What Music Is

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Abstract

The article to follow engages with the human capacity to listen, produce, and have meaningful experiences from music. **The essay focuses on (1) the influence of music on the evolution of humans, (2) the anatomy that transduces music into electrical potentials in the brain to become the content of music, and (3) clinical applications for music therapy of PTSD.** The goal of this essay is to encourage its readers to more mindfully produce and consume music and understand its innate influence on emotions and well-being.

How to Perform in a Dive Bar

There is smoking in this bar, which is not unusual in the railroad city of Altoona, PA. There is a stale haze between the heads of the audience constantly thickening and thinning as the fans come through the door. The walls of the stage are painted black to highlight the performers and the stage lights come on revealing the start of the music. Anticipation resonates throughout the dive as I walk to the stage with my guitar, fully ready to transmit the cosmos to unwilling ears. Those who actively listen feel the emotional quality of the music, those who avoid it, feel a type of resentment. Either way the music is affecting them. It is not an easy thing, coming up against one's primal past when listening down infinite lines of evolution. Humans gather in dive bars, reminiscent of the great halls, and fire lit gatherings of old, every weekend with different results, among them is togetherness, as well as loneliness. They escape here, the week behind them, rent payments, dead end jobs. I sympathize and remorsefully play radio cover music to them, adding my own spin on the music, transmitting joy.

As the musician, I am in a place of power. I can influence the mood of everyone in the room, a large responsibility. There are people from all walks of life entering into the space where music is happening. What past do they all come from? Have they experienced moments of euphoria and trauma? What can the music and social setting provide them? Fluidly, we live our lives whether we realize it or not. One place to the next, week by week, we stumble as gracefully as possible through whatever is laid before us. The music conveys experiences, making them communicable. Because there is no separation between the music and the people in the midst of its wave, there is solace as well as treachery. The audience reverberates with the music emanating from the speakers beyond their choice of its quality of vibration. Their experiences coalesce beautifully, tragically, communally. There is a benefit to being overtaken by the content of the music. One must confront existence. Those in attendance have the right to leave if the content does not suit them, nonetheless a reaction to musical content. What is it about music that brings one's experiences into perspective and causes one's motivations to surface?

Amidst going through my own healing from trauma in the Fall of 2015, music was the activity that accompanied me into public and provided a safety harness. Upon the precipice of the abyss one can lose sight of the world and the universe for its true quality. One can be caught in cycles of self-disregard and self-uncare, at least this is my experience with trauma. It can keep one locked away. Music pulled me through the door of my apartment into the world, however. Trauma had been keeping me within the safety of my apartment. The world and its possible unsafety can be crippling. I had an obligation not only to the band members but to the audiences too. In 2016, my therapist told me that the best thing I could have done during the months following my trauma was the way I assimilated back into a society I distrusted. I played music in front of crowds of faces that looked like I felt. I played to the sad ones. I summoned the joy within my love of music and transmitted it to crowds. What I was really doing: retraining myself. The musical content provided me the context to regulate my difficult emotions at the time. The dark night of the soul yields a hero. Music gives me the context to express my story as it happens moment by moment, *now* by *now*.

One must channel something when playing music. An intuition of the next note is the music itself and what people love so much about music. The suspense and immediate release of the next pulse of music is a climax within itself. Show the audience the beat and melody and almost all of the work is done. One's mind, body, and spirit become

attuned to rhythm and melody. Music can be played without an attunement but the music has less energetic qualities. The structures that enable humans to experience music discern the quality of the music. When one performs, one can perceive the moods of each audience member. Even further, one can average those assumptions into an image of what the audience needs in order to feel the passion within the music.

One must proceed with care when performing to audiences. In reality, the best musicians and composers of all time did not take their role lightly. There is a significant responsibility to being the vessel for the music. There is an enormous amount of care in the works of master composers. Each note is carefully selected to modulate the energy of the audience. One holds the well-being of the audience in their sound, consequently. Humans are incredibly permeable to musical content. Music resonates within the hearts and minds of the performers and listeners whether they acknowledge the experience or not. It must be emphasized that even though an audience member may avoid the content or prefer another type or style of music, there is an affect nonetheless.

The responsibility of the artist can be framed many ways. For instance, one's responsibility may be to perform the most difficult and complicated death metal song to satisfy the musical preference of the audience who gathered to experience it and find it pleasurable. The audience deserves an experience that is positive and fulfilling. All humans deserve to be positively influenced and shown the bliss of life. Certainly, our Paleolithic ancestors took care in conveying important information to the members of the group. The musicians of the 1960s also took great care and conveyed their lives. Jimi Hendrix wrote the song "Little Wing" about a woman who helped him deal with his demons. He expressed his life and beyond to large crowds because it felt natural. Janis Joplin was subjected to brutal bullying in her young years. She was voted "Ugliest Man" on the cover of the school newspaper in high school. She sang her problems away on stage. There is something in her singing that conveys emotional pain. She sings blues in the rawest of ways, and one cannot help but be uncomfortable during her raspy live performances. One feels as though it is happening to them.

