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MUSIC AND THE EFFECTS ON THE BRAIN AND EMOTIONS

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ABSTRACT

In our daily lives, music plays a crucial role as a universal and significant art form that offers a verbal expression-free way of expression. This essay investigates the varied impacts of music, emphasizing how it affects mental growth, emotional resonance, and general well-being. According to neuroscientific studies, enjoyable music causes the brain's reward system to produce dopamine, resulting in a feeling of euphoria and adding to the emotional and physical impacts of music. Additionally, it has been demonstrated that listening to music improves cognitive capacities such as memory, attention, and problem-solving capabilities. As shown in studies, exposure to music from an early age promotes superior language and math skills, and learning to play an instrument enhances coordination and motor skills. According to the arousal-and-mood theory, listening to music raises arousal levels and increases interest in learning tasks, which improves memory recall. Additionally, music has an impact on stress levels and emotional states in addition to cognitive function. Neurochemicals that produce feelings of pleasure, happiness, and relaxation are released when emotional brain areas, such as the limbic system, are activated. Therefore, music can act as an outlet for stress and reduce tension, with some genres, such as classical or instrumental music, having a more relaxing impact than others. Additionally, it has been acknowledged that music may be used to treat mental health issues, including anxiety and sadness. For both children and adults, music therapy programs that are adapted to each person's tastes and emotional requirements have shown encouraging benefits in lowering depression symptoms and fostering peacefulness. It has been discovered that early exposure to music has long-lasting advantages that affect mental health and overall quality of life. As a result, including music in early childhood education programs and using music therapy in medical settings can have deep and long-lasting effects on people's well-being. In this essay, the changing potential of music is emphasized, along with its contribution to brain growth, emotional control, and the advancement of mental health and well-being.

INTRODUCTION

Music, which is influential, moving, and the most popular of all the arts, is a daily activity for most people. Some find it a way to express what conventional words cannot. Music has the ability to chemically alter one's brain, allowing them to feel a rush of pleasure as they start to get familiar with the rhythms and beats. According to research conducted by neuroscientists Robert J. Zatorre and Valarie N. Salimpoor, "When pleasurable music is heard, dopamine is released in the stratum—an ancient part of the brain found in other vertebrates as well—which is known to respond to naturally rewarding stimuli like food and sex and which is artificially targeted by drugs like cocaine and amphetamine." (Salimpoor, 2011). This release of dopamine in response to pleasurable music can create a sense of euphoria and contribute to the emotional and physiological effects of music on individuals. Although some might think that music is a source of distraction and is a minute part of our lives, it shows otherwise, as it has been proven that music plays a significant role in our brain development, cognitive performance, fluctuating emotions, and well-being.

LITERATURE REVIEW

Studies have identified the complex relationship that music has with the brain and how it impacts our brain functions. In a study published by Michael Trimble and Dale Hesdorffer titled Music and the Brain: The Neuroscience of Music and Musical Appreciation, they explore the neurological mechanisms behind music's ability to evoke emotions and stimulate cognitive processes. The authors discuss how various aspects of music, such as rhythm, melody, and harmony, activate various regions of the brain and contribute to emotional regulation and mood enhancement. Using techniques such as functional magnetic resonance imaging (fMRI) and electroencephalography (EEG), they showed how neural networks are involved in emotional processing, which engages several areas in the brain during musical experiences. Additionally, they highlight the therapeutic potential of music in treating neurological disorders like Parkinson's disease and dementia, further emphasizing its profound impact on mental health and well-being. However, a counterexample to this claim could be individuals who have a condition called amusia, which is the inability to perceive or appreciate music. Despite having intact neurological mechanisms, these individuals are unable to experience the emotional and cognitive effects that music typically evokes in others. Amusia is a rare condition that challenges the notion of music as a universal therapeutic tool. It highlights the complexity of the human brain and its varied responses to stimuli. While music may have a profound impact on most individuals, it is important to acknowledge and study cases like amusia to gain a deeper understanding of the brain's intricate workings and how it influences our perception and appreciation of music. In conclusion, research into how music affects the brain and emotions remains intriguing. Trimble and Hesdorffer's studies shed light on music therapy and demonstrate its therapeutic

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potential for the brain processes that underlie the emotional effects of music. A deeper investigation of individual variations in musical perception is prompted by the existence of conditions like amusia, which serve as a reminder of the variety of human responses to music. We can use music's transforming potential to advance mental health and well-being if we continue to understand how it affects the brain.

