

### Music Therapy: Exercising Music's Healing Touch

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#### Abstract

Music is an integral part of the human experience. It has diverse roles in many personal and social aspects of human activity. One of its most important roles is as a healing element. This is so because music and humans have co-evolved such that music confers extremely beneficial physiological effects on human listeners. These effects include decreased autonomic arousal and improvement in psychological states of being. Over the course of history, the impact of music on the mind and body has led to an increased integration of music as an adjunctive treatment for a range of conditions, specifically neuropsychiatric conditions such as dementia, traumatic brain injury, and post-traumatic stress disorder (PTSD). The utilization of music in this capacity is known as music therapy. In the era of evidence-based medicine, music therapy has not been fully

appreciated as a treatment modality. However, it is now emerging as an accepted noninvasive form of treatment for patients with a wide range of maladies.

*Keywords:* healing, music, music therapy, neuropsychiatric, posttraumatic stress disorder, traumatic brain injury

## **Introduction**

Music is one of the most profound elements in human daily life. The many different types of music give it a purpose in almost every aspect of social function. Music has traditional roles in ceremonies, child care, leisure and personal enjoyment, and expressions of individuality and identity (Gregory, 1997). However, one particularly important function of music is to induce relaxation and serenity. It is this ability of music that contributes to its powers as a potent healing agent.

## **Evolutionary Basis for the Appeal of Music**

The importance of music stems from the period in human evolution when modalities of expression were developing. Specifically, music was likely the primary form of communication before the advent of words with meaning (Schulkin and Raglan, 2014; Trimble and Hesdorffer, 2017). According to Darwin, as such, music was the basis of socialization, particularly the means by which mating occurred in early humans. This is why he described the ability to create and interpret music as a biological feature (Schulkin and Raglan, 2014).

The architecture of the human body also portends the importance of responsiveness to sound. Over the course of primate history, there has been a divergence in brain morphology of different species in regards to the processing of different senses. Compared to certain primates, humans have had significant increases in areas of the brain responsible for audition, such as the auditory cortex. Thus, humans have developed an enhanced capacity for sensing and processing aspects of sound (Trimble and Hesdorffer, 2017).

Additionally, the morphology of the structures responsible for capturing sound has implications as well. The ear is an open tube that has the ability to process sound at all times. This is opposed to other structures such as the eyes, which can voluntarily filter vision (Trimble and Hesdorffer, 2017). In many circumstances in nature, stimuli are heard before they are seen. This is an important measure for being able to assess potential dangers to oneself.

Furthermore, humans receive early exposure to sounds, such as words and music, during fetal development. The auditory system in humans becomes functional at approximately 25 weeks into the gestational period and requires specific stimulation for proper development. These cues include the rhythmic beating of the mother's heart and her voice (Graven and Browne, 2008; Webb et al, 2015).

Thus, even in-utero, fetuses have an exceptional capability to receive, process, and commit auditory stimuli to memory. In fact, EEG studies demonstrate that a newborn will exhibit neuronal activity consistent with recognition of sonic stimuli that they were frequently exposed

to during fetal development (Partanen et al, 2013). Thus, humans have been tuned by evolution to be exquisitely sensitive and responsive to music.

### Background of Music and Healing

The idea of music and its utility as a healing agent is deeply rooted in history. It is widely acknowledged in the Judeo-Christian Bible, in literature and the arts, and in many cultures across time. However, perhaps its greatest recognition as a spiritual healing tool is attributed to Greece. Music was a significant part of Greek society and had a role in all aspects of life, particularly the promotion of physical and spiritual well-being.

Aristotle was a firm believer that music was an effective tool for emotional cleansing (Meymandi, 2009). Greek physicians, particularly Hippocrates (460 to 370 BC), placed a strong emphasis on enhancing health by advocating for a “healthy body and a healthy mind” (Kleisiaris, Sfakianakis, and Papathanasiou, 2014). There was a strong belief in the connection between an ill mind and ill body. Thus, Greek doctors, most notably Asclepiades (c. 124 or 129 – 40 BC), employed the arts as a treatment for psychiatric illness as the arts could potentially lead to improvements in physical health (Yapijakis, 2009).

Musical instruments, such as the harp and flute, were used to treat agitated emotional states. Ancient plays were employed as forms of psychotherapy. Patients were given opportunities to release their emotions on the stages of Greek theaters. In addition, patients were designated to quiet rooms to ruminate about positive mental states (Kleisiaris et al, 2014; Meymandi, 2009).