Since an engaged audience member can allow the music to flow through them it is the responsibility of the performer to make the internalization of music as fluid as possible. Achieving this is not simple. One must perform the music but also place themselves in the audience's shoes and understand them as humans journeying toward their idea of happiness. One must practice the craft of music to be able to transmit properly. One must find their own way of best expressing oneself. Proficiency with one's instrument is not necessarily the most important aspect of expression but practicing how to connect to the audience emotionally is the true duty of the musician. Granted, many people play instruments without performing for crowds, but for those who do it is important that there is a deep consideration for how the crowd leaves the space where music was created. If a willing audience leaves the musical space feeling as though there is something left unsaid within them, they have been done a disservice. The most important step towards connecting to an audience is an active focus upon their lives and tribulations. We musicians must relieve the environmental stress of the 21st century, just as the Paleolithic humans searched for food and relieved the stress of famine. Musicians should love their audience to best connect to them. One must relate an endless universal bliss to audiences.

There are qualities to music that tickle the human spirit. When we listen to music, it just happens to us. No effort needed. Why is it so innate, primal? Going forward from here, to shed light on the taken for granted innate musical propensity, I will discuss (1) how music is transduced from sound—vibrations of air particles—to electrical potentials in the brain, (2) the origins of music in humans as they arise in evolution, and (3) discuss the prospect of clinical applications for music and mindfulness in Post-Traumatic Stress Disorder (PTSD).

The Transduction of Musical Content

Musical content is first and foremost sound, frequencies. Specific frequencies within the range of the human ear are perceptible. When a specific frequency is produced the ear picks up a *pitch.* The human ear is capable of receiving sound within a range of frequencies between 20Hz-20,000Hz (Zhang and Gan, 2012). When individual pitches are played at the same time an *interval* is formed. Intervals are two pitches that are perceived as a single sound. However, the human ear and auditory cortex make it possible to differentiate the two pitches of an interval (Koelsch, 2013). One can hear the two pitches working together to produce *harmony*. The grouping of pitches making harmony creates consonance and dissonance. The grouping of multiple intervals forms chords and each chord is identified by the quality, consonance/dissonance, roughness/smoothness, of the intervals. Each individual pitch or chord can be organized into patterns of length. The patterns consist of symmetries and asymmetries. In music these patterns are called *rhythms*. Repeating rhythms at the same rate for a duration of time reveals the *beat*. Dancing occurs with the beat - or sometimes off of it. The beat is often referred to as the pulse. Humans associate emotions to the whole of the elements but are cued by the pulse.

Music becomes a medium for color, emotion, and associations. At some level, the content of the music becomes a song to humans, and the song accrues and induces emotional meaning. Each song contains musical "messages" as Roederer (1984) points out. Each message is commonly understood or has an endless list of personal associations. Further the ordering of chords determines what context a melody resides in, the context for the message. A melody is a series of pitches ordered within the framework of a chord progression. Melodies carry dense amounts of emotional information as they are often easily recognized in the music and repeated.

At least in the West, music did not always contain these densely packed emotional messages. It was not until the Renaissance that music became more "euphonious," more pleasing to the ear, with the introduction of *tonality* (Perlovsky, 2008). Tonality refers to the overall *feeling* of the pitches, intervals, and chords working together creating the context of one another. Songs can keep the same tonality throughout or change dramatically between movements. The tonality of music in the West blossomed in a sacred sense with Bach during the Reformation of Christianity. Music was a medium by which God could speak to his children and restore Himself within human consciousness (Perlovsky, 2008). The works of art that accompany God in religion — music, painting, sculpting, and spoken word — are essential to the impact of the modern religious message. Music can restore spirituality in one's heart and it did just that for the Christians of the 17th and 18th century. The Christians were able to make sense of the works of Bach because humans can identify the movements of a songs. Movements are the flow and flux of tonalities and rhythms. Movements delineate and guide the listener through moments of emotional response. Movements exist in music today in the form of verses and choruses. In classical music, movements can be slow, lasting minutes, while some can be fast and create the feeling of rapid change. The anatomy that makes this all possible is the ear.

The content of music contains many elements, but music feels simply understood, like a complete package. The perception of music is a fluid process. When we listen to music, or perform it, the ear funnels sound into the ear canal to the eardrum vibrating and reverberating the bones of the middle ear. The cochlea receives the impulse of sound and sorts the frequencies with its structure. Frequencies vibrate down the fluid of the cochlea moving specific inner and outer hair cells. The hair cells are connected to nerves that lead to the brainstem, thalamus, and eventually the primary auditory cortex (PAC) (Koelsch, 2013)(Nouvian et al., 2006).

The action potentials from the ear eventually end up in the PAC. Koelsch (2013) deduces that the PAC works to analyze acoustic features such as the volume, pitch, and timbre. Timbre is the difference in texture between a piano and a trumpet. Both instruments can play the same pitch but they each have different qualities to their tone. Tramo et al. (2002) finds that if the PAC is damaged, individuals have difficulty differentiating pitches from one another. The patterns of pitches and rhythms humans readily discern are processed within the PAC as well (Fishman et al., 2001). The PAC processes the content of music and prepares it be interpreted emotionally. The emotional aspect of

music will be discussed further in the section dedicated to the clinical applications of music as it is a complicated and multi-facetted aspect of music transduction.

