Music therapy: presenting new medical treatments for the neurological diseases

Ziad Bahaa Eldien Ibrahim, STEM High School for Boys - 6th October

Ahmed Sameh Kahla, Dakahlia STEM School

Mentor: Jonathan Maged, STEM High School for Boys - 6th October

Abstract

A time-based sound art that communicated thoughts and emotions in meaningful ways via rhythm, melody, harmony, colour, tones, or sounds used in a single line (melody) or many lines (harmony) and heard or to be sounded by one or more voices, instruments, or both are all definitions of music. Music is more than some tones; music can help treat some severe diseases and significantly impact the physical and mental state of the person, which can be called music therapy. Music therapy is an allied health profession, " the clinical and evidence-based use of music treatments to achieve customised objectives within a therapeutic relationship by a certified practitioner who has completed an accredited music therapy curriculum." Music therapy is a diverse discipline. Music therapists use music-based experiences to address client needs in one or more of the following domains of human functioning: cognitive, academic, emotional/psychological; behavioural; communication; social; physiological (sensory, motor, pain, neurological, and other physical systems), spiritual, and aesthetics. This research paper aims to cover how the human brain understands and processes sound, specifically music.

I. Introduction

The brain is a complicated structure made up of linked parts. The brain's structural and functional connections have the characteristics of complex networks and may be studied using theoretical graph methods.[1]

Vibrations from a sound system pass through the air and enter the ear canal. These vibrations irritate the eardrum and are converted into an electrical signal, which goes down the auditory nerve to the brain stem and is reconstructed into what s referred to as music. Music is considered a popular entertainment and potent stimulation for

brain waves. Music characteristics alter depending on the style and genre of music, resulting in varied impacts on brain activity.[2]

According to UCF (University of Central Florida), music severely impacts brain function and human behaviour, including reducing stress, pain, and symptoms of depression, as well as improving cognitive and motor skills. Music affects many parts of the brain. Some of them are the temporal lobe, frontal lobe, amygdala, hippocampus, and cerebellum. [3]

This research paper will go into deep about the effect of music on specific parts of the brain, music's impact on daily routines and moods, and how music can participate in curing some diseases.

II. How Brains Process Sound

Music is a solid and frequent emotional experience for many individuals, yet so few of us comprehend entirely how certain sounds impact emotions. To grasp how bodies interact with sound.[2]

Simply put, the body senses sound as vibrations and convert them into electric pulses. The cochlear nerve system transports electrical impulses into the brain via nerve cells called neurons. The signals are sent to the brain's cerebral cortex via the cochlear nerve system.

While this may not appear to be incredibly "simple", it is one of the most complex things bodies perform daily - scientists have uncovered the critical phases of how sound flows from the source to the brain.[4]

The main parts that are affected by music are

- Temporal lobe
- Amygdala
- Frontal lobe
- Cerebellum
- Hippocampus

They will be explained in detail in the coming sections.

i. Temporal lobe

The temporal lobe is in the bottom part of the brain, immediately behind the temples within the skull, from where it derives its name. It is also located above the brain stem and the cerebellum. The temporal lobe plays a critical role in establishing and maintaining both conscious and long-term memory.[5]

The temporal lobe interprets various frequencies, noises, and pitches received through the ears. As part of this process, the temporal lobe in humans is responsible for selective hearing. Selective hearing aids in filtering superfluous frequencies, allowing a person to focus on the vital

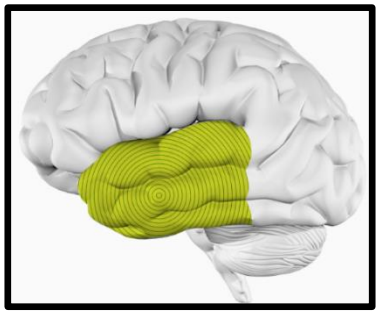

Figure 1 Temporal lobe [3]

noises in their surroundings.

As the brain's language centre, the temporal lobe enables song lyrics comprehension. The temporal lobe is always engaged when listening to music, especially songs without lyrics. The temporal lobe is the music processing centre, but two of its subregions allow for more enjoyment of what is heard.[6]

ii. Amygdala

The amygdala is a complex collection of cells located in the brain's centre, near the hippocampus (associated with memory formation). The amygdala is primarily.