METHODOLOGY

This paper uses a secondary, qualitative method of research due to the use of references from other papers, sources, and findings. The objective of this study is to investigate how this seemingly casual activity of enjoying music could have a significant impact on mental well-being and emotional regulation while also exploring the potential benefits. The limitations of this method could be subject to possible bias, and the findings may not be generalizable due to the preferences and habits of individuals. The findings of this paper can contribute to the understanding of the cognitive, emotional, and mental benefits of music, which allows different educational programs, therapeutic interventions, and policy initiatives to incorporate music into early childhood education and mental health practices.

RESULTS & DISCUSSION

Firstly, music aids in the development of our brain, progressing it in numerous ways. One of the major ways is through the enhancement of cognitive skills such as memory, attention, and problem-solving abilities. Numerous studies have shown that individuals who engage with music from an early age tend to have better language and mathematical skills compared to those who do not.

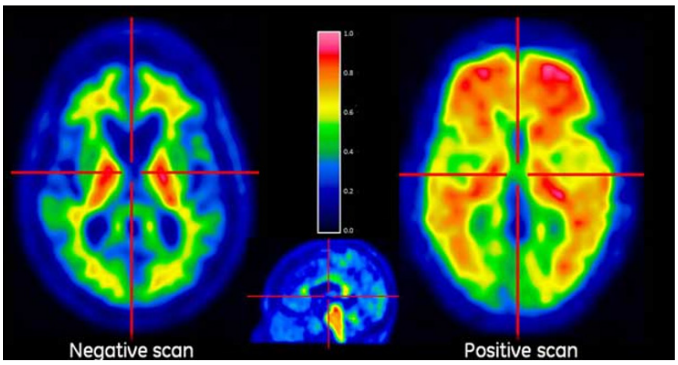
Additionally, learning to play a musical instrument has been linked to improved coordination and motor skills, further highlighting the positive impact of music on brain development. In a 2008 study published in the journal Perception and Motor Skills, researchers found that rhythm with or without musical accompaniment has an effect on a person's ability to recall, which means that listening to music could possibly help someone remember information.

In addition to the 2008 study, a 2010 study in Perception and Motor Skills found that music had the ability to improve our cognitive function, even outside the context of memory tasks. In an experiment that they conducted, 56 male and female university students were tasked with completing a linguistic and spatial processing task while listening to 10 excerpts from Mozart symphonies. The results showed that the background music was linked to the speed at which people process things, such as shapes and patterns, and the accuracy of their ability to process words.

Furthermore, the study revealed that participants who listened to Mozart's symphonies performed significantly better on both the linguistic and spatial processing tasks compared to those who completed the tasks in silence. These findings suggest that music, particularly classical compositions like Mozart's, can enhance overall cognitive abilities. The improvements in the brain could be explained by the arousal-and-mood hypothesis." The hypothesis states that music enhances one's level of how awake and alert they are, which puts one at an optimal level to enhance memory recall. The theory also suggests that adding entertaining auditory backgrounds makes a learning task more interesting, which increases the learner's overall level of arousal. Not only does listening to music improve one's cognitive function, but playing music can also provide such benefits.

Playing a musical instrument requires active engagement from multiple cognitive processes, including the sensory and motor systems, which means that many parts of the brain are activated during the process. This activation of various brain regions can enhance neural connections and improve overall cognitive abilities. Additionally, playing music has been shown to improve memory, attention, and problem-solving skills, making it a valuable activity for cognitive development.

