

# The Efficacy of Music Therapy on Brain Trauma Patients

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**Abstract:** Music therapy has been something that has been explored in small measures throughout different therapy procedures especially for patients with Traumatic Brain Injuries (TBI). TBI often leads to issues with motor function, memory, and information processing, therefore it is often part of standard rehabilitation to try and encourage retention through different stimuli including music. There has been some research in how listening to familiar music and or learning to play a new instrument has a positive impact on rehabilitation outcomes. Treatment plans can range depending on the goals of the patient, but music related therapies are often easy to implement and attractive because it does not involve any intrusive procedures. There is already extensive study on how music can have an effect on mood, and since brain injury often leads to issues in emotion regulation and depression it is worth further venturing how it could be used in cognitive remediation. Music can also be incorporated in multisensory therapies in order to further stimulation. Although music is undoubtedly a counterpart to other more concrete treatments like pharmaceuticals or surgery there is potential in its use in cognitive behavioral therapies to further help patients improve engagement and quality of life.

**Keywords:** Music Therapy, Traumatic Brain Injury, Alzheimer's Disease, Cognitive Behavioral Therapy, Rehabilitation.

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## I. INTRODUCTION

Most people can agree that music often elicits a very emotional response. Studies have consistently shown that when people listen to music, their emotions fluctuate; and that it has a clear effect on emotions, mental activities, and physical reactions. This being said, music therapy has always been considered as a plausible treatment and rehabilitation tool for patients with dementia, Alzheimer's Disease, and Traumatic Brain Injury (TBI). Traumatic brain injury, a disruption in the normal function of the brain that can be caused by a blow, bump, or jolt to the head which can lead to significant and debilitating damage. Therefore, even more care has to be taken to make sure that treatments are noninvasive as possible and can be implemented long term. This paper will analyze the effectiveness and benefits of this type of rehabilitation therapy to improve memory and brain function, and also the effect of music therapy in general for more prevalent diseases such as Alzheimers. There are multiple studies about different types of music therapy, and many results show that music therapy can improve cognition, boost muscle control, and aid patients to relearn speech skills. Music therapy engages several different areas in the brain at once, and therefore effectively improves overall brain function, which can help especially with TBI patients. Although music therapy is not considered a cure or a necessary treatment for survival, in many cases it has shown to ease the mental distress that often follows such a debilitating injury and is a non-intrusive, often pleasant treatment that can be consistently done for patients.

## II. PROCESS OF MUSIC THERAPY

Music as a form of treatment has always been considered in the field of mental rehabilitation; there is evidence that shows music therapy is prevalent in American culture. It was very important even during World War I and II. Wounded soldiers when listening to music, noticed a change in mood and reported that they felt less pain. Research has shown that music can function as a rhythmic structure for the systematic release of body tension, mood change, and positive thoughts. In hospitals,

people tend to have a lot of stress due to their anxious feelings toward illness. Those stresses usually include headaches, chest pain, and fatigue. One of the best treatments for stress and mental problems is music. Certain types of music can offer happy, energetic, and calm individualized people<sup>1</sup>. Music therapy (MT) is a non-pharmacological treatment that has been used for many years and has found relative success especially for dementia patients. For these patients music therapy can reduce cognitive decline especially in autobiographical and episodic memories, psychomotor speed, executive function domains, and global cognition. This type of treatment is especially attractive since it requires no pharmaceutical or intrusive procedures. The most common form of music therapy entails: listening to music in general, singing songs, or implementing background music while doing day to day activities. More intense music-based interventions can entail multisensory stimulation and cognitive remediation. This can include a range of different types of treatment plans- and could even require a patient to learn how to play a new instrument. When we listen to music or are in anticipation for something, our brain releases dopamine, which is a happy chemical we receive from our reward system. Hearing music can also help patients connect their current life events to events from their early memory<sup>8</sup>. Our brain develops very fast during the ages of 12 to 22, and music can often reignite memories that are associated with our pubescent and most formative years. Using melody and rhythm to interact and stimulate brain function can change patients' mood to improve cognition and influence behavior.