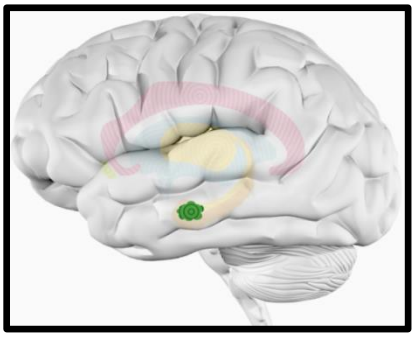

Figure 2 Amygdala [3]

While the amygdala might warn of an oncoming ambulance or an aggressive dog, it is also the portion of the brain that makes people happy when hearing a familiar voice or the soothing sounds of rain.[7]

The amygdala has a clear relationship to music, and studies suggest that reactions to specific music genres are practically universal. Music may generate the same emotional cues as the noises stated above: a horror film soundtrack can elicit nearly primordial terror, while a soaring war march can inspire enthusiasm.

Similarly, meditation music can help relax the mind and the body. And, regardless of the listener's prior mood, catchy pop music might induce an easy smile. The amygdala is responsible for all these physiological reactions to music.[8]

iii. Frontal lobe

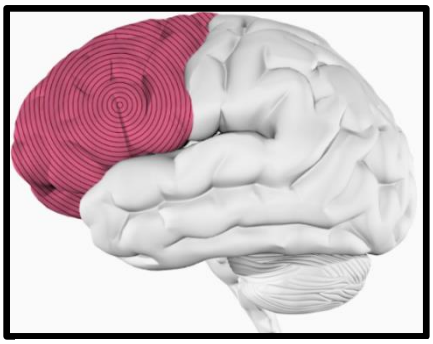

Figure 3 Frontal lobe [3]

The name implies that the frontal lobe is in the front of the brain. The frontal lobe's right hemisphere governs the left side of the body and vice versa.

While neurologists do not entirely understand how music influences the frontal lobe, musical interests, perspectives, and preferences for genres and songs are influenced by frontal brain activity.

According to research, the frontal brain serves as a centre for how to respond to music. Those are still being researched, although this portion of the brain is a common target for music therapists.[6]

iv. Cerebellum

The cerebellum is a part of the brain located at the back of the brain between the occipital and temporal lobes of the cerebral cortex. Despite accounting for only around 10% of the brain's volume, the cerebellum contains more than 50% of the brain's total number of neurons. [9]

The

Figure 4 cerebellum [3]

cerebellum does not originate motor signals; it changes motor commands from the descending pathways to make motions more adaptable and accurate. Movement is a typical musical result and is closely related to the cerebellum. The cerebellum is the brain region that prompts and coordinates movement in reaction to (or in rhythm with) music, whether tapping a foot, dancing a jig, or plucking an air guitar.

Playing instruments is likewise entirely dependent on this portion of the brain. According to research, even a few weeks of piano training can affect the cerebellum. Those functional alterations aren't limited to performing music; simply listening to music or envisioning playing the piano can have the same effect.

The cerebellum is also in charge of muscle memory. While cognitive ability and long-term memory might deteriorate with age, the cerebellum matures differently as a discrete portion of the brain. This has resulted in reports of coma patients reacting to the music, Alzheimer's patients playing instruments, and stroke sufferers rediscovering their voices via singing. As a result, the cerebellum is very useful for various types of music therapy.[10]

v. Hippocampus

The hippocampus is a complicated brain region located deep within the temporal lobe. It serves a crucial role in learning and memory. It is a malleable and fragile structure that many stressors may harm. According to research, it is also impacted by several neurological and mental illnesses.[11]

Music does not simply have a momentary

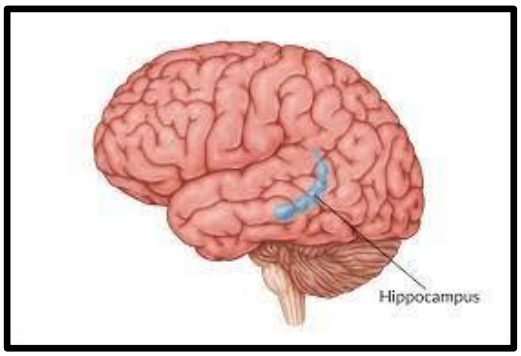

Figure 5 hippocampus [3]

influence on the brain; research reveals that hearing or playing music changes brain shape and brain function, especially when the same

music is played again. This is because the hippocampus is opposed to the cerebellum.

