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# Introductory Chapter: Introducing Biobehavioral Perspective of Music

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## 1. Introducing biobehavioral perspective of music

Listening to music is an important part of a pleasant human experience. It allows the ventilation of pent-up emotions in a socially acceptable manner. Music does affect large aspects of human emotions and impacts biobehavioral processes such as arousal, concentration, sleep, and social bonding. There is evidence reporting on the effect of music activating complex neural networks critical for cognitive and emotional processing. Therapeutic effects of listening or playing music have been a focus of research in recent years especially focusing on the regulation of mood under strained physical and psychological conditions. It is important to realize from a cognitive neuroscience perspective how the musical tones are linked to synchronous activation of certain emotional states with the genre of music that is being played. It is also crucial to understand the neural correlates involved in the transformation of musical experience into generating certain emotional or mood states. How music-based therapeutic model function is being explored and has been attempted under various clinical circumstances? Therefore, it is pertinent to comprehend the psychological aspects governing emotional responses to music in human beings.

## 2. Music types and significance from a biobehavioral standpoint

Literature supports the evidence for the induction of certain emotional states with music. The various psychological frameworks that are involved in listening to music are cognitive appraisal, episodic memory, musical expectation, emotional contagion, visual imagery, and rhythmic entrainment. The induction of pleasure experience is widely studied and dopaminergic activity reinforcement is considered as a postulated target for a music-induced rewarding experience. It is significant to understand that why some combinations of sounds become pleasant to humans but not to animals? A possible reason being the mesolimbic system interacts with other regions of the brain but structural and functional connectivity varies across the species due to the complexities of the brain. The concept of reward in human existence can take various forms, such as enjoying the process of attending music concerts, reading fiction, visiting museums, photography, and esthetic activities such as planting flowers, decorating wardrobes. Esthetic rewards are often abstract and involve significant cognitive components that could be appreciated by well-developed neuronal connections in humans. The rewarding nature of esthetic stimuli varies across cultures and between individuals within the same cultures, depending on previous experiences with a particular nature of stimuli. A musical

lexicon is a storage system for musical information, which stores whatever an individual has been exposed in their life. This system is considered to help an individual to categorize the type of music they are listening to and subsequently determine its reward value for that individual. It is observed that listening to classical and self-selected music can result in a reduction in anxiety, anger, and sympathetic nervous system arousal and lead to increased relaxation but not so when heavy metal music or such genres are played. Similarly, music with a slower tempo is associated with sadness and lower levels of evoked arousal. This is also associated with increased mind-wandering during sad music suggesting differential levels of enjoyment during sad and happy music [1]. Stimulation of the parasympathetic nervous system and positive emotional experience occurs when classical and relaxing self-selected music is perceived by an individual. There is strong support for self-selection of musical choice, which induces enhancement of mood states, greater joy, reduced anxiety, and sadness. Individuals with high levels of emotional distress and trait can benefit from musical upliftment of emotional state. It is to be noted that the impact of the type of music on subjective and physiological parameters may vary and may not be consistent. Therefore, it is crucial to consider individual variation for music-associated mood upliftment. However, most commonly observed responses include the experience of jazz music to enhance mood state with increasing age. A variety of musical pieces or genres may be required to see the influence on physiological and emotional responses and to determine the best suitable fit for any therapeutic purpose.

