Research Article

BIOMEDICAL Journal of Scientific & Technical Research

ISSN: 2574 -1241

DOI: 10.26717/BJSTR.2025.60.009482

# The Use of Music in Mental Health and NeuroScience

**Fulvia Anca Constantin* and Doru Ursutiu**

*Department of Musicology, Romania*

***Corresponding author:** Fulvia Anca Constantin, Department of Musicology, Romania

**ARTICLE INFO**

**Received:** February 13, 2025

**Published:** February 21, 2025

**Citation:** Fulvia Anca Constantin and Doru Ursutiu. The Use of Music in Mental Health and NeuroScience. Biomed J Sci & Tech Res 60(4)-2025. BJSTR. MS.ID.009482.

**ABSTRACT**

In recent decades, the enrichments of medical technologies help more psychological and neurological conditions to be diagnosed. There are included here numerous dysfunctions from the developmental spectrum and neurodevelopmental pathologies, age-induced neuronal deficits and, not the last, neuropsychological dysfunctions. Therefore, the scientific research groups and have focused on finding diagnosis and therapy of disorders such as schizophrenia, attention deficit hyperactivity disorder, autism, Alzheimer's disease, Parkinson's disease, dementia. As an interesting intervention with potential benefits for these neuro/ medical pathologies it was used music therapy. The aim of this paper is to bring some devices and examples of the use of Music in Mental Health and Neuroscience, some of them with interesting results.

**Keywords:** Mental Health; Music; Neuroscience; Music Therapy

**Abbreviations:** CT: Computed Tomograph; MRI: Magnetic Resonance Imaging; FMRI: Functional Magnetic Resonance Imaging; PET: Positron Emission Tomography; SPECT: Single Proton Emission Proton Computed Tomography; EEG: Electroencephalography; MEG: Magnetoencephalography; ICT: Information and Communications Technology; BCI: Brain-Computer Interfaces

## Introduction

In his definition of music, Ion Gagim stated that the beginning of music is "in the human consciousness - not in the voice, not in the fingers, not even in the hearing, but in the unfathomable depths of the I-self" (Gagim [1]). He gives importance to the relationship created between man and music, especially to the role and significance of music in the relational, healthy and intimate life of the human being. As a means of treatment, music is seen and defined as therapeutic and has been used since ancient times. The intimate relationship between music and the psyche is characterized by interaction and interrelation, and the repercussions are defining for both sides. Music is an emanation of the soul and the psychè owes its existence to music. It strongly influences the psychè because it influences vital inner processes, both physiological and psychological. "The action of music on the psychè is constitutive in nature because it is complex (in detail) and total (as a whole), beginning with the psychosomatic level and ending with the metapsychological one; it applies the entire inner universe, from mild affective states to states of deep meditation." (Gagim [1]). Although the emotional satisfaction of the perception of music manifests itself as a primary unintentional reaction, which we can also count as a characteristic of the perception of art in general, music, more than all other arts, often goes beyond this state of emotional reaction, somewhat diffuse, influencing and determining, as the case may be, different more complex psychosomatic attitudes.

The relationship with music can be interpreted either through a passive, positive or negative affective state, or through an active, physical and intensely conscious participation, referring to and acting independent of prior musical knowledge (Dennis, et al. [2]). In their research, Anne Cain and Jacques Cain start from the question of whether there is an incompatibility between psychoanalysis and music, based on Freud's stated relationship between those. They note that "the object of music and that of psychoanalysis have in common that they are defined by the impression that persists after their disappearance", in other words their effect, and find that both sciences are based on repetition and interpretation (Cain, et al. [3]). These terms can, however, in my opinion, have a different meaning. While in psychology the theory of repeatability is known as inductive (the repetitive induction of an idea comes to be taken as true), in psychoanalysis the repetition of certain states or dreams, or the repetitive retelling of them, is conclusive. Moreover, in music, repetition is seen as a way to

achieve perfection (in musical interpretation) or an expression of a feeling (in composition). In specialized medicine, music perception is explained by the fact that the auditory cortex plays a central role, processing the sound. At the same time, areas associated with emotional responses (e.g. amygdala) and memory (e.g. hippocampus) becomes activated.