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Scientific research on the hippocampus has revealed a substantial relationship between music listening and long-term and short-term memory. With its themes and phrases, music's repetitive nature stimulates short-term memory while creating long-term memories. That's why individuals may remember a song they heard on the radio the day before but also recall the dress they wore and who else was in the car when they heard that music 30 years later.

This impact varies depending on the sort of music being played. This lends credence to the notion that music may strongly influence brain activity. Music may be produced to target different brain areas, eliciting various emotions from the listener. While this enables musicians and composers to create profoundly emotional music works, it also demonstrates that music may be a beneficial tool for healthcare practitioners.[12]

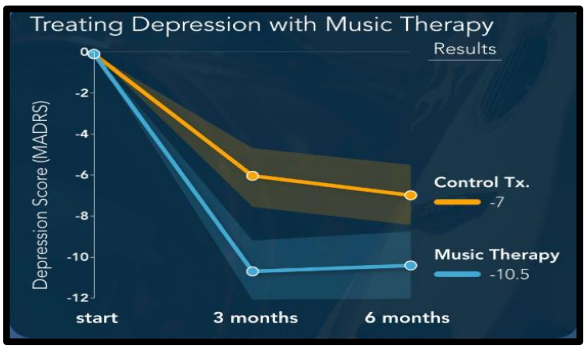
III. Music: A closer look

Music affects the feelings and mood of listeners and musicians in many ways that have been proven by research. It can be noticed when feeling special after listening

to the favourite music now, or when music excites, or when deeply moved when hearing a romantic song, but in all cases, when listening to liked music, have fun regardless of its nature, which happens scientifically.

i. Effect of Music on Dopamine

Dopamine is a neurotransmitter that transmits



Graph 1 Depression with and without music therapy [28]

information between nerve cells. It is also an essential and dangerous hormone that helps improve mood and a feeling of inner happiness and very comfortable satisfaction within a system known as the reward system within the brain. Neurons in the brain release dopamine within several dopaminergic pathways when doing a favourite thing or beloved to us, regardless of whether it is helpful or harmful.[13]

Some research indicates that listening to music can create peak emotions, which increase the amount of dopamine.

Thus, if this statement is confirmed, it indicates that music has two positive and harmful effects in the long run. As for the positive impact, it is represented in the feeling of pleasure, happiness, and satisfaction associated with listening to music and thus relaxation of nerves and calm. The bad thing is that research confirms that the secretion of dopamine over time is a result of Doing a sure thing that will lead to addiction, and thus addiction to music, which may hurt

the person, and from here conclude that listening to purposeful music must be sponsored to avoid that.[14]

ii. Music and attention

Most people have tried listening to music while performing specific tasks, such as studying while listening to music, believing that this helps them focus, motivates them to continue, and improves their mood, increasing their productive and absorptive capacity.

The result was uneven for people; for some, it was positive for him and increased their production capacity and helped them well, while for others, the music distracted their attention and reduced their productivity in the same period compared to others.

The answer to this problem is that music does not affect people similarly. It differs from one person to another. It may be helpful for people to produce and harmful to others.

When music is helpful for a person while performing his tasks, it will reduce pressure and impressively stimulate him, improve his mood, and help him to focus, memorise and understand well. Still, to be helpful, certain types of music must be listened to because some music may be harmful to them, and the kind of music varies according to the person the listener.

As for the other type of people harmed by listening to music while working, this happens because it reduces their focus, distracts their attention, and makes memorising and understanding complex. Therefore, the matter varies from person to person, and the process is not equal for everyone. The person must try it himself, in the beginning, to determine his condition in this matter.[15]

iii. Music and Memory

Some research says it has been found that in musicians, compared to non-musicians, there is more grey matter in the part of the frontal cortex known to accommodate neural networks involved in many crucial working memory processes.

After knowing this information, can music help develop memory and help treat Alzheimer's disease?

Research strongly indicates that music significantly improves memory, as music works to reactivate some brain cells responsible for memory.

