Abstract

This manuscript was abstracted from a lecture for grand rounds for medical physicians. This paper explores the science of how music can help induce sleep relieves anxiety, and pain in patients. This method has been practiced from decades as a way to treat neurological conditions. Now, advances in neuroscience and brain imaging are revealing what is actually happening in the brain as patients listen to music or play instruments and how the therapy works. It depends upon “frequency following” response, a naturally occurring phenomenon where the human brain has a tendency to change its dominant EEG frequency towards the frequency of a dominant external stimulus. Musical rhythm has been hypothesized to be a zeitgeber (ie pacemaker) with its ability to entrain neurons dependent on the strength of its signal relative to spurious signals from higher neural centers that introduce noise into the central pattern generator.. With fMRI brain imaging, the neuroscience of the effect of music can now be mapped to various regions of the brain. Intense

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of opioids in the brain and the release of dopamine. e pleasure of listening to music can be blocked with naloxone (Figure 3).

Cerebellum is also involved in movements such as foot tapping, dancing, and playing an instrument and involved in emotional reactions to music. Corpus Callosum connects the le and right hemisphere. Neuroscientist Gottfried Schlaulg has shown that the front portion of corpus callosum (the mass of bers) is larger in musicians than non-musicians. An increase of gray matter (cell bodies, axons and dendrites is also seen. Frontal Lobes put it all together and gure out if there is any structure and or order to the "temporal" patterning of it all.

e frontal lobes access our hippocampus and regions in the temporal lobe and ask it if anything in our memory banks that can help understand this signal (Figure 4).

Remembering a piece of music or song may simply be the process of recruiting that same group of neurons used to help form a mental image during recollection" [4].

e amygdala, considered the seat of emotions, is adjacent to the hippocampus, crucial for memory storage. e amygdala is highly activated to music, but not to random collections of sounds or musical tones. "Repetition, when done skillfully by a master composer, is emotionally satisfying to our brains, and makes the listening experience as pleasurable as it is" [2] (Figure 5).

According to one study, major keys and rapid tempos cause happiness. Minor keys and slow tempo cause sadness. Rapid tempos together with dissonance cause fear. Studies have shown that infants as young as 4 months show negative reaction to dissonance [5].

Clinical Trials of Music in Medicine

Live harp music has been shown to be bene cial in preterm infants in neonatal intensive care is associated with an reduced heart rate and deeper sleep at 30 minutes a er therapy. Compared with no musical therapy or even recorded music, there was no reduction in HR or sleep parameters [5]. Music therapy in premature infants demonstrated positive impact on oxygen saturation, heartbeat, and on the general level of relaxation. In this study live singing and pentatonic harp was studied in infants. e technique reduced the level of stress as indicated by the baby's increasingly relaxed demeanor and induced a measurable increase on the level of oxygen saturation and reduction of heart rate [6].

Nineteen studies (1513 subjects) were performed on the e cacy of music therapy (MT) on pain and anxiety in children undergoing clinical procedures. Overall MT showed a signi cant reduction in pain and anxiety (SMD)-0.35:95% con dence interval (CL), -0.55 to –0.14;9 studies: N=704; I(2) =42%. Music can be considered an adjunctive therapy in clinical situation that produce pain or anxiety [7].

Music therapy in ICU patients was studied in several studies on the hypermetabolic response of critical illness. Music may restore some of the distorted homeostasis seen in ICU patients as well as reducing

Figure 2: Temporal lobe.

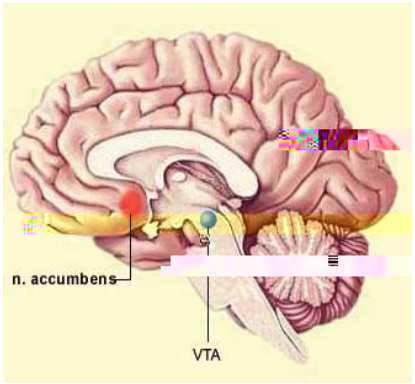

Figure 3: Nucleus accumbens.

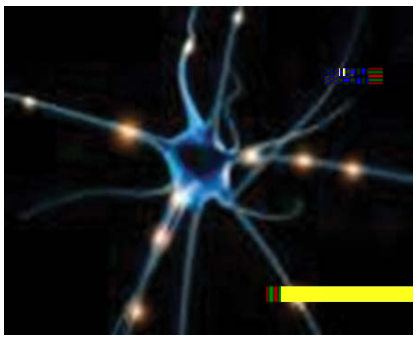

Figure 4: Neuroimaging a memory.