### **3. Differential effects of music on neuronal circuits during listening, singing, and playing**

Music is considered a language of communication among musicians because it exhibit characteristic features such as melody, timbre, rhythm, and expression. Music composition essentially involves a complex interplay of mathematics, geometry, and language that gives the amalgamation of existential and materialistic interwoven structure and texture to it [2]. Passive listening to the music of a certain type involves passive engagement of the auditory apparatus and resting-state network of the brain. Perception of self and passive participation of audio-visual sensory apparatus is best understood through activation of the default mode network of the brain [3]. Surprisingly, the processing of the music among non-musicians can be effectively handled by our neuronal networks of the brain to produce feelings of joy, tears, and love! This endorses the hypothesis that the interplay of music and emotions is a part of collective unconsciousness accessible to each individual that can be tapped without learning the theories of music. Further active participation in listening can help to express emotions openly, which is automatically executed by different areas of the brain. The best example is the semi-automatic participation of the motor cortex in activating different areas of the body such as hands, legs, fingers, and trunk to simulate the generalized dance-like movement of the body. What happens during singing then? Singing is an active sensory-motor process that orchestrates the multisensory involvement through direct and active neuronal participation in addition to inputs from audio-visual sensory apparatus. We all have a song that we deeply connect to and appreciate; therefore, even the analysis of lyrics provides an opportunity for an individual to identify the song that may correlate with their experience. On the other hand, playing a musical instrument additionally adds up the active processing of the motor cortex through activation of the pre-frontal area of the brain. The fine motor aspects of finger movements and bilateral hand-eye-ear coordination set a platform that establishes sensory-motor harmony

with the internal state of consciousness and vibes of music. Songwriting gives freedom to articulate in a positive and remunerating way that can help to mirror own contemplations and encounters with the help of instruments and beats. This cycle can be self-approving and can help in building self-esteem and immersing oneself within. The imprints generated from this harmony help to build a neuronal primer for functional neuroplasticity of the brain [4]. This affects emotion processing through decoding by the same reward system of the brain used for hunger, thirst, and sex. The difference lies probably in the ceiling effect of the basic rewards in contrast to music-associated rewards. Our neuronal networks are adapted to have a specific threshold of inhibitory signaling to garner the internal homeostasis of the physical body. This is applicable for satiety and orgasm; the processes help to keep the inhibitory check on the basic reward system. For music, the sheer nature of the combination of predictability and expansive creativity, there is no ceiling effect observed by the brain and even the old pieces of music can be perceived as completely new through alteration in varieties of neuropsychological parameters such as attention, memory, motor control, imagery, spatial processing, and abstract thinking. Though contemporary music is blended with a semantic word, mere listening to instrumental tunes or ragas brings about the identity of music as a universal and existential construct [1]. This is probably the biggest reason why psychophysiological processes are inherently involved beyond the geographic, ethnic, linguistic, religious, and cultural context to give rise to the feeling of connectedness with the language of music. The language of the music can engage the different areas of the brain simultaneously with neurohormonal changes to produce its effect through tears, goosebumps, bringing changes in skin conductivity, and heart rate variability. The extra edge of the impact of musical processes on the human mind opens up the possibility of infinite potential and carries the ability to transcend to ecstasy as described by spiritual texts.

#### **4. Neuronal reward mechanisms and the process of subjective “high” with music**

It is seen that the reward produced by the components of music is mediated through areas of the brain involving ventral tegmentum, nucleus accumbens, insula, and hippocampus through neurohormones involving dopamine, oxytocin, vasopressin, and opioids [5, 6]. Additionally, immune mediators such as interleukins and cytokines are also activated in carrying out the perceived response to music. Oxytocin as well as vasopressin have a strong effect on the development of empathy and social bonding. Thus, a group singing activity has the potential to hypnotize millions of individuals that work through a sense of cohesiveness produced by the differential effect of components of music [7]. Besides oxytocin being the hormone of love, it generates affection by regularizing the emotional disharmony in our mind [8]. This happens to be the reason why components of music are generally appreciated for motivation, peacefulness, and tranquility by many of us. Many people perceive music as energetic, powerful, and inspired when presented with the contextual semantic context. In a way, music has the quality to amplify and transcend our emotional state to a higher level [1]. The reason for portraying the symbol of gods and goddesses with a variety of music organs is a testimony of our ancient understanding of music. Music brings the union of unconscious memory with conscious emotions and this technique is being researched in neuroscience. The recollection of events associated with happy memories and their powerful coding can be traced in the form of the personal toolkit in patients with recurrent depressive disorder, post-traumatic stress disorder, and Alzheimer’s dementia [9].