Music has played a significant role in helping Alzheimer’s disease treatment, as listening to music brings back old memories related to the patient, which allows us to treat him better.

Alive Inside movie tells how music can help restore parts of memory and improve brain health and quality of life for Alzheimer's patients.[16]

IV. Music therapy

Music therapy is the clinical application of music to achieve customised goals such as stress reduction, mood enhancement, and self-expression. It is a well-established

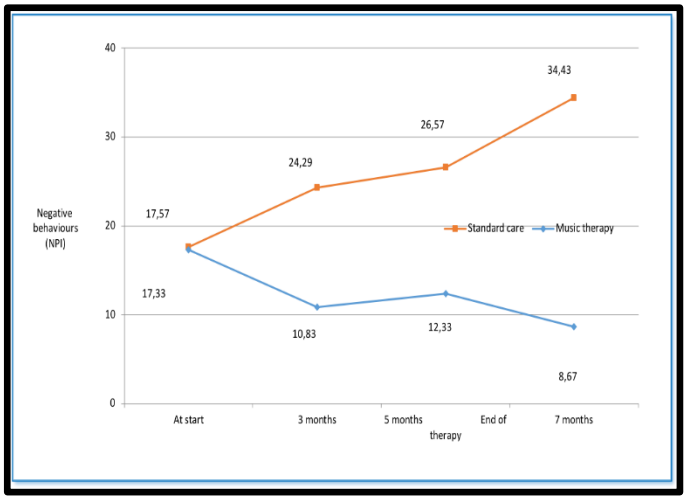
evidence-based treatment in the medical world. Listening, singing, playing instruments, or making music are all examples of music therapy experiences.

Behavioural, biological, developmental, pedagogical, humanistic, adaptive music instruction and other paradigms may be used in music therapy.

Music therapy improves one's quality of life by incorporating interactions between a skilled music therapist and one individual and another, the individual and their family, and the music and the participants. These connections are organised and changed using musical components to create a good atmosphere and set the stage for successful growth. [17]

Music therapy can treat things like

- ASD
- Alzheimer's disease



Graph 2 Negative behavior with and without music therapy [29]

- Chronic pain
- Substance abusing

Those things will be discussed in detail in the coming sections.

i. Autism spectrum disorder (ASD)

Autism spectrum disorder is a brain development illness that affects how a person sees and socialises with others, producing difficulties with social interaction and communication. The condition also exhibits restricted and repetitive behavioural patterns. The word "spectrum" refers to the various symptoms and severity associated with an autism spectrum disorder.

Autism spectrum disorder encompasses formerly distinct disorders such as autism, Asperger's syndrome, childhood disintegrative disorder, and an unidentified kind of pervasive developmental disability. Some individuals still refer to autism spectrum disorder as "Asperger's syndrome," which is widely regarded at the moderate end of the spectrum.[18]

Autism spectrum condition manifests itself in early infancy and ultimately creates social, academic, and occupational functioning difficulties. Autism symptoms often appear in youngsters during the first year of life. A tiny proportion of children seem to grow normally in the first year but subsequently have regression between 18 and 24 months when they acquire autistic symptoms.

While there is no cure for autism spectrum conditions, early intervention may significantly impact the lives of many children.

Music therapy may assist children with ASD in improving their abilities in main outcome areas such as social interaction, verbal communication, initiating behaviour, and socioemotional reciprocity. Within the treatment framework, music therapy may also assist in improving nonverbal communication abilities. Furthermore, music therapy may enhance social adaption abilities in children with ASD and promote the quality of parent-child interactions in secondary outcome domains.