### Physiological and Neurobiological Impact of Music

The utility of music in medicine is related to its physiological impact on listening recipients. Music has long been known to have a relaxing effect. The specific physiologic effects of music have been assessed in many studies and experiments throughout the years. Some of the earliest works on establishing a correlation between music and physiology were performed in the 1700s by Diogel, a French researcher. Diogel found that music lowers blood pressure and heart rate and increases blood outflow from the heart (Meymandi, 2009). Subsequent assessments in the modern day, such as the 11 investigations meta-analyzed by Loomba et al (2012), substantiate to varying degrees that music does indeed elicit the effects stated.

Studies evaluating other physiological effects of music have yielded significant results as well. For example, listening to Mozart has been found to increase growth hormone levels and decrease stress-related molecules such as epinephrine, interleukin-6 and dehydroepiandrosterone in intensive care unit patients (Conrad, 2010). Another meta-analysis study performed by Chanda and Levitin determined that music activated the immune system and reduced the levels of cortisol (Novotney, 2013).

The physiological effects of music are borne from its impact on the central nervous system. Music, as does all sound, passes through the ear canal and contacts the ear drum and the three tiny bones of the middle ear known as the malleus, incus, and stapes. These structures magnify the stimulus as it is transmitted to the cochlea and the basilar membrane of the inner ear. Hair cells on the basilar membrane convert the stimulus into a nerve impulse that is relayed by the

auditory nerve into the central nervous system (National Institute for Deafness and Other Communication Disorders [NIDCD], updated 2018). Specifically, the impulse travels via the following neuronal pathway: the dorsal/ventral cochlear nucleus, then bilaterally to the superior olivary complex, then to the inferior colliculus via the lateral lemniscus, then to the medial geniculate nucleus of the thalamus, then to the primary auditory cortex (Cope, Baguley, and Griffiths, 2015), after which it is then further processed for understanding and appreciation.

The integration and recognition of sound stimuli can have implications on other neuronal pathways. This is due to the auditory cortex's projections to many other areas of the brain including the basal ganglia, the amygdala, ventral tegmental area and nucleus accumbens, anterior cingulate cortex, hippocampus, parahippocampal gyrus, and motor cortex (Camalier and Kaas, 2011; Pereira et al, 2011; Thaut, McIntosh, and Hoemberg, 2015). Thus, music modulates pathways that are involved in reward and motivation, physiological arousal, immunity, and socialization (Chanda and Levitin, 2013). In fact, research has demonstrated that listening to music elicits specific neurological effects such as the increased release of dopamine and decreased renal sympathetic nerve activity through modulation of the suprachiasmatic nucleus (Regacone et al, 2014), both of which can lead to decreases in heart rate and blood pressure, among other physiologic manifestations.

In addition to the aforementioned regions, activities involving music also activate regions of the brain that are related to creativity. One particular network, known as the default mode network (DMN), includes the dorsomedial prefrontal cortex, lateral temporal cortex, ventromedial prefrontal cortex, posterior cingulate, and temporal pole. Other regions outside of the DMN include the supplementary motor areas and dorsal premotor cortical regions (Bashwiner et al, 2016). These regions are thought to be involved in cognitive tasks such as daydreaming, divergent thinking, imagination, and reasoning. For example, they have been demonstrated to be highly active in the brains of individuals who improvise during their musical performances compared to individuals who have their performances planned beforehand (Bashwiner et al, 2016).

## **The Rise of Modern Music Therapy in the United States**

Given its impact, music has the potential to have a substantial role in medicine. As such, there has been a steady process to incorporate music as a legitimate treatment option in the United States over the last couple of centuries. Music utilized by certified professionals to manage various types of patient needs while using a foundation of evidence-based medicine is known as music therapy (American Music Therapy Association [AMTA], n.d.a). It was thought to be a valuable asset as early as the beginning of the 19<sup>th</sup> century when it was described in scientific papers written by Atlee (1804) and Mathews (1806). Indeed, Edwin Atlee's dissertation for his medical degree from the University of Pennsylvania had this to say in introducing the piece:

Theses, in general, are but extracts from such authors as are put into the hands of students, dressed in a somewhat different garb, and ornamented by modern improvement in language....little new can now be thought of. I have, however, chosen a subject for my inaugural dissertation, which, I am well aware, will excite the risibility of many, and the just censure of a few; but though, in thus publishing my opinion to the world, I make known

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my own failings, I must beg leave to say, that its originality entitles it to some degree of notice, and that future investigation of the subject will, no doubt, give it that place in the *Materia Medica* which it merits. I therefore resign it to its fate (Atlee, 1804).