A research group in Spain conducted an analysis on whether these benefits are restricted to lifelong musicians or if they can also apply to those who begin musical training later in life. They assessed the cognitive function of adults who are 59 and older who engaged in music for the duration of their lives, and a separate assessment was made of participants who received musical training as older adults, aged 60–85. According to the results, they found that being exposed to musical instruments throughout life was associated with protection over cognitive functions, especially when musical training started at an early age. The benefits extend beyond musical training; they also include improvements to general cognitive functions such as attention, reasoning, and speed of processing. Those who start musical training later in life also receive similar enhancements as lifelong musicians. Unlike those who started training in their youth, where benefits were maintained throughout life, the effects of training in later life were lost after participants stopped their musical training. This suggests that continued engagement in musical practice may be necessary for long-lasting benefits.



Source: Nordic Life Science News (2015)

Figure 1: A Diagram of a Brain Before and After Listening to Music

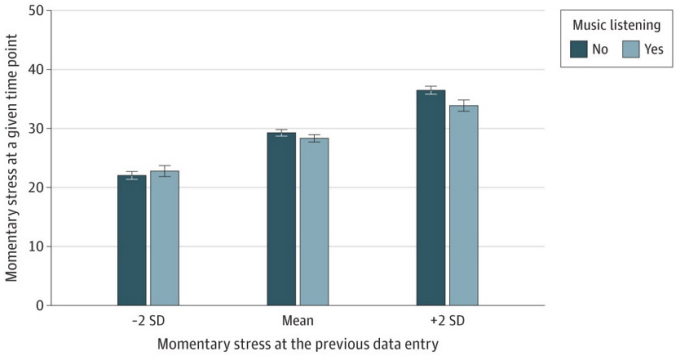
Secondly, music is in charge of our fluctuating emotions and stress levels. When one presses the play button on their device to start up their playlist, this action triggers increased blood flow to areas of the brain that generate and control our emotions. The emotions that we feel when we listen to music are the result of

dopamine, which triggers sensations of pleasure and well-being. Dopamine is a signaling molecule that acts as a messenger in our nervous systems and as a hormone that affects tissues in the body. It performs many roles in the body but is best known for its ability to make us feel pleasure and happiness. When our dopamine levels rise, we feel better, and our mood improves.

Dopamine is also involved in the brain's reward system, which explains why we often feel a sense of satisfaction and reward when listening to music. This neurotransmitter plays a crucial role in reinforcing pleasurable behaviors, such as listening to music, by creating a positive association in our brains, which not only boosts our mood but also relieves us from anxiety. When we start to get familiar with a certain song, our brains automatically trigger the release of dopamine upon the first few notes of the song. Just as Pavlov's dogs were able to associate the ringing of a bell with food, even if it was not provided, we humans are similar in this sense, as our brains actively set off a feeling of bliss whenever we encounter recognizable rhythms. This phenomenon is not limited to just familiar songs, as even new and unfamiliar music can also stimulate the release of dopamine.

Our brains are wired to seek out and respond to patterns, and when we discover a new rhythm or melody that we enjoy, it can still trigger a pleasurable response. This release of dopamine in response to pleasurable music can create a sense of euphoria and contribute to the emotional and physiological effects of music on individuals. Additionally, the researchers found that the anticipation of pleasurable music also triggers the release of dopamine, further enhancing the overall experience. Music has the power to uplift our spirits, soothe our souls, or even bring us to tears. Whether we are happy, sad, or somewhere in between, it can resonate with our emotions and provide a cathartic release. Just like how yoga, meditation, and exercise can help lower physical and psychological stress, music can also have the same effect on our bodies. In a 2015 study published in the journal The Lancet, it was mentioned that music affects the release of neurochemicals in the brain, which increases the release of serotonin and dopamine, reducing the effects of cortisol, as music stimulates physiological and psycho-emotional responses that open brain pathways that link positive memories and feelings to reduce stress.