Children with ASD have the same obstacles in music therapy as in other therapeutic modalities, in school settings, or at home. To date, research has provided some evidence of effectiveness. In secondary and tertiary diagnostic services, child development centres, and clinical and educational settings where music therapy is included as part of the multidisciplinary services, this intervention is most notable in promoting interpersonal communication, reciprocity, and the development of relationship-building skills. [19]

ii. Alzheimer's disease

Alzheimer's disease is a brain illness that progressively deteriorates memory and cognitive functions, as well as the ability to do fundamental tasks. Most people with the disease — those with late-onset symptoms — have symptoms in their mid-60s. Early-onset Alzheimer's disease is uncommon and occurs between 30 and 60. Alzheimer's disease is the most common cause of dementia among the elderly.[20]

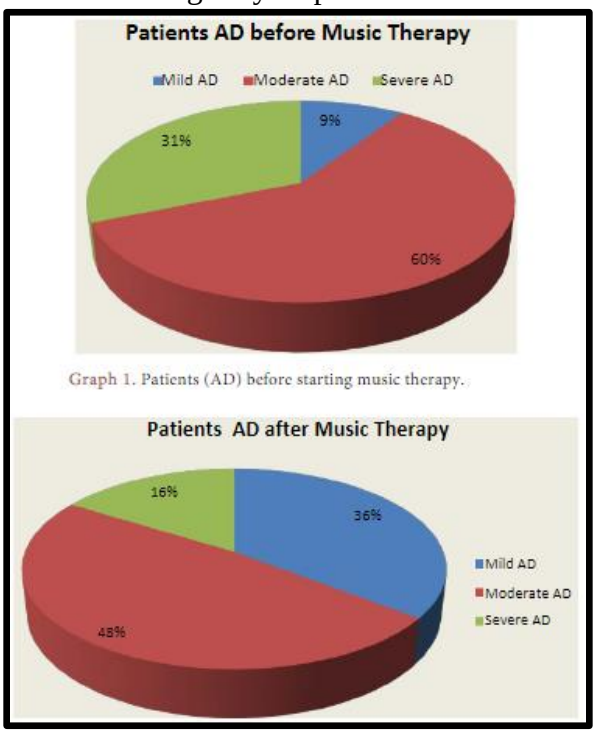
Because there is no treatment for the condition, others focus on measures to enhance a patient's quality of life. Music has several advantages for people living with Alzheimer's at various stages of the illness. Music therapy has been shown in studies to enhance a patient's attention and capacity to interact with people close to them and may reduce their need for psychiatric medicines.

Music has various advantages for people with Alzheimer's at each stage of the illness. This is particularly true in the latter stages of Alzheimer's disease, when individuals may become disconnected from their surroundings and lose their capacity to interact and connect with people verbally.

When people with Alzheimer's hear music, they often experience a perceptible shift. They may perk up and become more interested in their environment. They may sing, dance, or clap their hands when they hear music. Responses to rhythm bypass the brain's standard response mechanism. Instead, the brain reacts directly to the music and instructs the body to respond by clapping, swaying, or humming.[21]

Going out dancing or attending a concert may aid patients in the early stages of the condition. Respect their preferences, even music they used to like. Brain alterations may influence their musical perception. Those who used to play an instrument may find it pleasurable to do so again. Note and play precious pieces, such as wedding tunes, to evoke good recollections.

As the condition worsens, listening to music while walking may improve balance. Music may also be utilised to lift a person with Alzheimer's mood, and relaxing music can assist with nocturnal behaviour concerns. Later, while recalling old occurrences, the same favoured bits may spark a person's recollection. Music often stimulates people living with advanced Alzheimer's to exercise. Relaxing music also relaxes and comforts.[22]



Graph 1. Patients (AD) before starting music therapy.

Graph 3 AD patients with and without music therapy [30]

iii. Chronic pain

Endorphins are released when listening to music, according to this article. Endorphins are chemicals that interact with pain receptors in bodies, disrupting pain signals and providing a sense of well-being. They operate similarly to opioids but without undesirable side effects. Endorphins function as the body's natural painkillers.

For years, music has been used to treat acute pain (such as during cancer treatment and before, during, and after surgery) with substantial success. Many studies show that when music therapy is used after surgery, patients take fewer painkillers and have a more positive attitude.[23]

This use of music in acute pain treatment may also be used for chronic pain. In the long run, the same analgesic effect may be obtained, reducing the need for medicines. When combined with other established pain treatment techniques and therapies, patients may have a significant reduction in pain and a notable increase in their levels of functioning.