Music creates a context for one to be emotionally expressive within oneself. Music achieves this through tonality and rhythm. The pulse of the music allows one to anticipate the coming pulses. Tonality and pulse give us the bedrock, foundation, of the musical content. The sounds — vibrations — become electrical potentials in the brain and become emotional. For Rap music a context is created by the rhythm that accompanies impactful lyrics, and for some classical music a context is created by complex movements — drastic changes in tonality and rhythm. When one hears music, however, there is not a consideration of these elements. The deconstruction of music through language does not necessarily accurately describe musical experience in reality, or most experience for that matter. The process of perceiving music is without effort, almost a completely passive affair. The music happens to us and pulls emotional life into view. The music creates a space for one to engage their experience with guidance.

The anatomy that transduces the music has arisen through thousands of years of evolution. Where is the origin of musical behavior in humans? How did humans acquire the capacity to passively or actively receive music? The next chapter will argue that music is an innate part of the human experience brought about through thousands of years of practice. In the broader view of the essay, the innateness of music transduction gives humans a universal medium for the transmittance of emotional content.

Music is Innate

Humans have a propensity for music. Easily absorbed and interpreted, music is involved in the everyday lives of humans. Most humans are driven to consume music on a daily basis. The masses commute with the radio on, vacation to live performances, or turn on Spotify as soon as they have the chance. Modern humans hold millions of songs, works of art, and feats of ability in their pockets. Musical content is so easily consumed that it can be taken for granted as an essential part of the human today. What makes music so easy to consume for humans? Are humans utilizing the power of music to its fullest potential? Have humans lost touch with the healing power of music? The human brain is innately ready to receive audio patterns and rhythms at birth, interestingly. According to Roederer (1984) an infant's brain is ready at birth to begin learning how to associate sound with meaning and develop speech. An infant's first auditory perceptions happen in utero during the final days of pregnancy. The patterns of tone and rhythm become ingrained at the beginning of human life. Roederer calls the preconditioning to understand speech "priming." An infant's brain is prepared at birth to receive the patterns of tone and rhythm of speech. Eventually the infant forms words and produces language from a young age. The brain regions associated with speech overlap with regions that are associated with melody production (Brown, Martinez, and Parsons 2006). Roederer's findings illuminate the "survival value" of music. There being a survival value of music implies that humans have benefited from the expression of music throughout history as an answer to environmental stress. The overcoming of environmental stresses is paramount to the survival of a species, but before the discussion of the anatomical features that give humans the capability to produce, perceive, and benefit from the tool of music, there must be an examination of the evidence that humans actually did carry out musical practices over millenia.

Bone flutes from the Middle (200,000-40,000BCE) and Upper (40,000-12,000BCE) Paleolithic periods have been unearthed in Europe (Morley, 2013). The few earliest flutes were used during the Middle Paleolithic period, while the majority of the bone flutes appear during the Upper Paleolithic Period in Europe. Artistic expression of music is not limited to flutes and includes other sound producing objects including drums, shakers, and natural formations of the environment (Morley, 2013). McBrearty and Brooks (2000) suggest that artistic expression may not have been contained to Upper Paleolithic Europe due to the Western bias of the discoveries of the late 19th century that favored intelligence of early western humans. They posit that artistic expression may have begun long before *Homo sapiens* spread into Europe. In fact, the claim that artistic expression suddenly "exploded" in Europe is refuted as the human voice is likely to have been the first musical instrument in many parts

of the world, most notably, Africa. Morley notes that there is a lack of empirical evidence to support the origin of music in Africa. However, a recent ethnographic study by Johnston (1989) found that the Yupik Eskimos produce most of their music vocally. His ethnographic study supports the hypothesis that instruments are not needed to produce music. Therefore, the archeological discovery of instruments does not necessarily indicate the first music making *Homo sapiens*. If humans made instruments 40,000 years ago, how long was solely vocalized music being utilized? Often accompanying music is dancing, a physical representation and expression of the content of music. Dancing plays an important role in the effectiveness of music.

Music and dance contribute to enhancing and strengthening social bonds within community members (Garfinkel, 2003). Garfinkel notes that as societies became more stratified, social tensions needed to be dissipated. Art motifs on pottery, figurines, and caves across many cultures depict musical behaviors and dancing. Garfinkel states, "On an individual level, it enabled self-expression and active participation in ritual. It enabled entry into trance states, which are the core of religious-mystical activity, and the creation of a relationship with divine powers. It was utilized as a method of creating social solidarity," (2003). The survival of a group of humans was contingent upon their cooperation and ability to gather and produce their source of food. The interdependence of early societies was strengthened by music. Garfinkel posits that music not only synchronized the society and relieved tension, but provided essential information for those of the group who needed education about the world, children. From the archaeological and ethnographic evidence it is likely that *Homo sapiens* have been practicing music for millennia, and quite possibly long before their entrance into Europe and manufacturing of instruments. So, we return to a question, what is it about music that gives it a "survival value" and how have humans adapted to utilize it?

