte Ficek-Tani has loved music since birth. She plays piano and violin, sings, and conducts youth choirs. Neuroscience research has been her jam for the last decade—she researched music and the brain with the USC Brain & Music Lab, and brain stimulation in people with aphasia (a language disorder) at Johns Hopkins. Now she is a medical student at the University of Washington, based in Bozeman, Montana. Her hobbies include hanging out with her husband and friends, running and hiking in the mountains, and making music with friends.

ASSAL HABIBI

Assal Habibi is an Associate Research Professor of Psychology at the Brain and Creativity Institute at University of Southern California. She is interested to understand how biological dispositions and environmental factors interact and how learning experiences during childhood shape human development. She is an expert in the use of neuroimaging methods to investigate human brain. Dr. Habibi completed her doctoral work at UC Irvine, investigating the effects of musical training in musicians, non-musicians and patients with auditory impairments. Currently, she is the lead investigator of a multi-year longitudinal study, in collaboration with the Los Angeles Philharmonic and their Youth Orchestra program, investigating the effects of childhood music training on brain, cognitive, and social development. Dr. Habibi is a classically trained pianist and has many years of musical teaching experience with children. https://dornsife.usc.edu/labs/brainandmusic; *ahabibi@usc.edu