Studies show that music stimulates parts of the brain that control and decrease pain. This indicates that listening to music may assist the brain in managing and minimise discomfort in the body. Those suffering from chronic pain often feel detached or dissociated from our bodies as a coping mechanism. This may lead to a loss of self-awareness. Patients may benefit from music therapy by being more aware of their bodies and reconnecting with themselves. This understanding may assist patients in learning how to control their symptoms better.[24]

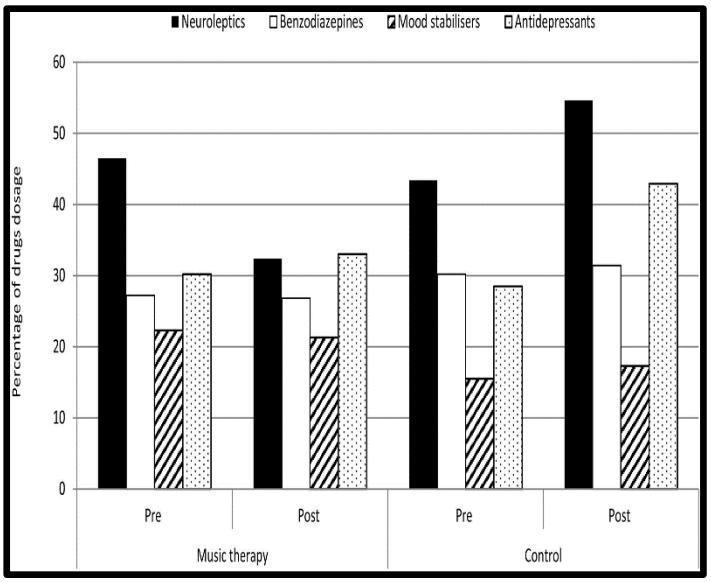
Distraction tactics (such as listening to music) may be helpful in everyday life. Distraction is one of the primary coping mechanisms to deal with chronic pain and bipolar condition. Distracting allows attention to more positive things rather than lingering anxieties or pessimism. Music can greatly assist, whether it's distracting from discomfort during exercise or singing a song to improve mood and re-energize when taking a break from work.

Research on the use of music as a treatment for chronic pain sufferers discovered that those who listened to music had a higher quality of life despite their discomfort. "Music may offer an emotionally engaging diversion capable of lowering both the sense of pain and the associated unpleasant affective experience," they discovered.

Many patients retreat from social events for fear of aggravating their pain or inability to keep up with loved ones. This may lead to loneliness, exacerbating chronic pain symptoms, stress, and destructive emotions. Music therapy may provide a feeling of connection and involvement, mainly when done in a group setting where patients can meet others who are going through similar challenges.[25]

iv. Substance abusing

One advantage of music therapy is that it can be utilised in almost any situation. It may be used in intense inpatient treatment programs, outpatient programs, group settings, and any other structured intervention. Music therapy may be used to treat drug use disorders to reduce stress, help people relax, boost focus on recovery, and assist those struggling to adapt to the demands of substance use disorder recovery. When utilised under the supervision of a music therapist, music therapy has defined aims, and its application is employed to achieve these goals.[26]



Graph 4 Percentage of drug dosages with and without music therapy [31]

vdo not need to participate in a structured music therapy intervention program to benefit from the use of music. Music may be used discreetly to improve mood, forget about the stresses of the day, and as a distraction tool to cope with cravings and other challenges typical in recovery. Whether used as a standard form of therapy or as a private method of relaxation and treatment improvement, music is not intended to be a replacement for a professional drug use disorder treatment program. It is intended to boost the effectiveness of these initiatives.[27]

v. Conclusion

Many things related to the effect of music on the brain have been clarified in two ways, the first psychological and the other from an anatomical point of view of the brain. From a psychological point of view, it was concluded that music affects mood, attention, and memory. The seven strategies that improve the listener's perspective were concluded behind the impact of music on dopamine. The impact of music on memory was influential, as it is used to enhance the process of treating Alzheimer's disease. On the other hand, the research paper showed how music affects the brain in terms of the physiology of some parts of the brain affected by music. At the beginning of this part, the mechanism of the hearing process and its understanding through the brain have been explained well. The five elements of the brain that are affected by music have been clarified: the temporal lobe, amygdala, frontal lobe cerebellum, and hippocampus. The location of each part of the brain, its role in the listening process, and the effect of music on it were shown clearly. In the third and final section of the research paper, the significant role of music in treating many diseases and solving many health problems was presented. It has been shown that music therapy effectively solves many health problems, and four examples of health problems that music can contribute to their treatment have been clarified. These four diseases are autism spectrum disorder (ASD), Alzheimer's disease, chronic pain, and substance abuse. From all these words, we can deduce the role of music and sounds in our lives. In the end, every process that happens is calculated and accurate, and not a coincidence, and with careful consideration and patience, everything can be exploited for the benefit of man.