Since humans have grown together with the tool of music, there must be essential features within human physiology that make it possible to internalize the content of music. The ability to receive and produce spoken language, the sound of varying tones and rhythms, is a logical place to start when discussing the survival and evolution of humans. How are language and music related? Brown et al. (2006b) finds that the motor program for dance coincides with vocal sound production, phonology. Expressing the content of music with one's body is dance. If the motor program that produces of the sounds of language coincides with the bodily expression of music the two must be related. Brown, Martinez, and Parsons (2006a) suggest that the areas of the brain that generate sentences are separate from the generation of melody, however. The distinction between the information behind the language and the phonology of speech must be highlighted here. The areas of the brain that produce the sounds of speech are related to the areas that produce music but are not connected to the semantics of the sentences. The view by Brown, Martinez, and Parsons assumes that language and music arose separately in the human evolution and gives a primacy to language over music. These studies reveal that overlap does not necessarily indicate that music and speech share all of the same brain regions (Peretz et al., 2015).

Perception of the tonal quality of music and speech is worth examining since there is an overlap between phonology, melody production, and dance. The volition that exists behind the organization of language production is similar to music. One can produce language with ease, just like producing a simple rhythm with one's hands, music. The organizing of sounds and rhythms is the very music. Sounds and rhythms allow one to convey one's internal experience. Fortunately, humans have language and music, which allows us to prosper in difficult environments. Even more fortunately, humans have music to express the nonverbal parts of life. Since music is universally understood, is it more innate than language?

Turner and Ioannides (2009) find that music is processed by both hemispheres of the brain while language is processed primarily by the left hemisphere and that humans are universally affected by music. They also suggest that language is a, "highly specialized subset of music cognition." From this viewpoint music is encompassing language entirely. This may not be far off since the Paleolithic humans were possibly making vocal music for tens of thousands of years before the manufacturing of instruments and maybe even having sophisticated language systems. Music and speech convey information, and it is easy to assume that language is separate from music because

humans use language more than they produce music on a daily basis. If the purpose of music is to convey information, it mirrors the purpose of speech. Could it be possible that the modern experience of language is due to millennia of music production? Could language be the product of musical communication throughout evolution? Dissanayake (2008) suggests that music has innate qualities that indicate it has a role in the adaptation of humans. Music is universal, meaning it exists in all societies. She also notes that cultures spend valuable time partaking in the pleasure of music and include music in important cultural moments. Beyond the cultural value, back to the individual, babies can understand music and "spontaneously (without being taught) move, and even vocalize music." Dissanayake takes a positive view of music in evolution, suggesting that music was essential to the human evolution of speech, communal activity, and survival of infants. Pinker (1997) does not give music the value that Dissanayake does. He believes that music is a "by-product" of adaptation and that music is not an innate feature of the human experience. In other words, the structures of perception that transduce music precede the production of music. Music is simply a way of entertaining the senses. If Pinker argues that music is not innately received and is solely the by-product of already evolved anatomy, how does he account for premature infants that benefit from music therapy? If music is not a pre-programmed propensity for the modern human, then a premature infant would not benefit from music therapy.

Cassidy (1995) examined the physiological responses, heart rate, oxygen saturation levels, and respiratory rate, of severely premature infants while they listened to music. Infants in the intensive care unit were played music for 16 minutes each day for three days. On the first day the infants displayed higher oxygen saturation, lower heart rate and respiration rate. Over the three days the infants became habituated to the musical stimulus and the physiological effects diminished. The experiment by Cassidy reveals that music affects the physiology of premature babies with newly created, unexposed, perceptions. If music is received by a premature infant, the faculties that transduce music, in a raw evaluative sense, must be developed early in life (Trainor and Heinmiller, 1997). If music is an invention by recent humans to entertain the senses, why do infants, who do not know of a self to entertain, experience physiological change that benefits their survival? As humans progress from babies to adults the ability to transduce music into emotional messages increases and preferences between types of music arise.

A study by Trainor and Heinmiller (1997) revealed that 6 month old babies have a preference when listening to music, specifically related to consonance and dissonance. Further, 6 month old babies and adults can better identify the pitches of an interval if they are consonant. Human musical preferences originate in the affective relationship between consonance or dissonance. The researchers conclude that, "even though infants do not yet have the musical-system-specific knowledge of scale structure that is involved in adults' emotional reactions to music, infants are similar to adults in their evaluative reactions to consonance and dissonance." The early development of music transducing faculties indicates that music is essential to the survival of a baby. The capacity to acquire language is important in the sociality of the human. Music may have preceded language and provided humans with the tools to form language. The cohesion of the group was paramount to survival. Music engenders community through emotional bonds (Morley, 2003).

Sacks' Musicophilia describes several case studies where music drastically brings out certain qualities within a person. Sacks (2008) writes of one of his patients who suffered a brain aneurysm and lost the use of much of the right hemisphere of his brain. Sacks describes that the patient's personality, mainly his emotions, only partially recovered. The client's emotional life was, "inert, flat." Although, when the patient sang, all of the emotions of the song were visible on him. In one of Sacks' severely autistic patient's music completely transformed him. He notes that the autistic teenager, who normally acted socially shut down, began singing. Sacks notes that the teenager no longer avoided his eye contact during his singing and seemed as though the autism had left him. When the music stopped his symptoms arose again.

