Available online at http://www.ijims.com
ISSN - (Print): 2519 – 7908 ; ISSN - (Electronic): 2348 – 0343
IF:4.335; Index Copernicus (IC) Value: 60.59; Peer-reviewed Journal

The Impact of Hindustani raga Sangit on the Human Brain

Nibedita Shyam

Department of Hindustani Classical Music, Sangit Bhavana, Visva-Bharati (A Central University), India

Abstract

This research paper focuses on the influence of the Hindustani raga sangeet on the human brain. The paper reveals how the functioning of the human brain on exposure to Hindustani raga Sangit has been analyzed through neuroimaging techniques (EEG) and the enhanced effect on the human brain. Hindustani music has been known from ancient times to have healing effects on the human body. Different ragas through their musical properties are found to help in diffusing mental tension, pacifying anger, excessive mental instability, excitement, etc. This research paper is aimed to trace the changes in the human brain on the application of Hindustani ragas as a stimulus. This research paper was reviewed and explained with the secondary sources available through various journals, magazines, government publications, previous research papers, and other useful internet material.

Keywords: The Human Brain, Hindustani music, neuroimaging techniques, EEG, stimulus

Introduction

It has been scientifically proven that music has a powerful effect on the human brain. Scientists have found out that music stimulates more parts of the brain than any other brain functions. Studies have shown that listening to music has increased brain connectivity, working memory, auditory skills, and cognitive flexibility. Music has an impact on the way the neurological system works in the human body depending on perception. The neurons and synapses become more active on listening to music. Indian music is one of the oldest systems of music and has developed from the Vedic chants nearly 6000 years back where they developed the system of musical scales and rhythmic cycles. The soul of Hindustani music is 'raga' which originated in Sanskrit and is described as "the act of coloring and dyeing". These are musical compositions that are known to have the capacity to evoke specific moods and emotions. A raga uses a set of five or more notes from a fixed scale of seven notes to construct a melody. Each different raga holds its different rules upon which the melody rests. Hindustani ragas have been acclaimed to have healing effects and are known to stimulate the brain, ease tension, remove fatigue, etc. Many research studies have shown that Indian music can be an important tool for evaluating the brain system as different parts of the brain are involved in processing music. Neurological studies have identified that listening to the ragas arouses specific emotional responses which can help in activating certain regions of the brain through which there can be an improvement in brain functions and also can improve cognitive areas such as neural mechanisms for speech, learning attention, and memory.

Objectives

• To study how listening to Hindustani ragas has influenced the functioning of different parts of the human brain.

Research methodology

The current study aims to explain the impact of listening to Hindustani raga Sangit in the human brain. The nature of the research is completely descriptive. It is conceptual research that is based on the review of previously done researches in this area. All the relevant data used in the research paper has been collected from secondary sources e.g., journals, govt publications, and other various e sources.

The concept of raga and emotions in Hindustani music

Indian classical music is one of the leading music systems in the world with a highly developed melodic framework and its rhythmic structure. It is believed to be have originated during the Vedic period where the Vedic chants developed the system of notes and rhythmic cycle. A raga is a melodic framework in which the arrangement of the notes(swaras), as well as their relative duration and order, is defined. The order in which the musical notes are used is fixed. The notes form a scale that is different in ascending (*Aroha)* and descending(*aavroha)* phrases. There are rules laid down that specify phrases to use and to avoid and which notes to be used sparsely and often.

Evoking emotions within human beings is one of the unique powers of music. Indian ragas as classified by their unique distinct phrases have some mood associated with their pitch classes and they establish the flavor or mood of the raag. This pitch class conveys emotions. Particular 'rasa' (aesthetic delight) is evoked by Indian ragas. Listening to the ragas arouses distinct emotional responses which in turn affect the mood of the individual and results in changes in brain activity. Nine types of basic emotions are evoked by Indian art music collectively known as 'navarasa' as mentioned by sage Bharata in "Natyashastra". One of the unique characteristics of Hindustani raga Sangit is that allocation of different times of day and night to perform a raga melody. This connection of time with the ragas is directly associated with the subtle changes that are constantly undergoing in our moods and emotions that arose in different moments of the day. Conventionally, each raga in Hindustani music has been assigned a corresponding emotion and it is known that when it is performed, it conveys those particular emotions. For example, raga Yaman conveys a serene mood and at the same joyful and lively, raag Todi is associated with a mournful mood. The neurological system in the human body is impacted by the perception of these pitch classes. Music evoked emotions are known to change the activities in limbic and para-limbic brain structures.

How does the brain process music?

To understand the impact of listening to ragas in the human brain, it is important to have a basic understanding of how does the brain process music or what parts of the brain are involved in processing music, or if there are separate parts of the brain structures that respond to different emotions. Several neuroimaging techniques such as MRI (magnetic resonance imaging), fMRI (functional magnetic resonance imaging), PET (positron emission tomography) have been carried to study the processing of music in the human brain that has provided insights into the aspects of nonverbal brain function. The way the human brain process music is indeed complex.