The properties of the auditory system along with culture-specific factors have an impact on the perception of music and furthermore on therapeutic working with it. As noises (harsh sounds) arouse various emotions, states of anxiety, nervousness or aggression. Music has a similar effect. The neural-hormonal studies mention catecholamines, cortisol and endorphin. On the level of the catecholaminic reaction, only adrenalin and noradrenalin were studied as reactions to the sonorous stimulus giving reactions of the neural-vegetative type, such as tachycardia and the rise of the arterial pressure. Dopamine acts on cells in different parts of the brain to produce effects. (Levitin [4]) One of its functions is creating a good feeling after something enjoyable , another is controlling the body movements and is having a role in mental illnesses. What we expect in music is no harm, listening to something as "innocuous" as music it enables the experiential "rewards and punishments that arise in response solely to the accuracy of the expectation" we experience (Croom [5]). Lately, neuroscientists have been endeavoring to show which biological components are involved in "brain activation" and "musical pleasure" and the role played by these components play.

Neuroimaging and electrophysiological studies make known that in both, normal individuals as well in patients with neurological lesions, music can modify the state of large-scale neural systems of the human brain not limited to brain sectors related to auditory and motor processing but also in regions related to the regulation of life processes (homeostasis), including those related to emotions and feelings, in the amygdala, and in certain upper brainstem nuclei (Habibi, et al. [6]). Functional neuroimaging studies show that music perception involves emotion-related brain networks and can modify brain structure and function after either immediate or repeated exposure. It was found that music, with its multimodal activation of the brain, serves as a useful model for neuro-rehabilitation through neuroplastic changes in dysfunctional or impaired networks, and neurologic use of music therapy. Neuropsychological studies have suggested that imagery processes may be mediated by neuronal mechanisms similar to those used in perception (Zatorre, et al. [7]).

## The Use of Music

Sometimes, listening to music brings back memories from different stages of personal history, emotionally charged moments, other times it is just a pleasure or displeasure caused by the music. The relations between the individual and music are varied and reveal different psychological mechanisms of defense, regression, identification (with the artist), reactional formations (an aggressive person listens to soothing music, condemning aggressive styles) or rationalization. The artistic act, in psychoanalytic terms, represents sublimation as a defense mechanism. Music is not only considered an influential tool to study the human brain, but there is evidence that using music, actively or passively, and music-based interventions help also understand neuroplasticity as the nature of the human brain (Chatterjee, et al. [8]). There is evidence of structural differences between the brains of musicians and non-musicians, musical training being reported to induce structural changes in cortical areas involved in sensorimotor functions, auditory perception and higher grey matter density (Gaser, et al. [9]). Also neurochemicals released in the central nervous system facilitates behavioral and emotional changes in the organism in the sense that their activity remodel in the progressive way the representation and functional importance of sensory stimuli in cortex. For example, hedonistic properties, changes in the volume of activity motivational, reward-seeking behavior and stimulation (dopamine), so on (Chatterjee, et al. [8]).

The inner conflicts of the person who composes or performs a particular melody find their resolution through the act of creation itself. The person - music relationship is two way, from the outside, when music acts as a stimulus, or from the inside, when unconscious tendencies determine conscious choices for certain genres and subgenres of music as a form of compromise for unconscious contents, music being the manifest content through which latent content is expressed. Music can convey an infinite variety of subtle and primitive emotions. It is the universal language of human emotions, to express what is inexpressible in words and chooses qualitatively different ways of being communicated (Brog M A, et al. [10]). Patricia Skar states that "emotional values seem to be fixed and we can imagine that they might conflict with feelings that want to move, develop and transform. So when we listen to music initially it connects us to our unconscious processes, and this phenomenon happens because the internal processes, represented by melody, harmony, rhythm, tempo and all the forms that music takes, are archetypal in nature, and connect us to the deep archetypal layers in our own nature (Skar [11]). Psychotherapist Suzanne B. Hanser says that to use music in therapy is to bring out the creative side in each person she meets. Everyone has their own music, that part of their being that is completely free, that part that sings and has a rhythm.