In that dissertation, Atlee also proclaimed he believed that music is to the mind what opium is to the body—a Divine Medicine. He further stated that: “I believe that music ought justly to be esteemed as one of the most agreeable, powerful, and effectual means of relieving human misery (Atlee, 1804).”

The 20<sup>th</sup> century saw the first utilization of music therapy in a clinical setting (AMTA, n.d.b). Modern music therapy practice was borne during World War II. Many musicians traveled to military hospitals across the country to play music for recovering veterans. The promising responses to these gestures prompted the United States War Department to implement a program to utilize music as an aspect of treatment in military hospitals (AMTA, 2014).

The popularity of music therapy led to the advent of the National Association for Music Therapy (NAMT) in 1950, which established criteria for becoming certified in music therapy. Nearly 20 years later, a second similar organization, the American Association for Music Therapy (AAMT), was established (AMTA, n.d.b). To reinforce the integrity of the credentialing process for music therapists, the Certification Board for Music Therapists (CBMT) was founded in 1983. Lastly, in 1998, the NAMT and AAMT merged together to form the American Music Therapy Association (AMTA), the premier global music therapy organization that represents most of the certified music therapists in the world (AMTA, n.d.b).

The profession continues to grow. As of 2011, there were 3,532 members of AMTA in 30 countries, with the vast majority (3352) being present within the United States (AMTA, 2011). Domestically, music therapists are predominately located in New York, California, Texas, and Pennsylvania (AMTA, 2011). In 2010, approximately 21,230 facilities provided some form of music therapy services to nearly one million people at an average cost of \$59 per hour. A majority of the funding for these services was provided by the facilities themselves because many music therapy services are not covered by traditional insurance (AMTA, 2011). In fact, one of the authors of this article (Dr. Etienne) regularly sends his patients to a local music therapist, namely the second author of this article (Mr. Friedberg), and has invited the music therapist to present to a local brain injury support group.

### The Music Therapy Experience

Understanding the music therapy experience is indispensable to realizing the contribution of music to healing. Examples of music therapy that patients can undergo are playing an instrument, listening to music, singing, improvisation, and song writing. The therapy chosen is based on many different factors such as the patient’s musical background, musical interests, and clinical needs. For example, if a patient is known to play an instrument proficiently, that patient may potentially be a candidate for therapy centered on the playing of that particular instrument. However, even with no experience a patient is able to engage in and benefit from these forms of therapy. This is because the needs of the patient are a significant factor in determining the appropriate therapy. If a patient has motor or coordination deficits, then activities such as playing instruments can be implemented to strengthen those neuromuscular pathways. This is so because the auditory perception of the rhythmic aspects of the activity would help to entrain

the neural pathways associated with voluntary movement; that is, the auditory cues provide a component of timing for which the motor system can prepare and execute movements (Thaut et al, 2015). Establishing associations between auditory stimuli and muscular activity can help to enhance the quality and intent of motion in patients with movement and coordination challenges. Musical improvisation can be used with musician and non-musician patients alike to help build communication, social skills, emotional regulation skills, as well as auditory processing skills.

If a patient has speech or expression deficits, then singing may help regain functioning in the language area of the brain. This is because singing therapy would serve as a bridge to regular speech. This is known as melodic intonation therapy (MIT) (Norton et al, 2009). MIT deconstructs phrases into syllables with alternating emphasis that are tracked by a cue, e.g. a tap on the left hand for every syllable spoken. The alternating emphasis (high and low) introduces a musical element to the verbal expression (Norton et al, 2009). For example, the phrase “The dog is cute” would be expressed as “the DOG is CUTE”, with the capitalized words receiving the greater emphasis. This entire process allows for a slower, yet much more precise processing of words through the right hemisphere that helps to pace and enhance verbal expression (Norton et al, 2009).

One of the most notable recipients of melodic intonation therapy was former Congresswoman Gabrielle Giffords, who suffered extensive traumatic brain injury from gunfire in a 2011 Arizona mass shooting. The injury to the left side of her brain resulted in a severe language impairment known as aphasia. Her rehabilitation team utilized knowledge of neuroplasticity (reprogramming of the neural networks) as part of the plan to help her regain her language function. In most people, language is predominantly on the left side of the brain. However, music stimulates multiple neural pathways throughout the entire brain. In her rehabilitation from the traumatic brain injury Ms. Giffords received intensive physical therapy, occupational therapy, speech and language therapy among other therapies. Melodic intonation therapy was incorporated into her treatment plan and this helped to pave new pathways to facilitate regaining her language function (Law, 2012).