These cases display the basic nature of music transduced into emotion. A patient suffering from a lesioned brain that left them emotionless displayed what Sacks describes as "genuine emotion." One could argue that the emotions are just the reflection of the music, that the patient mimicked the emotions. If he could mimic the

emotions it is possible that he did not feel them. One can speculate exactly what this observation means for the emotional quality of music, but the teenager with autism more solidly displays the innateness of music perception and transduction. The autistic individual sings a song and suddenly seems sociable. How does music break through the barrier of autism and bring out typical social behavior? The answer may be within the development of the human.

The DSM-5 reports that the onset of autism spectrum disorders often occurs after the age of 12 months but in rare severe cases can occur before then (American Psychiatric Association, 2013). Zangwill (2013) finds that music listening therapy works for autistic patients because they struggle to think and imagine mental states, and music works because listeners do not have to imagine anything. The content comes to the listener without effort. An interesting finding from Zangwill is that autistic and non-autistic listeners display the same physiological change when listening to music.

The innateness of music gives it a universal umbrella over humans. The human life, a social, emotional experience is bolstered by music. The supplementary quality of music is a testament to the lineage it blooms from. The humans that came before us in the Paleolithic period quite possibly produced music for thousands of years before they made instruments. With archeological evidence showing instrumental musical behaviors 40,000-12,000 years ago and current ethnographic evidence of the Yupik Eskimos producing only vocal music is compelling for the notion that music was produced long before the fabrication of instruments. Morley (2013) argues that musical behaviors from 40,000 years ago shaped the way societies and their communication evolved.

Music is innate. So, how should humans use the knowledge that music is instinctually internalized as emotional content? Listeners and performers experience music differently, subjectivity. Patients with PTSD also experience a unique labyrinth of emotional states that can be crippling, subjectivity. It is evident from archeological evidence and evolutionary perspectives that communication has its roots in music. Is it possible to innervate intrusive language-based thoughts that become negative emotions related to PTSD with music to elicit a state conducive to emotion regulation?

It seems fairly intuitive that emotions are modulated by music. Humans know that music modulates emotion so they do it. Have you ever listened to music and cried about a breakup? However, music can easily be taken for granted in the 21st century. One is able to mass consume it. The background noise of the car radio and streaming services provides music in bulk. Luckily neuroscientists have been curious about the effects of music on the mind and body. Research has been conducted concerning emotional responses to music as well as the states of emotion regulation they can elicit. The ability of a PTSD patient to stop intrusive thoughts is important to living with PTSD (Blanaru et al., 2012). Clinicians are in search of methods that can possibly be universally effective for a range of disorders, among them is PTSD. The following chapter will examine studies focused on the treatment of PTSD and the related symptoms.

Clinical Application and Future Research

Post traumatic stress disorder (PTSD) is common following traumatic events. Symptoms of PTSD include intrusions (e.g. reliving the event), hyper-arousal (e.g. difficulty concentrating), and avoidance (e.g. avoiding reminders of the event) (Blanaru et al., 2012). The symptoms of PTSD are a high burden to the patient. These symptoms often lead to other comorbid diagnoses and disturbances such as depression, sleep disorders, drug addiction, and disruptions in work or social function (Blanaru et al., 2012). Therapy for PTSD is commonly non-pharmacological and based on managing the high burden symptoms through mindfulness. Music has begun to be closely tied to therapy as modern psychology extends its branches into many domains and modalities for answers. The efficacy of music as therapy has become more widely accepted in recent years. The efficacy of mindfulness has also taken shape and is evident in the current PTSD therapies. This chapter has two specific aims:

- Review findings about non-drug interventions for the common symptoms of PTSD available to patients, specifically focusing on music and meditative techniques and
- Provide a direction for the use of these techniques in a practical way for clinicians and touch on future directions for research.

Blanaru et al. (2012) provides a background for the techniques of progressive muscular relaxation (PMR) and guided imagery and music (GIM), or music relaxation, in the treatment of PTSD. Progressive muscle relaxation was created by Jacobson in 1934 with the idea that anxiety causes tension within the body. Cancer patients with insomnia that used PMR to treat insomnia showed a decrease in sleep latency from 124 to 29 minutes, whereas conventional methods only decreased latency from 116 to 104 minutes (Blanaru et al., 2012). Their findings support PMR and as a valid treatment for insomnia, a common symptom of PTSD. Guided imagery and music is the process of music listening and image provocation. Emotion regulation can be brought about through GIM and is an important element of PTSD therapy. GIM effects brain regions associated with emotional episodic memories (Lee et al., 2016). Insomnia can hinder the tools a patient has to deal with high burden symptoms. The study by Blanaru et al. is important for understanding the workings of one symptom of PTSD, insomnia, how it can be treated and consequently lower the burden of other possible PTSD symptoms. While this study does not seek to identify brain regions that are related to PTSD, it provides insight to a possible treatment for anxiety and depression within PTSD.

Guided Imagery and Music involves a patient and a clinician. The two parties typically listen to selected music and the clinician guides with verbal instructions to evoke emotions. This can be achieved through audio tapes as well. Music therapy has been found to decrease anxiety as well as hyper-arousal associated with PTSD (Blanaru et al 2012). Other facets of treatment include exposure therapy coupled with mindfulness, often focused on instilling compassion in patients. Blanaru et al. examine the differences in sleep latency when PMR and music relaxation are used as treatment. While this study does not seek to identify brain regions that are related to PTSD, it provides insight to a possible treatment for insomnia, anxiety, and depression related behaviors of PTSD.