"We all have this music in us! When we are unable to think, speak, move or be who we know we can be, we have the music within us that helps us to express and communicate, to feel good, to move, often deeply and always naturally." (Hanser, et al. [12]). Also, Levitin looks into musician professional diseases at how that can be impaired by illnesses such as multiple sclerosis and Parkinson's disease, but also how cognitive functioning can sometimes improve when they are in contact with music even in a different way (Levitin [4]). He stated that "music influences the brain, mind, thoughts and spirit" which led into healing the body (Levitin [13]). It is also known that our own

body is made up of energy vibrating at different frequencies. Falling below the optimal average induces illness. Through the influence of other frequencies, the body can recover. This is also the case with the influence of sound (vibrational frequency), which is perceived both subconsciously and consciously. The example of so-called "magic self-therapy" is well-known: a well-tuned stringed instrument (e.g. guitar) whose sounds are clear is placed on the affected area and the strings are plucked for 15 minutes with the note whose sound corresponds to the malfunctioning organ (Cezar [14]). Moreover, human brain is also a receiver of sonorous vibrations which are transformed in sensations, emotions. The effect occurs on the level of physical features of the sound . The essential elements of human understanding of music are created when music is experienced as structure.

"Such feelings are not emotions as commonly understood, although they may engender emotions in some circumstances. The characteristics of music which engender these feelings are similar (or analogous) to characteristics of the experienced physical and biological world." (Sloboda [15]).

## Methods and Methodology

### Technologies of Quantifying the Music Effect

The use of technology in music has been a long-standing area of research, and the interdisciplinary nature of the field is reflected in the diversity of approaches to technical information and communication applications that consider music therapeutically (Cox, et al. [16]). The quantification technology of the effects of listening or practicing music is given by a series of devices used to diagnose changes. For example, functional neuroimaging studies show that music perception involves emotion-related brain networks and can modify brain structure and function after either immediate or repeated exposure. It was found that music, with its multimodal activation of the brain, serves as a useful model for neuro-rehabilitation through neuroplastic changes in dysfunctional or impaired networks, and neurologic use of music therapy. Neuropsychological studies have suggested that imagery processes may be mediated by neuronal mechanisms similar to those used in perception (Zatorre, et al. [7]). Examples of technology include:

- Computed Tomograph (CT) - equipment that uses X-rays to investigate, i.e. create detailed images of structures inside the body.
- Magnetic resonance imaging (MRI) - a medical imaging technique used to take pictures of the anatomy and the physiological processes inside the brain.
- Functional magnetic resonance imaging (FMRI) - technology that helps study the brain. In practice, fMRI images the effect of music on various interneuron connections.
- Positron emission tomography (PET scanning) - used to determine and evaluate the effectiveness of therapeutic management of neurological disorders such as Alzheimer's disease, Parkinson's disease and epilepsy.
- Single Proton Emission Proton Computed Tomography (SPECT) - the newest equipment used to scan the brain. Thanks to a substance (a radioactive marker) injected into certain areas of the brain, the CT scan (also X-ray) shows a three-dimensional image that highlights the flow of blood in the brain, with areas that are more or less active being visible.