Research has shown that listening to music can reduce levels of the stress hormone cortisol and promote relaxation. Moreover, certain genres of music, such as classical or instrumental, have been found to have a particularly calming effect on the mind and body. Overall, incorporating music into our daily routines can be a powerful tool for managing stress and improving overall well-being. When we hear a song, our auditory cortex, which is the part of the brain that is responsible for processing sound, is activated, which starts up other areas of the brain, including the limbic system and the motor cortex, which are responsible for emotions and movement. As more parts of the brain are activated, one may start feeling the effects of the music. For example, when someone listens to an upbeat and fast-paced song, the activation of the limbic system and motor cortex may cause them to feel a surge of energy, leading to increased heart rate and physical movements such as dancing or tapping their feet. On the other hand, if someone listens to a slow and melodic piece of music, the activation in these areas may induce a sense of tranquility and relaxation, causing them to unwind and experience a decrease in stress levels. However, there are certain individuals who may have different reactions to music. For instance, someone with a neurological condition like Parkinson's disease may experience involuntary movements or tremors when exposed to fast-paced music, even if they would typically induce a surge of energy in others. Similarly, individuals with anxiety disorders may find slow and melodic music agitating rather than relaxing, as it may trigger racing thoughts or heightened feelings of unease.



Source: Bob Yirka, Medical Xpress (2023)

Figure 2: A Graph of Stress Levels After/While Listening to Music

Thirdly, music can improve our mental health and well-being. Anxiety and depression have become increasingly prevalent in today's society, and music has been recognized as a potential tool for managing these conditions. According to a 2017 review published in the journal Frontiers in Psychology, music could be seen reducing symptoms of depression. When compared to the control groups that did not listen to music, there was a significant decline in depression levels over time in the group that did in 26 of the 28 studies that were examined. One example of music being used to manage anxiety and depression is the incorporation of music therapy in hospitals. For instance, in pediatric wards, children suffering from anxiety or depression are often given personalized playlists to listen to during their stay. These playlists are carefully curated by music therapists, considering the child's preferences and emotional needs. The soothing melodies and lyrics provide a sense of comfort and distraction, helping to reduce their uneasiness and promote relaxation.

Additionally, music therapy has been found to be effective for adults as well. Many hospitals offer group music therapy sessions where patients can come together and participate in activities such as singing, playing instruments, or creating music. Engaging in these activities allows patients to express their emotions in a non-verbal way and connect with others who are going through similar experiences. This shared experience helps to create a sense of belonging and support, which can significantly impact their mental health and well-being.

Overall, music therapy in hospitals offers a unique and

comprehensive approach to managing anxiety and depression, providing patients with a therapeutic and enjoyable outlet for their emotions. According to an AARP survey, people who listen to music have higher mental well-being scores and slightly lower levels of anxiety and depression than the general population. The survey also discovered that an introduction to music at an early age led to lasting benefits. 68 percent of those who were exposed to music as children rated their quality of life higher than those who had no prior exposure. These findings suggest that music not only has immediate positive effects on mental well-being but also has long-term benefits that can contribute to a higher quality of life. It is evident that early exposure to music plays a crucial role in shaping individuals' overall well-being and highlights the importance of incorporating music into early childhood education programs. In general, the inclusion of music in early childhood education can have a profound and lasting impact on individuals' overall well-being and future success.

CONCLUSION

Music is a potent and significant art form that transcends simple amusement. It has the power to change how our brains function biologically, causing dopamine to be released and resulting in feelings of pleasure and happiness. The growth of the brain is significantly influenced by music, which improves cognitive capacities like memory, focus, and problem-solving skills. Music engages distinct parts of the brain, whether it is heard or played, strengthening neural connections, and fostering cognitive development. Additionally, music has a significant impact on our feelings and levels of stress. Dopamine is released in response to enjoyable music, which can boost our spirits, calm our souls, and offer a cathartic release. It has the capacity to appeal to our emotions, ease tension, and encourage relaxation. Hospitals that use music therapy to treat anxiety and depression are among the locations where the therapeutic benefits of music have been documented. People can find solace, diversion, and support by creating personalized playlists and participating in musical activities. Furthermore, music benefits our physical and mental well-being.