If a patient is undergoing listening therapy, there are special considerations in determining the kind of music to which the patient will be exposed. The music that is chosen is often that which the patient would have enjoyed at age 18-25. The premise is that during this time period, the patient is undergoing a solidification of identity, of which contemporary music during early adulthood would be a tremendous part (Bonneville-Roussy et al, 2013). Listening to identity-relevant music is thought to elicit deeply encoded memories. This association between the music and treasured past experiences allows for the activation of regions of the brain associated with pleasure and satisfaction and can stimulate communication.

One of the authors of this article (Dr. Etienne) has numerous patients with dementia and traumatic brain injury who utilize music therapy as part of their own treatment. One example is an elderly gentleman who is a retired physician. He had previously served in the U.S. Army and was a member of the symphonic and marching band. He has played musical instruments and has enjoyed going to the opera throughout his entire adult life. Although he is now at a moderate stage of dementia, his son continues to take him for monthly visits to the Metropolitan Opera. During those visits, although he may have difficulty with the musical program (at times), he recognizes the music and continues to obtain great enjoyment from the opera. His history of

having been in the symphony and marching band has been instrumental in his healing. Indeed, by going to the opera he has been able to retain a connection to and derive pleasure from one of his great passions, music.

### **The Role and Benefits of Music Therapy**

Music therapy can be employed in a wide variety of patient scenarios. For example, it can be utilized to attenuate the progression of dementia, decrease pain in post-surgical patients, facilitate communication in patients with autism, and enhance motor function in patients with Parkinson's disease (AMTA, n.d.a). Another important application of music therapy is with regards to neuropsychiatric conditions, such as post-traumatic stress disorder (PTSD) and traumatic brain injury. In regards to PTSD, music therapy aims to create emotional stability, increase the activity of the parasympathetic nervous system that produces decreases in heart rate and blood pressure, and decrease anxiety and hyperarousal. For traumatic brain injury, the therapy seeks to augment cognitive and executive functions (speech, motor, memory) and decrease the incidence of headaches (Bronson, Vaudreuil, and Bradt, 2018).

Music therapy is an effective treatment modality for such conditions in this population for many different reasons. One important reason is its effects on the various neurochemical pathways previously mentioned. This is important given that many of these pathways may be dysfunctional in certain psychiatric pathologies. One such example is the hyperarousal experienced by individuals afflicted with PTSD or nervous dysfunction in those with brain injury. Music can be provided in many forms that can help to reshape one's physical or emotional responses to the external world (AMTA, 2014). For example, music can help to engage neurochemical processes responsible for neuroplasticity, allowing patients with injuries to regain lost function through neurological reprogramming (Bronson et al, 2018).

All of these facets clearly were a central inspiration for the creation of the fictional account of Marine Gunnery Sergeant and sniper Aaron Davis (portrayed by actor Taye Diggs) in the 300th episode of the popular television series, "NCIS." In that episode, Aaron Davis is haunted by a near-assassination that resulted in loss of body parts, peace of mind, and control of his life. While therapy was important for his eventual healing, most powerfully important were the heart-to-heart talks he had with NCIS team leader and star of the series Leroy Jethro Gibbs (portrayed by actor Mark Harmon). Gibbs drew upon his own experiences while on active duty. He was a fellow former sniper and suffered his own traumas in family life. He used his own experiences to help to break through the Gunny's trauma. But the pain of the Gunny's experience threatened to drive the wounded soldier to "end it all." Fortunately, the identification of the would-be assassin and special support from friends and loved ones, including his daughter, allowed him to open up and seek healing in a simple yet exquisitely powerful tool – music. He found the powerful tool of music by joining MusiCorps at Walter Reed National Military Medical Center. Located in real life in Bethesda, Maryland, MusiCorps is an actual, real life activity at the medical center. This episode was filmed at the medical center and with the actual uniformed members of MusiCorps. In a most special way, this NCIS episode of "Scope" demonstrated how the arts, specifically music, hold a most powerful therapeutic capacity.