As methods that capture information on brain structures and functions and further could be investigated, other than FMRI (described above) could be magnetoencephalography (MEG) - captures the magnetic fields generated by neural activity, and electroencephalography (EEG) - record brain processes that occur soon after the onset of visual or audio stimuli and measure electrical activity generated by different cortical layers of the human brain. New developed devices, straight forward and easy to use equipment found on the market could be used to recording and quantify results of using music. We only give example of BioRadio, EEG Crystal and Crystal-Sleep, MindWave and Muse, nonprofessional equipment that could be easily used. Few

- BioRadio - a portable, easy to wear (lightweight and wireless) medical handheld device with programmable recording and transmission of different combinations of signals (such as pulse and blood pressure values).
- EEG Crystal and Crystal-Sleep - medical devices that record heart rhythms during sleep.
- MindWave is a professional EEG headset with forehead and ear sensors from NeuroSky that measures attention (concentration) and meditation (relaxation).
- Muse is a professional headset whose activated sensors induce a meditative state. A generation after MindWave, Muse does not, however, offer the possibility of recording and analyzing the results.

Of course, on top of these there are more professional equipments used in research, to only give the example of BrainMap (qEEG) - a more specialized and complex version of an electroencephalogram (EEG) that collects and processes data about the brain activity from which could be detected brain areas that require neurofeedback training. Moreover, great potential for brain research it has fNIRS technology, but it necessitates specialist skills, and experience which makes it limited to the use of scientists. A number of new innovations related to brain monitoring including portable and wearable solutions to directly measure brain electrical activity also include applications, basically wearable headsets that enable EEG brain training through neurofeedback. The examples are listed such as: MUSE (improved generation),

Emotiv EPOC, Actiwatch 2, Motionwatch 8, WatchPAT, Sleep Profiler, Beddit 3 Sleep monitoring system, S+sleep sensor, ES contact-free sensor, Kinesis Health Technologies, APDM Wearable Technologies, MC10, F-Scan™ system, Moticon insole, SensoMotoric Instruments, Project EVO (cognitive function), SensoMotoric Instruments, Tobii, Right Eye, GazeCapture. (Byrom, et al. [17]) – New breakthroughs in the field of technology involve interdisciplinary collaboration, choice of application strategies based on real demonstrations and experiments in music therapy with results targeting the effect of music from neurological and psychiatric point of view. And here the importance of quantification technology is obvious.

The use of ICT (Information and communications technology) has a progressive effect on many areas of attainment in science. Through the use of ICT, researchers have a better understanding of scientific concepts, of the scientific reasoning and explanations.

## Example of Working with MindWave

Easy to use, prized for its value for money and results in EEG-oriented research, the MindWave headset consists of an adjustable headband, sensors, ear clip, battery and ThinkGear chipset. The Mindwave headset measures raw signals and EEG power spectra, i.e. the user's brainwave data, aiming to "monitor electrical signals generated by neural activity in the brain." The interface of the MindWave set as it appears on the computer shows, on the left side, the brainwave frequency and, on the right side, the frequency range with the associated color and the eSense attention and meditation meters. During the experiment, the MindWave headset has the values communicated via Bluetooth to a computer where the electrical activity of the brain can be followed in a dynamic EEG EEG evolution. The eSense meter value (describing mental states) quantifies the ratios of attention (concentration) and meditation (relaxation) levels. A description of the type and range of brain wave frequency, associated color and mental state characteristics is shown below (Figure 1). The experiment method consists in determining the action of a particular piece of music. The steps followed in the measurements are:

(i) checking the functionality of the device (the program requires prior installation on the computer).

(ii) The choice of music - based on the results of the music test applied to the subject and taking into account the characteristics of the music.