The participants in the study all were diagnosed with PTSD symptoms from traumatic events while at war. All of the 13 participants complain about sleep difficulties. Sleep abnormalities can compound symptoms of PTSD therefore it is important to establish a regular sleep schedule for patients. Data was taken by subjective reports and a small actigraph worn on the wrist during sleep. Measures of sleep quality and latency were taken in three circumstances: no relaxation, muscle relaxation, and music relaxation. The data takes into account the order in which the treatments were received. The three treatments were experienced one at a time for a week each. Cassettes and CDs were given to the participants with PMR, Jacobson's method, and GIM recordings. Participants slept in their home to reduce the burden of sleeping in an unfamiliar place. Over the course of 3 weeks data was taken, each week being a different treatment for insomnia.

The results showed that when patients used PMR and music relaxation, sleep latency was decreased below the diagnostic criteria for insomnia. Sleep improvement was found by objective measures in the actigraph data. For example, GIM significantly improved sleep latency and quality. Progressive muscle relaxation did not improve sleep quality but reduced sleep latency to healthy levels. The subjective reports of depression after music relaxation showed a marked improvement over baseline levels (Blanaru et al. 2012). Improved sleep latency and quality could be the reason for the improved depression scores.

The study by Blanaru et al. demonstrates the value of PMR and music relaxation. The therapies are non-pharmacological which is important for treating PTSD. It must be noted again that mindfulness is a key element to treating trauma and related anxiety. Going forward, identifying specific brain regions can provide deeper insight to the working of trauma on the brain. Therapy for a high burden disorder like PTSD is not always effective since the subjective feeling of the patient is crucial to a therapy's success and efficacy. Now, the essay will turn towards the brain anatomy that are influenced by the treatments PMR and GIM.

Lee et al. (2016) uses fMRI to shed light on the efficacy of GIM therapy. Understanding emotion processing is essential to psychotherapy for numerous disorders. The goal of psychotherapy is to change negative emotions and their subjective feelings into good emotions and subjective feelings. Previous studies have used music to elicit neurological response with success, deeming music as a viable option for emotion regulation. Lee et al. (2016) attempts to determine the efficacy of GIM as opposed to a unimodal approach of either Music

(M) or Guided Imagery (GI) through fMRI and to identify the networks related to emotions, imagery, and episodic memory related to GIM.

The study consisted of 24 participants all with no pre-existing psychiatric conditions. Negative emotions were elicited through the song "Mars, the Bringer of War" from Gustav Holst's composition *The Planets.* The same track was used for all the conditions. Guided Imagery was used to evoke negative emotions by asking the participants to re-experience a time they felt negative emotions. The researchers attempt to elicit negative emotions to allow for the chance for emotion regulation. Three conditions were used in the experiment: GIM, GI, and M. The purpose for the three conditions is to differentiate the neural networks related to them. In between each condition a period of silence was allowed. The GIM method was adjusted to lower the amount of time in the fMRI machine. Guided imagery was presented prior the M component to fit the amount of time required by the block-design fMRI experiment.

Areas of the brain related to negative emotions are the left amygdala, dorsal and ventral regions of the anterior cingulate gyrus (ACG), left insula, and culmen (Lee et al., 2016). These brain regions showed an increase in activation when GIM and M images were compared. The amygdala is commonly referred to in the context of fear and aversion. Also, the amygdala is active in the gating of emotions. The dorsal regions of the ACG are linked to information processing, while the ventral regions are linked to emotional processing. Further, the insula, the brain region responsible for basic emotions like fear, sadness, anger, and happiness, showed a marked increase in activation as well. The activation of the amygdala and ACG indicate that GIM can bring out negative emotions and give the opportunity for regulation. Activation of the insula supports the claim that GIM can elicit subjective emotional states (Lee et al., 2016).

Brain regions related to episodic memory in an emotional context showed increased activation when GIM was compared to M (Lee et al., 2016). Activation of the amygdala is included in episodic memory processing due to its role in emotional processing, explained in the previous paragraph. Activation of the angular gyrus (AG) is associated with memory retrieval and subjective experience. Both regions were activated by GIM indicating that M combined with GI helped the participants focus on their emotional episodic memories. When GIM was compared to GI there were similar results but different brain regions activating. The posterior cingulate gyrus (PCG), AG, and bilateral parahippocampal gyrus activated during GIM and GI comparison. The PCG is related to autobiographical information and the parahippocampal gyrus, connected with PCG, is for encoding memory and recognizing scenes.

Results indicate that GIM can elicit a subjective experience due to the activations in areas related to emotion, episodic memory, visual, motor, integration of cross-modal sensory processing, empathy, and out-of-body experience (Lee et al., 2016). GIM is effective at giving the participant a salient experience of an emotional episodic memory. The recalling of memories gives the opportunity for emotion regulation, an important part of PTSD therapy. If GIM is effective at bringing about emotional experiences then there is a possibility for clinical application in PTSD therapies.