According to studies, listening to music can lessen the symptoms of depression, and early exposure to music can have positive effects on mental health for a lifetime. It has been discovered that using music in early childhood education programs can influence people's quality of life, encouraging a greater feeling of well-being and long-term success. Music stands out as a distraction-free, cross-cultural language that enables us to communicate in ways that words alone are unable to. It significantly impacts our thoughts, feelings, and behavior daily. Music has the capacity to move us, uplift us, and link us to the depths of our humanity, whether we are looking for motivation, comfort, or just pure delight. Its importance as a life-changing force is highlighted by its profound impact on mental health, emotional stability, and brain development.

REFERENCES

1. Budson, A. E., MD. (2020, October 7). Why is music good for the brain? Harvard Health.https://www.health.harvard.edu/blog/why-is-music-good-for-the-brain-2020100721062
2. Ferreri, L., Mas-Herrero, E., Zatorre, R. J., Ripollés, P., Gómez-Andrés, A., Alicart, H., Olivé, G., Marco-Pallarés, J., Antonijoan, R. M., Valle, M., Riba, J., & Rodríguez-Fornells, A. (2019). Dopamine modulates the reward experiences elicited by music. Proceedings of the National Academy of Sciences of the United States of America, 116(9), 3793–3798. https://doi.org/10.1073/pnas.1811878116
3. J. (n.d.). Why — and how — music moves us | Pfizer. https://www.pfizer.com/news/articles/why_and_how_music_moves_us#:~:text=Music%20and%20Mood&text=The%20limbic%20system%2C%20which%20is,when%20our%20ears%20perceive%20music.&text=The%20chills%20you%20feel%20when,of%20pleasure%20and%20well%2Dbeing
4. Mehegan, L., & Rainville, C. (2020). 2020 Music and Brain Health Survey. https://doi.org/10.26419/res.00387.001
5. Moreno, S. (2009). Can music influence language and cognition? Contemporary Music Review, 28(3), 329–345. https://doi.org/10.1080/07494460903404410
6. Salimpoor, V. N., Benovoy, M., Larcher, K., Dagher, A., & Zatorre, R. J. (2011). Anatomically distinct dopamine release during anticipation and experience of peak emotion to music. Nature Neuroscience, 14(2), 257–262. https://doi.org/10.1038/nn.2726
7. Shepherd, B. (2022, December 15). How does music affect your brain? livescience.com. https://www.livescience.com/how-does-music-affect-your-brain
8. Speranza, L., Pulcrano, S., Perrone-Capano, C., Di Porzio, U., & Volpicelli, F. (2022). Music affects functional brain connectivity and is effective in the treatment of neurological disorders. Reviews in the Neurosciences, 33(7), 789–801. https://doi.org/10.1515/revneuro-2021-0135
9. Trimble, M., & Hesdorffer, D. C. (2017). Music and the brain: the neuroscience of music and musical appreciation. BJPsych International, 14(2), 28–31. https://doi.org/10.1192/s2056474000001720
10. Wang, J., Wang, J., Wang, Y., Chai, Y., Li, H., Miao, D., Liu, H., Li, J., & Bao, J. (2023). Music with Different Tones Affects the Development of Brain Nerves in Mice in Early Life through BDNF and Its Downstream Pathways. International Journal of Molecular Sciences, 24(9), 8119. https://doi.org/10.3390/ijms24098119
11. Warren, J. D. (2008). How does the brain process music? Clinical Medicine, 8(1), 32–36. https://doi.org/10.7861/clinmedicine.8-1-32