(iii) Connecting the device and turning on the switch. The experiment could be adapted from passive - sitting/standing to active - moving or even playing music and measuring mental activity.

| Frequency type | Frequency range (Hz) | Mental stage characteristics | Associated color |
|---|---|---|---|
| *Delta* | 0-4 | State of unconsciousness, absence, lack of concentration. | red |
| *Theta* | 4-8 | Deep relaxation, internalization, meditation, intuitive access to imagination, fantasy, dreaming. | orange |
| *Low Alpha* | 8-10 | Conscious relaxation, awareness without effortful attention or concentration, good mood, calm. | yellow |
| *High Alpha* | 10-12 | Increased self-awareness and concentration, a state conducive to learning, accumulating new information and performance. | green |
| *Low Beta* | 12-18 | Alert thinking, active attention, problem-solving orientation, settling and decision-making. | light blue |
| *High Beta* | 18-30 | Engagement in mental activity, alertness and restlessness. | dark blue |
| *Low Gamma* | 30-50 | Cognitive processing, intelligence, compassion, self-control. | violet |
| *High Gamma* | 50-70 | Higher cognitive tasks: memory, reading hearing and speech. | purple |

**Figure 1:** EEG signal frequency ranges from NeuroSky website.

At Transilvania University of Brașov, we had conducted a serie of experiments on expressing emotions and synesthesia. During these sessions, the subjects - user of the devices showed an increase or decrease in the level of concentration or, on the contrary, in the level of relaxation, which varies depending on various psychological factors (stress, mood, preference for a particular musical genre, fatigue, and so on). Once the musical pieces ended, the brain wave frequency type appeared on the screen describing the activity intervals according to the eSense calculation (Girase, et al. [18]). The results obtained, for example, the average values that emerged as a result of the audience, were noted in a table for comparison. It should be noted that the average recorded frequency value is a qualitative estimate of the test. For a more accurate result, all these values could be refined in LabVIEW. The interpretation of the results focuses on the information provided by the frequency type table. Simultaneously –it is recommended to measure temperature, blood pressure and the pulse values. Also, during the experiments, the observations are recorded as valuable (movements, blinking, facial expressions, so on.) The results obtained can describe ranges of activity for users exposed to the same or different stimuli. The identified range of frequencies refers to specific mental states and varies from subject to subject, showing different levels of attention and concentration. The MindWave apparatus has been used in various research studies and is one of the current ways of measuring the effect of music.

### Few Examples of Latest Research Worldwide

Recent studies have demonstrated neural decoders that are able to decode acoustic information from a variety of neural signal types including electrocortiography (ECoG), functional magnetic resonance imaging (fMRI) and electroencephalogram (EEG). It was recorded brain activity while participants listened to music (Daly [19]). Also, it was targeted the automatic prediction of the human response to music exploring the correlation between EEG features and music features aiming to provide the basis for the extension to the application of music (Luo, et al. [20]). A group of Chinese researchers considered studying electroencephalography signals related to investigating brain function and cognitive processes in a study that addressed the challenges of recording and analyzing high-dimensional EEG signals while listening to music to recognize emotional states and combining Bi-LSTM with attention mechanisms to providing technical support for applications in brain-computer interfaces (BCI) and affective computing (Wang, et al. [21]). Several functional imaging and lesion studies have associated the amygdala in responses to unpleasant music. Using FMRI, it was compared the neural responses to unpleasant music with the responses to consonant pleasant music (Koelsch, et al. [22]).

Researchers have focused on disorders including both temporal extremities of brain developmental stages, studying from developmental conditions of autism and attention deficit hyperactivity disorder to ageing-related pathologies of Parkinson's disease and dementias, analyzing the relevance of music therapy in the treatment of these specific disorders (Ramaswamy et al. [23]). Sometimes, listening to music brings back memories from different stages of personal life, emotionally stimulating moments, other times it is just a pleasure or displeasure caused by the music which activates thinking and memory. Deficits in attention and memory (cognition issues) have been stated to be attenuated by neurologic music therapy which was linked to significant improvements in motor deficits and spinal cord injuries, as well. Moreover, rhythmic music was demonstrated to improve multiple spatio-temporal attributes of gait, including speed, symmetry and cadence (Alashram, et al. [24]). Recent literature reviews confirmed the effectiveness of music therapies in inducing improvements of motor functions, cognition, communication, mental health status and spatio-temporal reasoning in aged adults with Parkinson's disease and dementia (Machado, et al. [25]). Clinical music therapists integrate various techniques into cardiac care treating patients with acute myocardial infarction, coronary artery bypass graft, and other cardiac conditions, people who require assistance in dealing with stress (Hanser, et al. [12]).