Again, mindfulness is an important component of PTSD therapy, and the previous study displays how GIM can facilitate therapy. Exposure therapy, a common treatment for PTSD, is driven by the capability of the patient to recall negative memories and engage with them in a healthy way. Music elicits emotions in a similar way within the network of brain regions working for episodic memory. Here, music seems to have profound power in changing one's emotional state and facilitating the chance for emotion regulation. The next study examines another possible therapy mentioned, PMR.

Kobayashi and Koitabashi (2015) used fMRI to study the effects of PMR on brain activity. Previously, research on PMR used Electroencephalogram (EEG) but the limitations of EEG do not give the detail necessary for identifying specific brain regions involved in PMR. Blanaru et al. (2012) provides the behavioral basis for the validity of the technique but a deeper understanding of the brain regions associated with PMR can provide more possibility for clinical application.

The experiment included 12 male participants with no prior experience in PMR and no history of psychiatric abnormality. During the control, subjects were instructed through a battery of tensing and relaxing muscle groups but were not instructed to pay attention to their breathing and bodily

changes. Whereas in the PMR session subjects were guided through the PMR process and told to focus on their breathing. The control session preceded the PMR session to avoid the subjects knowing how to do a PMR exercise correctly. The participants tensed their muscles for 15 seconds followed by 30 seconds of breathing and relaxation followed by another 15 second tensing and 30 second relaxation. Each trial consisted of eight 90 second blocks (Kobayashi and Koitabashi, 2015).

Eleven of the participants' gave usable images and there was a noticeable difference in brain activity between the PMR condition and control. There were less changes in brain activation when the subjects performed the PMR session. In the cerebral cortex and limbic system specifically, participants only showed small changes. The researchers note that experienced meditators show less brain activity related to emotion and stimulus (Kobayashi and Koitabashi, 2015). The largest changes in activity during PMR occurred in the superior frontal gyrus (SFG), inferior frontal gyrus (IFG), and posterior cingulate cortex (PCC). The SFG is commonly associated with inhibition and self-awareness. Working memory and focus are associated with the IFG and the PCC. The PCC is commonly associated with the nodes of the Default Mode Network (DMN) (Kobayashi and Koitabashi, 2015). The control trials showed deactivation of the SFG but did not show a decrease in PCC activity. The PMR session deactivated the PCC significantly. Deactivation of the DMN is commonly associated with meditation and is the basis for many studies is mindfulness. The insula and anterior cingulate cortex (ACC) were regions of interest for the researchers. The ACC is associated with attention while the insula is implicated in emotion regulation. The ACC and insula are commonly implicated together in certain disorders such as, panic disorder, anxiety disorders, and depression. Activation of the ACC and insula decreased following PMR sessions but not in the control. The researchers finally claim that PMR can reduce brain activity and provide treatment for the patients with psychological disorders (Kobayashi and Koitabashi 15).

The findings of Kobayashi and Koitabashi suggest that PMR, a form of mindfulness, can innervate symptoms of anxiety. PTSD has an element of anxiety and depression that can be debilitating and high burden for the patient. If PMR can modulate brain activity in inexperienced, first time, participants, then a clinical application must be considered. If PMR alone can decrease brain activity of regions associated with anxiety and depression, what does music have to offer to patients simultaneously? Could a combination of music relaxation and PMR be valid as a treatment for PTSD and other disorders?

The final portion of the essay is concerned with the clinical application of music relaxation (GIM) and PMR. As stated by Kobayashi and Koitabashi the effect of PMR is closely connected to an experience of meditation. Mindfulness, crucial to therapy, cannot be disconnected from music and PMR because of the profound effect that music and PMR have on brain regions related to anxiety, depression, and meditation. When one is focused on something one experiences deactivation of the PCC, which is associated with the DMN (Kobayashi and Koitabashi, 2015). Meditators experience the same result and gain a resilience to external stimuli following deactivation of the DMN (Kobayashi and Koitabashi 2015). What does PMR and music relaxation have to offer patients suffering from PTSD, since not all patients are experienced meditators? When inexperienced participants in the fMRI study on PMR focused on their breath and physiological state, brain activity decreased in areas implicated in PTSD symptoms and the DMN (Kobayashi and Koitabashi 2015). PMR deactivates the DMN, which means self-referential narrative decreases. A decrease in the DMN could mean that triggers or flashbacks and other negative external stimuli simply do not affect the patient as heavily.

Music specifically gives patients the opportunity to engage with negative emotions in a safe, unthreatening way (Lee et al. 2016). Clinicians have multiple ways of garnering emotion regulation in one on one settings but music is unique in that it can be experienced by the patient again after they leave therapy. In the study by Lee et al. (2016) activation of brain regions related to episodic memory increased when GIM was introduced. Overall, music elicited the emotion brought on by the imagery and sound of the music. Since music has a profound effect on the emotional state of the listener, and it requires no training for the patient, techniques for therapy could possibly be built stemming from GIM. Also, music directs one's attention and focus toward its content and context. Music could possibly be used to draw one's

attention and use resources in working memory similar to meditation. Does music affect the DMN?

There is a possibility that music could be linked to meditation since working memory and attention are modulated during the act of listening and place the listener in a state of focus (Kobayashi and Koitabashi, 2015). Lee et al. go as far as to say that GIM gives the opportunity for emotion regulation. The goal of PTSD therapy is emotion regulation and integration of episodic memories, which is often achieved through mindfulness. PMR and GIM give patients the opportunity to experience mindfulness and emotion regulation therapy.