Music therapy is also highly individualized and adjustable for each patient. This is important for properly addressing patient needs, whether they be physical, emotional, or a mixture of both (AMTA, 2014). Connecting with patients in this manner aids the expression and exploration of feelings that cannot be conveyed or accessed by traditional means. This can provide benefits such as the uncovering of repressed memories or induce states of mind that can prove to be therapeutic for patients (AMTA, 2014; Nizamie and Tikka, 2014). For example, a Veterans Administration (VA) Hospital in Miami has a program in which veterans with PTSD share two songs – one that elicits memories of wartime and the other that represents life with PTSD. Through this forum, the veterans can bond through their shared experiences (Moore, 2017).

Additionally, music therapy helps to maintain strong patient engagement. This is owed to several factors. As previously mentioned, music is highly individualized and, thus, significant to the patient (AMTA, 2014). Therefore, it serves as a strong stimulus that can elicit strong responses. One of the benefits of the magnetic quality of music is that it becomes an escape from the monotony and displeasures of one's daily life. It can also help to increase a desire to socialize with others (for example, at the Miami VA hospital mentioned above (AMTA, 2014; Moore, 2017). Because of this, patients are more likely to stay with the program and demonstrate adherence to the treatment plan, thus increasing the efficacy of the therapy (Hegde, 2017).

Lastly, music therapy produces very promising results in patients suffering from a variety of conditions. This effect is substantiated by different bodies of research. For example, one study conducted by Nizamie and Tikka (2014) determined that, compared to standard therapy and cognitive behavioral therapy, music therapy was found to produce a much greater decrease in depressive symptoms. Another study by Guetin et al (2009) demonstrated that music therapy had a drastically positive impact on traumatic brain injury patients with anxiety and mood disorders. A third study, conducted with funding from the Veterans Administration Health Services Research and Development, found that music therapy was successful in reducing PTSD and depression (US Department of Veterans Affairs, 2014). Thus, music therapy has a demonstratively positive effect on those who receive it, particularly veterans.

It is very important to note that these benefits are not only achieved by listening to music. A meta-analysis by Raglio et al (2015) demonstrated that individuals who are involved in the creation and delivery of music also achieve very positive outcomes. For example, patients with dementia who played instruments and sang songs exhibited a marked decrease in depression, improved their psychological state, and improved cognition. Patients who had suffered a stroke and who played instruments also reported increased communication, better moods, and decreased depressive symptoms as well (Raglio et al, 2015). Similar results were achieved in patients with multiple sclerosis, Parkinson's disease, and amyotrophic lateral sclerosis (Raglio et al, 2015).

### Conclusion

The impact of music on humans is undeniable. Humans have been evolving with music for their entire existence. We have seen evidence of music being used in a therapeutic capacity in the Judeo-Christian scriptures, in ancient Greece; and we see it being used today as part of modern medicine. Indeed, even before the advent of clinical trials, the powerful impact of music on our health was being appreciated and this form of therapy has withstood the test of time as it is being used more now than ever. Indeed, although we have come a long way with music therapy, there is a great deal more work to be done. In the era of evidence-based medicine, it will be important that more clinical trials are conducted to describe more clearly the impact of the healing nature of music. For this to occur, there will need to be more funding available to support this research.

Elements of music are omnipresent in nature; and humans are extremely sensitive to those cues. Additionally, the connections of music processing centers to neurological pathways that elicit calming physiological responses belie the positive impact of music and its utility as a healing agent. This is especially true of psychiatric and emotional conditions. Some of the most significant benefactors of music therapy have been veterans who are suffering from PTSD, traumatic brain injury, and many other afflictions.

Music therapy has been a tremendous force in helping individuals recover from a wide range of neuropsychiatric conditions with demonstrable positive outcomes. As such, music should be recognized as a treatment modality and incorporated into the regimens of patients suffering from a wide range of medical conditions, particularly those conditions which tend to have comorbid depression or anxiety. As the beneficial outcomes are well documented, music therapy should be recognized as an intervention that is covered by health insurance plans.

Despite music therapy's massive potential for good, there is still much to learn about this relatively young discipline from a neurological, physiologic, biochemical, and behavioral standpoint. Initiatives such as the National Center for Complementary and Integrative Health's Notice of Intent to Publish a Funding Opportunity Announcement should help to raise awareness, promote research, and create new interventions aimed at enhancing the practice of music therapy. It is a revolutionary field that, once understood better, can provide substantial clarity about how the human body works and how to maintain health. Music therapy in essence, is the place where the arts and sciences truly merge and thereby allows one to truly understand the journey that is health and human experience.



*The MusiCorps Wounded Warrior Band of the Walter Reed National Military Medical Center performs at the Annual Bob Woodruff Foundation event in Washington, DC, April 3, 2013.*

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