vi. Literature Cited

1. *Brain anatomy and how the brain works*. Johns Hopkins Medicine. (2021, July 14). Retrieved August 2, 2022, from https://www.hopkinsmedicine.org/health/conditions-and-diseases/anatomy-of-the-brain
2. *Music*. Cambridge Dictionary. (n.d.). Retrieved August 2, 2022, from https://dictionary.cambridge.org/dictionary/english/music
3. *Music and the brain: What happens when you listen to music*. Pegasus Magazine. (n.d.). Retrieved August 2, 2022, from https://www.ucf.edu/pegasus/your-brain-on-music/#
4. *Copyright 2004 scientific American, Inc.*. (n.d.). Retrieved August 2, 2022.
5. Jeneson, A., & Squire, L. R. (2011). Working memory, long-term memory, and medial temporal lobe function. *Learning & Memory*, *19*(1), 15–25. https://doi.org/10.1101/lm.024018.111
6. *Hub*. Sci. (n.d.). Retrieved August 2, 2022, from https://sci-hub.mksa.top/https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4953706/

7. Olucha-Bordonau, F. E., Fortes-Marco, L., Otero-García, M., Lanuza, E., & Martínez-García, F. (2015). Amygdala. *The Rat Nervous System*, 441–490. https://doi.org/10.1016/b978-0-12-374245-2.00018-8
8. Gosselin, N., Peretz, I., Johnsen, E., & Adolphs, R. (2007). Amygdala damage impairs emotional recognition of music. *Neuropsychologia*, *45*(2), 236–244. https://doi.org/10.1016/j.neuropsychologia.2006.07.012
9. Middleton, F. (1998). The cerebellum: An overview. *Trends in Neurosciences*, *21*(9), 367–369. https://doi.org/10.1016/s0166-2236(98)01330-7
10. Khorram-Sefat, D., Dierks, T., Herminghaus, S., & Hacker, H. (1997, January 1). *fMRI correlates of music listening cortical-cerebellar activation pattern*. Psychiatry Research: Neuroimaging. Retrieved August 3, 2022, from https://www.infona.pl/resource/bwmeta1.element.elsevier-03c8e581-aa68-3608-8148-f5ff88c157cc
11. Eichenbaum, H., Otto, T., & Cohen, N. J. (1992). The hippocampus—what does it do? *Behavioural and Neural Biology*, *57*(1), 2–36. https://doi.org/10.1016/0163-1047(92)90724-i
12. Watanabe, T., Yagishita, S., & Kikyo, H. (2008). Memory of music: Roles of right hippocampus and left inferior frontal gyrus. *NeuroImage*, *39*(1), 483–491. https://doi.org/10.1016/j.neuroimage.2007.08.024
13. Ferreri, L., Mas-Herrero, E., Cardona, G., Zatorre, R. J., Antonijoan, R. M., Valle, M., Riba, J., Ripollés, P., & Rodriguez-Fornells, A. (2021). Dopamine modulations of reward-driven music memory consolidation. *Annals of the New York Academy of Sciences*, *1502*(1), 85–98. https://doi.org/10.1111/nyas.14656
14. Sutoo, D., & Akiyama, K. (2004). Music improves dopaminergic neurotransmission: Demonstration based on the effect of music on Blood Pressure Regulation. *Brain Research*, *1016*(2), 255–262. https://doi.org/10.1016/j.brainres.2004.05.018
15. Shih, Y.-N., Huang, R.-H., & Chiang, H.-Y. (2012). Background music: Effects on attention performance. *Work*, *42*(4), 573–578. https://doi.org/10.3233/wor-2012-1410
16. Ferreri, L., Bigand, E., & Bugaiska, A. (2015). The positive effect of music on source memory. *Musicae Scientiae*, *19*(4), 402–411. https://doi.org/10.1177/1029864915604684
17. *Music therapy*. Physical Medicine & Rehabilitation, Chang Gung Memorial Hospital, Taipei. (n.d.). Retrieved August 4, 2022, from https://www1.cgmh.org.tw/intr/intr2/c3390/en/music-therapy.htm
18. Lord, C., Elsabbagh, M., Baird, G., & Veenstra-Vanderweele, J. (2018,