PMR and GIM could be integrated together in a clinical setting by a clinician who has a background in music. The experienced clinician could administer a PMR session to selected musical tracks while simultaneously working guided imagery into the session. The clinician would need to cater the music to the specific patient, possibly asking the patient what they prefer. PMR or GIM could be administered separately or in whatever order the clinician sees fit. The effects of PMR should not be understated because the meditative state that PMR elicits to inexperienced patients is ideal for therapy. The coupling of the meditative state and GIM could be the future of some PTSD therapies.

Future research should be concerned with the connection of music relaxation, PMR and mindfulness. The three are connected in that they modulate brain activity significantly. Studies utilizing fMRI should compare PMR and deactivation of the DMN to deactivation related to meditations. Further, music relaxation should be compared to the meditation studies to find whether music acts within the DMN. Music may modulate activity of the DMN, but it is improbable that music acts exactly like meditation. Music is more innate than meditation and does not require training. Music is stimulus whereas meditation is breathing beyond stimulus. Due to the nature of music, emotion can be elicited and a space created for emotion regulation, but it is unlikely meditation is in tandem with music.

It is evident that PMR can be used as a viable therapy for insomnia, a common occurrence among PTSD patients. Further, PMR elicits a mental state much like meditation and places the patient in a comfortable and open mindset similar to mindfulness, which is commonly needed for emotion regulation and episodic memory integration in PTSD therapy. Music relaxation, specifically GIM, places the listener into a state where emotion regulation is possible. Music can elicit a mental state with its content and context, giving clinicians a basis for drawing out specific emotions, possibly the emotions that are most problematic for the patient. Overall, GIM and PMR are viable vehicles for eliciting openness in emotional states, which is useful for PTSD therapy. As non-pharmacological treatments are studied, music and PMR should be considered as possible options for PTSD patients.

Conclusion

Music can be playful, tragic, puzzling, fear provoking, disorienting, and compassion evoking. When adult humans dance and frolic to the music, they resemble their years as children. As they playfully enjoy themselves, there is a release. Music's release takes infinite forms as it happens to us. Music can bring us to soaring highs that elicit euphoria, bringing us to tears. Music can bring us to tragedy's doorstep and ring the bell. One can step into the musician's heart and encounter their deepest feelings or lightest humor. The bottomless ocean of musical emotions coalesce with one's endless flowing of strife to bliss. One steps into a mindset of observation. The observation of another's emotion then reveals one's reflective capacity.

Music is innate and useful. Humans communicate experience through music to relate to one another. Those who do not make the music participate in it regardless of attitude because music is passively received. There is an effect caused by the music beyond the control of the subject. When one actively participates in the music through dance, performance, or active listening there is the possibility of a deep emotional response that not only brings one together with fellow humans but provides the space for one to encounter the sometimes-difficult human experience. The capacity for one to regulate their emotions with music gives individuals presented with psychological stress a possible remedy.

When one observes their experience while listening to music there is a fundamental feature common that remains constant. The music happens to us. It is not the listener that chooses the emotion

they feel. One can modulate their associations about music after the moment of listening, but when the music is brand new and untouched, there is a flowing forward that is fluent. A message is being received by one's musical telegraph. The message flows from a faraway location into one's consciousness. The human mind cannot help but read these messages as they occur, beeping in like Morse code. The moment of receiving new music is different from listening to a piece one has known for a duration. There is a newness to it. It is simply that, a new musical experience.

Music gives the listener a glimpse of the moment, *now*. For the listener the translation of a new musical message is involuntary. The music itself happens to one's consciousness and orients attention. What an amazing thing, to witness change while in a mindset of observation! Observant, mindful, listening is important for the experience of GIM and PMR when used jointly. One is not in control of a new musical experience; therefore, one is not in control of the emotions that are evoked by the new music itself. One is not in control of the new music vibrating toward one's ear. Out of control, we react to the new music. We accept or deny the change that the music provides. We are drawn to it or driven away. Why do humans change the radio station during a song? Music pushes us to be emotionally influenced. Just like any art, though, new music can then be interpreted.

Clinicians can use the conditioning of music to aid their clients. The features of the music can be remembered by the client and framed in helpful ways. After multiple sessions using a specific piece, clients will be able to recall the emotions of prior therapies. Christmas songs may be viewed as positive for some but negative for others. The associations we make to pieces of music stick with us. Therapy should be geared towards this mechanism of association. Luckily humans are trained to absorb music in this way naturally.

Music can be utilized as therapy because it is innately received, out of one's control. There is no training needed to incorporate music into therapy. With guidance, however, it is possible to direct the energy of music. It is easily wielded by clinician and client. The effect of musical content brings one into a malleable state of emotionality. Emotions can be modulated within the flexible medium of music. Mindfulness is useful in PTSD therapies but must be taught to clients who are inexperienced. Music can aid patients in observing their own experience, a seminal aspect of PTSD therapies based in mindfulness. Clinicians can teach mindfulness with the bolstering, innate, power of music. Music coincides with human evolution, granting a unique emotional quality. Music engenders the opening of the door to emotion. It is a large room, and one is free to organize it.

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