### **III. EFFECTS OF TRAUMATIC BRAIN INJURY (TBI)**

Traumatic Brain Injury is often debilitating for patients as it leads to impairments in sensory, motor, language, and emotional processing, and also in cognitive functions such as attention, information processing, executive functions, and memory. As with other types of brain injuries even after the crucial health concerns are mitigated, it is hard to be certain about the extent of damage in individual patients and even more difficult to come up with an effective plan for treatment given these circumstances. One of the symptoms of TBI is the inability to recognize and respond to emotional cues. In many cases "Traumatic Brain Injury (TBI), areas of the brain commonly associated with emotion are particularly susceptible to damage; as a result, people with TBI often exhibit impaired recognition of others' emotions, despite the heterogeneity of their injuries...Quality of interpersonal interactions and relationships partially depends on accurate interpretation of others' emotions via nonverbal, semantic, and contextual cues. Thus, it is important to consider how these cues are processed under various conditions so that interventions that target specific issues can be designed"<sup>4</sup>. An area of research is that of the ability of TBI patients to recognize positive and negative facial emotions in others. As stated, "To experience and express appropriate responses to everyday emotional situations requires the ability simultaneously to interpret a combination of nonverbal emotion cues, including contextual ones...If contextual information enhances affect recognition, people with TBI may benefit from interventions that match various affective cues (eg, vocal emotion expressions) to contextual situations...allowing clinicians to demonstrate subtle and obvious emotion expressions and point out contextual cues that might help patients to infer emotions of others"<sup>4</sup>. Through this study we can see how other modes of stimulation such as the film and television clips proposed could allow patients to pick up on contextual clues to better interpret emotional cues from others. In some cases even just having background music on better helped participants recall past memories. In accordance with this theory, music has also become widely used as an external stimulus to encourage TBI patients to be able to more accurately decipher emotions and social cues from others. Damage to the orbitofrontal cortex is also common in TBI patients as, "The orbitofrontal networks are in close proximity to bony protrusions and are vulnerable to trauma-induced rotational acceleration of the brain"<sup>10</sup>. This damage is also what could be causing some of the interpersonal challenges as well since the orbitofrontal cortex is crucial in decision making as "...it is the highest integration center for emotional processing. It also receives inputs from the visual system, taste, and somatosensory regions...Damage to the orbitofrontal cortex (OFC), which can decode some primary reinforcers such as taste and touch, can lead to complex behavior changes. Including difficulty in concentrating"<sup>10</sup>. As a result patients with TBI have to seek treatment not just for the physical consequences of the injury but they also have to rehabilitate areas like their fine motor skills and emotion processing.

### **IV. MUSIC IN COGNITIVE REMEDIATION THERAPY**

TBI leads to impairment in sensory, motor, language, and emotional processing, and also in cognitive functions such as attention, information processing, executive functions, and memory. When an individual has TBI we can see clear markers of stress regulated by the hypothalamic-pituitary-adrenal axis (HPA or HTPA). Music has been proved to be an effective intervention to decrease stressful hormones like beta endorphins and cortisol. The data showed that music had a positive effect in four areas "...(a) reward, motivation, and pleasure mediated by dopamine and opioids; (b) stress and arousal mediated by cortisol, corticotropin-releasing hormone (CRH), and adrenocorticotropic hormone (ACTH); (c) immunity mediated by serotonin and the peptide derivatives of proopiomelanocortin (POMC), alpha-melanocyte-stimulating hormone

and beta-endorphin; (d) social affiliation mediated by oxytocin<sup>5</sup>. They also hypothesized that listening to music can repair cerebral nerves by adjusting the secretion of steroid hormones, allowing for neural plasticity. After music interventions, researchers found out that listening to music that has strong emotions can encourage and trigger real life emotions and areas of our brains, such as the mesolimbic system, the reward center of the brain or increase dopamine levels. Therefore, it is safe to assume that listening to music can improve engagement in the brain. The goal for functional recovery is to minimize as much cognitive impairment as possible. Cognitive Remediation Therapy was designed with the goal of “providing patients with the behavioral repertoire needed to solve problems or to perform tasks that seem difficult or impossible”<sup>2</sup>. Solving problems and performing tasks take much more than we perceive- cognitive systems such as attention, information processing, planning, decision making, and language all work together to convey meaning and help us decide how to respond to a stimulus. Music specifically plays a part in this type of therapy, and there is even a focus on music in cognitive remediation therapy called- Neurologic Music Therapy, defined as the therapeutic application of music to cognition<sup>3</sup>. It works by combining the neurological, psychological, and physiological foundations of music cognition and production to rehabilitation of functions in the non-music domain. Although it is hard to gauge the effects of these neurological techniques on an individual level there is enough evidence to see the overall positive impact and effectiveness of music interventions in cognitive therapy.