August 2). *Autism spectrum disorder*. The Lancet. Retrieved August 4, 2022, from https://www.sciencedirect.com/science/article/abs/pii/S0140673618311292

19. *Hub: Music therapy for people with autism spectrum disorder. Cochrane Database of Systematic Reviews: 10.1002/14651858.CD004381.pub3*. Sci. (n.d.). Retrieved August 4, 2022, from https://sci-hub.mksa.top/https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD004381.pub3/abstract
20. Bush, A. I. (2003). The metallobiology of Alzheimer's disease. *Trends in Neurosciences*, *26*(4), 207–214. https://doi.org/10.1016/s0166-2236(03)00067-5
21. Fukui, H., Arai, A., & Toyoshima, K. (2012, September 26). *Efficacy of music therapy in treatment for patients with Alzheimer's disease*. International Journal of Alzheimer's Disease. Retrieved August 4, 2022, from https://www.hindawi.com/journals/IJAD/2012/531646/
22. Brotons, M., & Pickett-Cooper, P. K. (1996, March 1). *Effects of music therapy intervention on agitation behaviors of Alzheimer's disease patients**. OUP Academic. Retrieved August 4, 2022, from https://academic.oup.com/jmt/article-abstract/33/1/2/916222
23. Magill-Levreault, L. (1993). Music therapy in pain and symptom management. *Journal of Palliative Care*, *9*(4), 42–48. https://doi.org/10.1177/082585979300900411
24. Korhan, E. A., Uyar, M., Eyigör, C., Yönt, G. H., Çelik, S., & Khorshıd, L. (2013, January 31). *The effects of music therapy on pain in patients with neuropathic pain*. Pain Management Nursing. Retrieved August 4, 2022, from https://www.sciencedirect.com/science/article/pii/S1524904212001749
25. Selm, M. E. (1991, January 1). *Chronic pain: Three issues in treatment and implications for music therapy*. OUP Academic. Retrieved August 4, 2022, from https://academic.oup.com/mtp/article-abstract/9/1/91/1075071
26. DINGLE, G. E. N. E. V. I. E. V. E. A., GLEADHILL, L. I. B. B. Y., & BAKER, F. E. L. I. C. I. T. Y. A. (2008). Can music therapy engage patients in group cognitive behavior therapy for substance abuse treatment? *Drug and Alcohol Review*, *27*(2), 190–196. https://doi.org/10.1080/09595230701829371
27. Aletraris, L., Paino, M., Edmond, M. B., Roman, P. M., & Bride, B. E. (2014). *The use of art and music therapy in Substance Abuse Treatment Programs*. Journal of addictions nursing. Retrieved August 4, 2022, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4268880/

28. MD, C. L. (2019, March 22). *Data on Music Therapy & Depression: Visualized Health*. clearvuehealth.com. Retrieved August 4, 2022, from https://www.clearvuehealth.com/b/music-therapy-depression/
29. *Embedding Music and music therapy interventions in Dementia Care Pathways: Research Trends, clinical practice and policy in the 21st Century*. Music, Mind & Brain @ Goldsmiths. (2019, May 12). Retrieved August 4, 2022, from https://musicmindandbrain.wordpress.com/2019/05/12/embedding-music-and-music-therapy-interventions-in-dementia-care-pathways-research-trends-clinical-practice-and-policy-in-the-21st-century/
30. *Illustration of follow-up ad patients results in absolute numbers ...* (n.d.). Retrieved August 4, 2022, from https://www.researchgate.net/figure/Illustration-of-follow-up-AD-patients-results-in-absolute-numbers-before-and-af-ter_tbl1_351948858
31. *Figure 2: Difference between baseline, pre-test, and post ... - researchgate*. (n.d.). Retrieved August 4, 2022, from https://www.researchgate.net/figure/Difference-between-baseline-pre-test-and-post-test-outcome-variables-by-using-repeated_fig3_322546427