Different types of music can resonate with the functional networks in the brain, which indirectly help in inducing alteration in the perception of emotions and thoughts. Regular listening or playing of a certain type of music delivers potential neuroplastic effects on the structural synapses and exerts functional changes that could be utilized as a facilitatory approach in certain mental health conditions [10]. The fundamental basics of which lies in the synchronization or matching between the frequency of structured sound waves and neuro-hemodynamic oscillations needs to be addressed in future research.

The impatience and impulsivity of the mind can be effectively replaced by music by changing the attentional processes of the brain. Music can be used to direct the mindset. Because of its rhythmic and repetitive aspects, music engages the neocortex of our brain, which calms us and reduces impulsivity. In addition, since music utilizes the same reward pathways of the brain used by the substances of addictions, can music be proposed as a form of healthiest addiction in such clients remains the area of future research [11].

## **5. Music therapy as a primer for disorders of mental health**

There is emerging evidence to support the use of music therapy in the treatment of disorders of mental health. Literature shows different models of music therapy that have been developed. In a systematic review of music therapy in an adult acute psychiatric care setting, delivery of music therapy and its effect on acute stages of mental illnesses were assessed [12]. It is important to note that the delivery of music therapy faces a challenge when disorders of mental health are concerned and chronic mental health conditions could be better suited than acute states. These challenges could be the type of music, type of setting, diverse needs of the patients, and ethical fitness. Due to the severity of symptoms, engagement and attendance become difficult for music therapy. It is challenging to establish the role of isolated music therapy in depressive disorders as studies have limitations in terms of methodological approaches and heterogeneity across the models [9]. But some randomized trials have shown that the combined approach of music therapy and standard care has been effective in ameliorating depressive symptoms, anxiety, and quality of life. Findings from a recent review on the role of music therapy in depression versus treatment, as usual, indicated that music therapy does provide short-term beneficial effects in reducing depressive symptoms. Treatment as usual combined with music therapy has done better in improving depressive mood states compared to treatment as usual approach in addition to the reduction of anxiety levels and enhancement of overall functioning in depressed patients. In a review comparing music therapy with standard of care, placebo, or no treatment, moderate to low quality of evidence for music therapy as add-on treatment was established in improving negative and general symptoms, social functioning, and quality of life of patients with schizophrenia. It is important to note that outcome effects have shown variation due to the number of sessions given and the quality of music therapy delivered. It is considered that musical experience and improvement in relationship development may help in communication and expression in patients with autism spectrum disorder, a study that compared music therapy or music therapy add-on to the standard of care with placebo or no treatment. Short-term and medium-term effects on music therapy delivered in children diagnosed with autism were assessed from 10 studies indicated that music therapy may assist children in improving social interaction, communication, understanding social–communication reciprocity. Music therapy also enhanced non-verbal communication skills in these patients. It is suggested that music therapy positively contributes to enhancing social adaptation

skills in patients with autism and improve the quality of child–parent relationships. But important to understand the fact that music therapy services require specialized academic and clinical training, which may halt the wider reach. More research in this area can improve our understanding regarding overcoming the challenges in research designs and improve the effect size of the outcome in mental health disorders.

## 6. Music therapy for mental healing and conclusion

Much old is the relationship between music and the mind. Ancient Greek Philosopher, Plato (428–347 BC), cited “Music gives a soul to the universe, wings to the mind, flight to the imagination and life to everything.” Plato thought that music played in various modes would excite various feelings. This is applicable even today, where an influence of music is utilized to build up a remedial relationship, sustain an individual’s development, and aid in self-realization. The relief from day-to-day stress could be achieved through self-selected music by non-professionals to the development of deeper connection with the self by professionals, the cycle is a vicious process. In this process, music is consciously being used for the enhancement of living, being, and becoming. Music acts as a medium for processing emotions, trauma, and grief but music can also be utilized as a regulating or calming agent for anxiety-like states. In a nutshell, music therapy is the use of music as a therapeutic tool for the restoration, maintenance, and improvement of psychological and physiological health through achievements across physical, social, and spiritual dimensions.

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