

The Magnitude of a Melody: Analyzing The Neurological Impacts of Music on Children and Adolescents

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Abstract

This paper discusses the impact of music on children, and especially adolescent, brain health. Most of these studies are often conducted on adults and give less information about how adolescents can utilize music to process and regulate their emotions and behaviors. This may not seem significant since adolescents are often treated as small adults and the concept of a distinct period of “teenagehood” in the United States has only been around for less than a century. But for adolescents growing up in this period of more technology, stress, and an entirely different lifestyle than previous generations, it becomes even more important to differentiate their brain anatomy and adults’ to understand the different outcomes they can experience through music. Teenagers that engage in musical activities have been shown to have stronger and more efficient neural connections which improve memory, mood, and cognitive development. This impact is further extended to young, receptive children who can grow into adolescents with healthy brains. Research points to the conclusion that there are many neurological benefits of interaction with music, especially for youth.

Introduction

Since the outbreak of COVID-19, the cognitive health of adolescents’ brains has become an increasingly popular discussion amongst scientists. During the pandemic and up until now, it seemed as if the average adolescent brain was aging too fast, with stress and anxiety being to blame [1]. That meant damaging long-term outcomes for teenagers, such as less mental activity and a decreased ability to learn or form new neural connections. Of course, these aspects of teenage life have not disappeared; in fact, they only seem to be on the uptick. Can listening to and engaging with music be used to negate external pressures and difficulties so that these stressors have less of an impact on children and adolescent’s brains?

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Comparing Children’s Neurological Response to Music with Adolescent Response

Studies have shown that listening to music strengthens cognitive abilities, develops neurological connections, and improves emotional regulation. Catharsis can be described as a method of emotional regulation. As introduced by Aristotle, catharsis is a practice which allows a person to “purge”, or relieve, their emotions in a controlled setting. The idea is that if one can release all the negative emotions that they have built up in this short or controlled period, they can experience less emotional turbulence and return to a sort of ‘homeostasis’ and normalcy afterward. In adolescents, using music to facilitate this process may be helpful in mitigating the problems that neuroscientists worry about in abnormal brain development. Such problems include premature brain aging and shrinkage that can lead to depression, loss of memory, lack of motivation, or decreased ability to learn. It is caused by an inadequate amount of positive emotions like connection and belonging. While it is important to try and increase the amount of positive feelings to improve brain health, it is just as essential to remember to care for the opposite problem: reducing and regulating the amount of negative emotions through catharsis. The three main areas in control of emotional responses to music are the amygdala, the nucleus accumbens, and the cerebellum [2, 3].

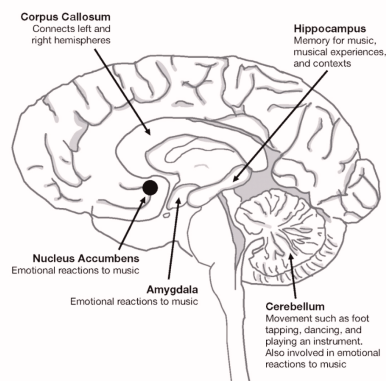


Figure 1: Diagram of the amygdala, the nucleus accumbens, and the cerebellum [2]

The amygdala is an important part of the developing brain because it assists in regulating emotions and decision making. Because the prefrontal cortex does not fully develop until the age of about 25, adolescents can have issues with their feelings overriding their decision making, especially in situations involving powerful or heavy emotions [4]. For example, in situations of extreme sadness, listening to sad music (songs in minor keys and with slower tempos) stimulates the brain to form a chemical called prolactin, which is a chemical that deals with grief. For one to have a catharsis moment that affects this part of the brain, they would need to pick a song that somewhat relates to their situation and evoke the desired emotions by purging their words (singing along) or having an emotional response (ex. crying).

The cerebellum is associated with movement and balance, cognitive function regulation, and sleep. A key difference between the cerebellum of an adolescent versus that of an adult brain is that adolescent brains continue in the process of synaptic pruning, especially during puberty [5]. In this process, extra or unnecessary neurons or synapses (the connections between neurons) are removed to strengthen the current connections. This creates a more efficient and focused brain. How do these two relate? Because the cerebellum is involved in these two main functions, adolescents can engage it by listening to music that engages their body to clap, dance, or sway. That will make room for an emotional release and, in turn, improve their cognitive function and efficiency in focus and decision-making.

Is Catharsis Bad?