Although there are many other researches with impressive results we conclude that an significant aspect of music therapy interventions for chronic disorders, including neurological conditions, lies in the ability to affect (in a benefic way) the circadian rhythm (Nassan, et al. [26]) and sleep-wake cycle (Loewy [27]).

## Conclusion

No doubt a healthy person has an increased level of well - being. If an activity such as musical engagement (of any kind) can be shown to positively medical and psychological influence would be convincing evidence that an activity (e.g. musical engagement) can positively contribute to one's living quality of life and overall functioning. Using music for therapy is increasingly being used to promote physical and mental health. The dual relations between man and music are diverse so they reveal different psychological mechanisms of defense, regression, identification (with the artist or with the message), reactional formations (an aggressive person listens to soothing music, condemning aggressive styles) or rationalization (Levitin [13]). Music, apart from being a source of affective and pleasurable experience, moving us both physically and emotionally and, by playing an instrument, shaping the brain structure and function, has been studied as an auditory phenomenon using passive listening paradigms. Listening to music changes moods, improve functions but also generate predictions about future which give us a comprehensive understanding of music processing involving brain structures implicated in action, emotion and learning, in creativity and improvisation. As dr. Levitin used to say. "Music promotes relaxation when we're stressed; it can reduce blood pressure or make diabetes management easier; it soothes us when we're depressed and energizes us for exercise.

[…] Engaging with music, whether as a listener or a player, facilitates entry into the brain's Default Mode Network (DMN), a path to the subconscious that is instrumental to everything from problem-solving to relaxation, from creativity to immune system function. And for many, music can connect us to a sense of a higher power, of great and enduring beauty, and listening to or playing it can provide some of the most exhilarating and meaningful moments of our lives." (Levitin [4]) It is what makes music meaningful from a psychological, neuroscientific perspective [28-31].