## **V. MUSIC THERAPY FOR ALZHEIMER'S DISEASE**

One area where music therapy has been shown to have a positive effect is with dementia and Alzheimer’s patients. Dementia is a neurological disorder that causes brain cells to die and which makes it hard for people to recall memories and perform daily tasks. Reports say that the number of Alzheimer’s patients has reached over 35 million worldwide in 2013, and this number is estimated to triple by 2050<sup>5</sup>. Over the past 30 years, research has linked moderate and severe traumatic brain injury to a greater risk of developing dementia years after the original head injury<sup>5</sup>. Since Alzheimer’s in and of itself is an issue that so many people have to live with there has been much research into a more non-pharmacological, long term behavioral approach to treatment. As a consequence, non-pharmacological interventions are of utmost importance for treating dementia and Alzheimer’s Disease. Music therapy (MT) is a non-pharmacological treatment that has a long history with dementia patients. People now are considering adding music therapy with other non-pharmacological treatments, such as dance, physical exercise, video and art<sup>9</sup>. Making patients sing is also a technique that’s been used. After 6 months, the result shows that the Japanese Raven’s Colored Progressive Matrices reduced and the neuropsychiatric symptoms improved. Also, when compared to different songs that contained different emotions, such as sad, happy, cafeteria sound, music without an emotional component, and absence of sound they found that music that contains sad emotion are most likely to recall autobiographical experiences especially for the remote memories<sup>9</sup>. Which alludes to the hypothesis that music can trigger emotions which can help to recall memories. Music based intervention is also used; this technique uses rhythm and melodies as a support to help patients recall memories and better perform tasks that they have done before. Not only listening to music, doing activities that involve music, such as playing instruments, doing rhythmic movements, and dancing can improve cognition and mood as well. In one study researchers made 42 mild to moderate dementia patients play instruments, dance, and greet... After 6 weeks, the results show that music with other activities could improve cognitive status and alleviate neuropsychiatric symptoms of dementia patients. The results also showed that it improved MMSE scores and decreased the scores of the Geriatric Depression Scale and Beck Anxiety Scale<sup>6</sup>. A recent report also reported that a 6 months intervention including art, music, exercise, recollection and horticultural therapy improved the memory test scores and the domain of community affairs of Alzheimer’s patients. Many articles have shown that music therapy can improve multiple domains of cognitions in Alzheimer’s patients, including attention, psychomotor speed, memory, orientation and executive functions<sup>7</sup>. Also, using music therapy can have other multiple positive effects; anxiety was reduced, and delirium, hallucinations, agitation, irritability, and language disorders were reduced in moderate Alzheimer’s patients.

## **VI. CONCLUSION**

Music as an intervention tool has proven to be effective in many different types of settings and rehabilitation treatments. Especially in cases like TBI (Traumatic Brain Injuries) it is usually the case that treatment needs to continue over a long period of time and also be sustainable for the patient to do as part of their daily routine. Although pharmaceutical interventions can prove to be necessary for immediate treatment it is in the patient's best interest over the long run to have a less invasive form of rehabilitation. Therefore music as a tool in cognitive behavior therapy should be further researched since it seems like data on it thus far has shown positive results. Another area of research that could be further explored are how other things we utilize in everyday life such as video games since they also have the components of music therapy such as physical movement and cognitive stimulations. It would be worth further researching what could be used as tools

in behavioral therapies for patients with TBI or other brain traumas. Although music therapy is not something that can cure brain trauma outright there has been positive data and results that show that using this type of therapy only enhances the quality and effectiveness of treatment.

#### REFERENCES

- [1] Baker, F., & Bor, W. (2008). Can Music Preference Indicate Mental Health Status in Young People? *Australasian Psychiatry*, 16(4), 284–288.
- [2] Gilbertson, S. (2009). A reference standard bibliography: Music therapy with children who have experienced traumatic brain injury. *Music and Medicine*.
- [3] Glassman, L. R. (1991). Music therapy and bibliotherapy in the rehabilitation of traumatic brain injury: A case study. *The Arts in Psychotherapy*, 18(2), 149-156.
- [4] Guétin, S., Soua, B., Voiriot, G., Picot, M. C., & Herisson, C. (2009). The effect of music therapy on mood and anxiety–depression: An observational study in institutionalised patients with traumatic brain injury. *Annals of physical and rehabilitation medicine*, 52(1), 30-40.
- [5] Li, H. C., Wang, H. H., Lu, C. Y., Chen, T. B., Lin, Y. H., & Lee, I. (2019). The effect of music therapy on reducing depression in people with dementia: A systematic review and meta-analysis. *Geriatric Nursing*, 40(5), 510-516.
- [6] Maratos A, Gold C, Wang X, Crawford M. Music therapy for depression. *Cochrane Database of Systematic Reviews* 2008, Issue 1. Art. No.: CD004517. DOI: 10.1002/14651858.CD004517.pub2. Accessed 30 August 2022.
- [7] Nayak, S., Wheeler, B. L., Shiflett, S. C., & Agostinelli, S. (2000). Effect of music therapy on mood and social interaction among individuals with acute traumatic brain injury and stroke. *Rehabilitation Psychology*, 45(3), 274.
- [8] Pereira, C. S., Teixeira, J., Figueiredo, P., Xavier, J., Castro, S. L., & Brattico, E. (2011). Music and emotions in the brain: familiarity matters. *PloS one*, 6(11), e27241.
- [9] Reddy, B. U., Phanisree, P., Priyanka, M., Kavitha, D., Indira, S., Bhandarkar, P., ... & Agrawal, A. (2017). Effect of music therapy in patients with moderate-to-severe traumatic brain injury. *Journal of Datta Meghe Institute of Medical Sciences University*, 12(1), 51.
- [10] Vik, B. M. D., Skeie, G. O., & Specht, K. (2019). Neuroplastic effects in patients with traumatic brain injury after music-supported therapy. *Frontiers in human neuroscience*, 13, 177.