According to Betterment, catharsis might have harmful effects, particularly in contexts where it amplifies negative emotions such as anger. The author uses the example of a domestic abuser. “If catharsis was effective, an abuser might stop at a punch. Instead, they continue beating until their partner, or child, or anyone, really, is dead” [6]. While this may be true in some situations, catharsis is best used to foster positive emotion rather than exacerbating negativity. The beauty in music is its fluidity—just a subtle alteration such as a half-step up from the third note in a chord can create a major chord that evokes feelings of happiness and elation. The same goes for changing the song to one with a faster tempo. As Daniel J. Levitin puts it in *This Is Your Brain on Music*, in Western culture we tend to associate major scales with happy or triumphant emotions” [2]. Continuing to use

music as a way to “purge” gloomy emotions can be beneficial, especially when it’s followed by a different type of music that can help increase positive feelings.

Effects on Children

“Music does evoke a sense of wonder and awe for lots of people,” notes Daniel Levitin, a brain-scanning neuroscientist at McGill University. Levitin’s research explores music’s effect on the brain and its ability to amaze people—particularly its profound effects on children [7]. Children’s brains have heightened neuroplasticity, which enables the brain to reorganize itself and adapt to new stimuli, due to brain-derived neurotrophic factors [8]. This heightened neuroplasticity primes children’s brains to swiftly receive and form new connections when they encounter unfamiliar experiences; particularly, when they have their first encounters with music. A common early exposure to music for children is through lullabies. In the process, their brains release an abundance of oxytocin. Evidence has emerged saying that in developing brains, oxytocin plays a pivotal role in organizing neural circuits (which deals with increased memory retention) and helps children develop context-appropriate social behaviors and cognition later on in life [9]. Their natural curiosity and eagerness to enjoy a world that they have not yet seen puts them in the perfect position to experience a sense of wonder. Dacher Keltner, a professor of psychology at UC Berkeley, reports that experiencing wonder causes us to orient our focus to something bigger than ourselves. foster a sense of community, countering our desire for selfishness or hyper-individuality [10]. Embracing a communal perspective is especially important for children in their brain development. Feelings of community rather than hyper-individuality lead to greater feelings of connectedness, thereby releasing feel-good chemicals like serotonin, and feeling like they are a part of something bigger makes room for more neural pathways as the brain expects to experience and learn more in the future. For these reasons, it’s best for people (and their brains) to be exposed to music at early ages.

The exposure to music from an early age initiates a process of reorganization and expansion for new neural connections happens, as they absorb information on types of genres, instrument families, melodies, and rhythms. And of course when this knowledge is built up after a long enough time, it can eventually be applied. Children can begin to form creative ideas and

make music themselves. Yumi Kendall, now a professional cellist in the Philadelphia Orchestra, exemplifies this trajectory. Introduced to her older brother playing the violin from an early age, she began playing the cello at the age of five. Music gave her a sense of community as it allowed her to play music with her friends on playdates, which further demonstrates music's ability to connect children to a larger community and give them the sense of awe as they not only listen, but also play with others [10].

Can Music Also Have the Opposite Effect?

While music generally benefits children and adolescent brain health, it can have adverse effects when used in the wrong environment or circumstance. Research indicates that young children are especially susceptible to being distracted by music while trying to complete a task. This can lead to overstimulation and a diminished attention span. However, research by the National Library of Medicine does show that when separating music from task completion, children can have greater attention spans. Still, exposing children to music before completing tasks will help them have better concentration and focus which can possibly lead to overstimulation when trying to concentrate and complete a task [11].

The type of music being played can also influence whether or not music will have a negative effect. Prolonged exposure to excessively loud music can lead to hearing damage at any age, so more aggressive music genres may not always have the presumed advantages. That is especially true for children and young adolescents who have more sensitive hearing. A downside for adolescents is that because the amygdala is stimulated when strong emotions are at play, the activity of the prefrontal cortex decreases and can lead to more impulsive decision-making [12]. These effects can be mitigated by refraining from music that triggers a strong wave of negative emotions before making a decision, and instead listening to music that brings clarity, like slower classical or jazz music, or upbeat music that brings serotonin and feelings of happiness.

Conclusion

This essay underscores the universal benefits of music across the developmental spectrum. Developing brains require avenues to expand and form new connections, and engaging in musical activity is conducive to that need.

It exposes youth to a broad variety of sounds and rhythms that gives them a sense of awe and connection, which can initiate healthy brain activity. Music has the capacity to counteract the harmful effects of stress and anxieties that adolescents face. Its ability to both evoke heavy emotions to trigger catharsis as well as evoke positive emotions to induce serotonin and joy makes it all the more beneficial for adolescents dealing with emotional stressors and other issues. Music, in all its styles and genres, has the power to build better, healthier, brains for youth now and in the future.

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