## References


1. Gagim I (2003) Dimensiunea psihologică a muzicii, Editura Timpul Iași.
2. Dennis R, Talmazan Y (2003) Music in Multicultural Activism. Santa Barbara Praeger Publishing.
3. Cain A, Cain J (2003) Freud și muzica. Editura Trei București.
4. Levitin D (2024) Music as Medicine How We Can Harness Its Therapeutic Power. Published by Penguin Random House (UK).
5. Croom A M (2012) Music, Neuroscience, and the Psychology of well-being: A précis. Frontiers in Psychology 2: 1-14.
6. Habibi A, Damasio A (2014) Psychomusicology: Music, Mind, and Brain. American Psychological Association 24(1): 92-102.
7. Zatorre R J, Halaern A R, Perru D W, Meyer E, Evans A C (1996) Hearing in the Mind's Ear: A PET Investigation of Musical Imagery and Perception. Journal of Cognitive Neuroscience MIT press Direct 8 (1): 29-46.
8. Chatterjee D, Hegde S, Thaut M (2021) Neural plasticity: The substratum of music-based interventions in neurorehabilitation. NeuroRehabilitation 48 (2): 155-166.
9. Gaser C, Schlaug G (2001) Brain structures differ between musicians and non-musician. NeuroImage 13(6): 1168-1168.
10. Brog M A (2002) "Living Turned Inside Out": The Musical Expression of Psychotic and Schizoid Experience in Talking Heads' Remain in Light. The American Journal of Psychoanalysis 62(2): 163-184.
11. Skar P (2002) The goal as process: music and the search for the Self. Analytical Psychology 47(4): 629-638.
12. Hanser S B, Mandel S E (2005) The effects of music therapy in cardiac healthcare. Cardiology Review 13(1): 18-23.
13. Levitin D (2006) This Is Your Brain on Music. The Science of a Human Obsession DUTTON Published by Penguin Group (USA).
14. Cezar C (2003) Sonologia. Editura Anastasia Bucharest.
15. Sloboda J A (1991) Music structure and Emotional Response: Some Empirical Findings. Psychology of Music 19(2): 110-120.
16. Cox M, Abbott C, Webb M (2004) ICT and Attainment: A Review of the Research Literature. Information Systems (Business Informatics) Becta Publishing.
17. Byrom B, McCarthy M, Schueler P, Muehlhausen W (2018) Brain Monitoring Devices in Neuroscience Clinical Research: The Potential of Remote Monitoring Using Sensors, Wearables, and Mobile Devices. Clinical Pharmacology and Therapeutics 104(1): 59-71.
18. Girase P, Deshmukh M (2016) MindWave device wheelchair control. International Journal of Science and Research. 5(6): 2172-2176.
19. Daly I (2023) Neural decoding of music from the EEG. Nature Scientific Reports, pp. 624.
20. Luo G, Sun S, Qian K, Hu B, Schuller B, et al. (2023) How does Music Affect Your Brain? A Pilot Study on EEG and Music Features for Automatic Analysis. IEEE Conference On engineering Medical Biology and Sociology, p. 1-4.
21. Wang J, Wang Z, Guiran Liu G (2024) Recording brain activity while listening to music using wearable EEG devices combined with Bidirectional Long Short-Term Memory Networks. Alexandria Engineering Journal 109: 1-10.
22. Koelsch S, Skouras S, Fritz T, Herrera P, Bonhage C, et al. (2013). Neural correlates of music-evoked fear and joy: The roles of auditory cortex and superficial amygdala. Neuroimage 81: 49-60.
23. Ramaswamy M, Laji J P, Priya V, Priyadarshini S, Ramasamy M, et al. (2024) Therapeutic Use of Music in Neurological Disorders: A concise Narrative Review. Science Direct Publishing Heliyon 10(16).
24. Alashram A R, Janada Q, Ghrear T, Annino G (2023) Role of music therapy in improving cognitive function post-traumatic brain injury: a systematic review. Applied Neuropsychology Adult, p. 1-10.
25. Machado Sotomayor M J, Arufe Giraldez V, Ruíz Rico G, Navarro Paton R (2021) Music therapy and Parkinson's disease: a systematic review from 2015-2020. International Journal of Environmental Research and Public Health 18(21): 11618.
26. Nassan M, Videnovic A (2022) Circadian rhythms in neurodegenerative disorders. Nature Reviews Neurology 18(1): 7-24.
27. Loewy J (2020) Music therapy as a potential intervention for sleep improvement. Nature and Science of Sleep 12: 1-9.
28. Cytowic R E (1997) Synesthesia: Phenomenology and neuropsychology-A review of current knowledge. PSYCHE An Interdisciplinary Journal of Research on Consciousness, p. 17-39.
29. Ramachandran V S, Hubbard E M (2001) Synesthesia-a window into perception, thought and language. Journal of Consciousness Studies. 8(12): 3-34.
30. Sloboda J A (1998) Does Music Mean Anything? Musicae Scientiae 2(1): 19-31.
31. Victorino D B, Scorza C A, Fiorini A C, Finsterer J, Scorza F A (2021) "Mozart effect" for Parkinson's disease: Music as Medicine. Neurological Science 42(1): 319-320.

**ISSN: 2574-1241**

DOI: 10.26717/BJSTR.2025.60.009482

**Fulvia Anca Constantin .** Biomed J Sci & Tech Res

This work is licensed under Creative *Commons* Attribution 4.0 License

**Submission Link**: https://biomedres.us/submit-manuscript.php

**Assets of Publishing with us**

- Global archiving of articles
- Immediate, unrestricted online access
- Rigorous Peer Review Process
- Authors Retain Copyrights
- Unique DOI for all articles

https://biomedres.us/