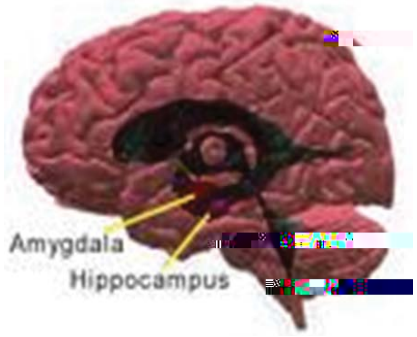

Figure 5: Amygdala and hippocampus.

Speci city of mozart's music

According to JS Jenkins, analysis of Mozart's music as compared

founder of Songs for the Journey. She has founded a nondenominational volunteer ministry o ering live music for those who are near death and for their families.

She presented how song and harp are used in “Vigil Music” and discussed her experience with hospice patients (Figure 8).

Breaking News

Music therapy interventions in Parkinson’s disease (PD); the state of the art. August 2015: Alfredo Raglio sums it up stating the many studies report that musical rhythm in PD treatment can improve gait (speed, frequency and step length, limb, coordination, postural control and balance. “More ever, making and listening to music can be considered as strong stimuli from the emotional point of view, playing an important role in the activation of the limbic system and neurochemical circuits” [25].

Project smart phone app for “Music as Medicine”: Biometric trackers are helping scientist tap into the body’s response to songs and sound. “Pandora, Spotify and other music-streaming services try to predict what users might like to listen, based on their tastes and what’s popular with people near them (Figure 9).

Imagine, according to this Atlantic article, if those apps could predict exactly which song would be best to help you focus, or to slow your heart rate a er a run. (“You seem stressed. How about Sigur Ros?”) And if technology could predict how music a ects the body, could it suggest music to treat symptoms of a disease?”

This idea is the basis of The Sync Project, a new company based in Boston. Its mission is, as CEO and co-founder Alexis Kopikis puts it; “*To fig re o t if m sic can tr l be sed as medicine*.” Music’s effect on the mind and body has long been acknowledged anecdotally—who hasn’t tried to use music to influence their mood? Kopikis says “it’s only now that the technologies in both the music and health industries are advanced enough to provide the opportunity for this research. The Sync Project currently takes the form of an online and mobile platform that pairs users’ music-streaming services with their wearable body monitors—Fitbits and the like—to track how music might be interacting with their body. The collected data is then shared with scientists who may be able to use it for their own research. If you play music that has a steady beat, or even just a metronome, patients with Parkinson’s seem to have improvements in their walking” [26].

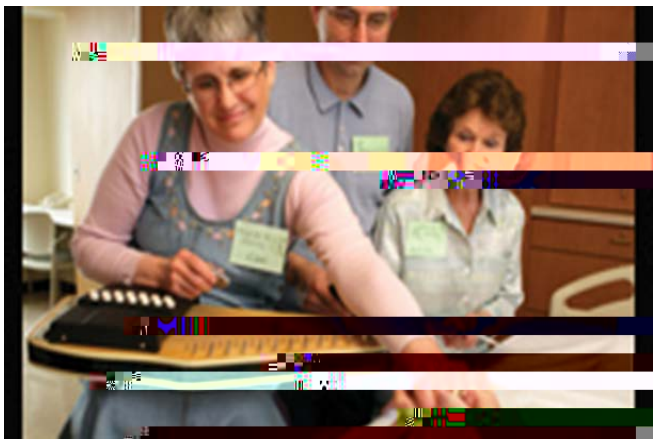

Figure 8: Music thanatology.

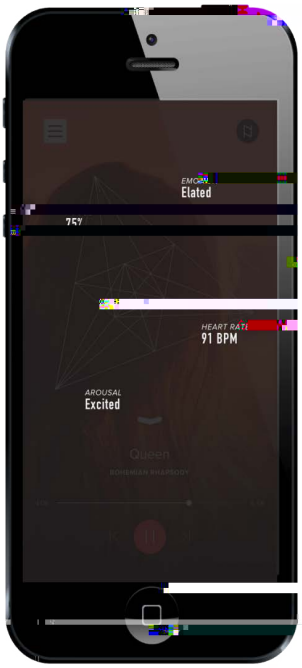

Figure 9: Smart phone app for “Music as Medicine.

Conclusion

Neuroimaging has helped scientist understand better the various parts of the brain that are involved in listening to music and how the biophysics of music a ect both musicians and patients. Clinical studies in children and adults elucidate that music can alieve pain and anxiety, reduce pain and help sleep. Music can be considered an adjunctive therapy in many clinical situations that produce pain or anxiety. Music can also be used to help ease the journey of the terminally ill. Its use in clinical medicine and surgery when more widely adopted will be an adjuvant to prescription medication and will help reduce the burden of narcotics with their many side e ects.

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