The initial perception is processed in the auditory pathway from the cochlea to the primary auditory cortex. The individual sound elements like pitch, loudness, etc. are coded in this processing. The cerebral cortex processes the subsequent stages. The acoustic correlates of pitch (such as energy is a particular frequency band) are coded in the auditory pathway while the perception of pitch arises at the level of the cortex. The medial part of the heschel's gyrus (part of the temporal lobe) contains the primary auditory cortex. There is a Centre for the perception of pitch in the latter part of the HG (Heschel's gyrus). There is a network of higher cortical areas in the temporal, parietal, and frontal lobes that surrounds the HG. This network includes auditory association areas that process certain properties (including their spatial location, the timbre of a voice or musical instruments) of complex sounds. Anterior to HG there is the superior temporal gyrus (STG) which analysis auditory information such as spoken sentence or musical melody. Circuits that exist in the parietal and frontal lobes act as an intervening agency between music and other sounds and also other behavioral responses to other sounds. Music processing includes a larger portion of the cortical mantle. In music, the pitch is used to construct melodies and brain activity during the analysis of melody includes the anterior and posterior, superior temporal lobes with a greater triggering in the right hemisphere. However, music processing doesn't exclusively include anyone hemisphere of the brain but two hemispheres are relatively more or less involved. Several functional imaging studies have shown that the reproduction of rhythm occurs in the lateral cerebellum and basal ganglia (group of subcortical nuclei responsible for motor control) and sequences with time intervals in integers ratios (more common in music) are distinctly represented. Some circuits mediate emotional responses which include the amygdala, hippocampus, their subcortical and cortical connections which together constitute the 'limbic system'. Within the limbic circuitry, the amygdala is one of the main structures which is associated with the initiation, termination, generation, maintenance, and detection of emotions that are needed for human survival. Music can evoke activity changes in the amygdala. Activity changes in the

amygdala, hippocampal formation, Para hippocampal formation, and temporal lobe found in fMRI studies says that these structures form a network that plays a prominent role in emotional processing.

How changes in the human brain are observed?

The tool for measuring the electrical activity in the human brain is Electroencephalography (EEG). EEG machines are used to measure the electrical activity in the cerebral cortex, the outer layer of the brain. This technology can accurately determine brain activity in a single millisecond and is relatively inexpensive and much simpler to operate. This is done by placing electrodes on the scalp which records the electrical field generated by the neurons. Researchers use these EEG signals to study the response of the brain to a particular stimulus and other events. When a particular stimulus is presented, various neural processes are invoked to process the stimulus and interpret it. In this way, researchers study the different brain processes that are involved in a particular situation and it provides an understanding of the human brain more comprehensively. The EEG signals with different frequencies are identified each as a distinct wave. It detects the activity in the brain region under it. Simple periodical waveforms in an EEG are distinguished when an input to a region is synchronized with electrical activity occurring at the same time. Four basic types of EEG rhythms are there which are given in **Table1 EEG rhythms**. On exposure to music, changes occur in the EEG pattern. It has been observed that listening to music increases the power at the alpha and theta frequencies of the human EEG.

The brainwaves are classified into four main types depending upon the frequency:

i) Beta brainwaves(14hz-32hz)- this brainwave is closely associated with alertness and active concentration, with a busy and anxious state of mind. Benefits include: increased concentration and alertness, improved reasoning and critical thinking.

ii) Alpha brainwaves (7hz-14 Hz)- this brainwave is associated with a relaxed, meditative state of mind. These are found in the occipital and posterior regions of the brain. Benefits include: triggers imagination, increased memory retention.

iii)Theta brain waves (3.5-7hz)- this brain wave is associated with peace and emotional stability. This brainwave is found particularly over the temporal regions. Benefits include: release beneficial hormones related to health and longevity, reduction of anxiety and stress, reduces mental fatigue.

iv)Delta brain waves (0.1-3.5hz)- associated with deeper stages of sleep, deep relaxation, and the deepest connection with the subconscious mind.

Impact on the human brain:

Different ragas have different healing effects. Research studies that used EEG signals to study the impact of listening of music on the human brain has observed that the alpha power relatively decreases at the left frontal lobe on the exposure of pleasant music and on the exposure to unpleasant music there is a decrease in alpha power in the right frontal lobe of the brain. Research studies conducted in NIMHANS through EEG signals on the impact of listening to Hindustani ragas said that there was an increased overall brainwave frequency power which is even higher than in relaxed meditative states. In a correlational study between music clip and EEG signal done with a pair of ragas '*chaayanat'* and '*darbari Kannada'*, which portrays contrast emotional attributes, the variation of the correlation coefficient for different lobes of the brain shows the engagement of several areas of Brain and provides new information regarding the extraordinary ability of music stimuli. EEG frontal electrodes and music clips showed a strong correlation. There was a distinct emotional categorization found in different pair of electrodes placed in the left and right hemispheres of the frontal lobe. There was an increase in the degree of correlation for 'darbari kanada' (portraying sad emotion) across the electrode combination while for 'chaayanat' (portraying happy emotion) it decreases. The inter-lobe correlation between the frontal electrodes appears to increase most in the case of sad music clips. Arousals in different lobes and the similarity and the differences in the behavior of different lobes under the effect of musical

stimuli studied, have shown that different lobes of the human brain activate themselves differently and in the different portion under the effect of simple auditory stimuli.

EEG study with raag darbari as an external stimulus, analyzing the brain state for a duration of first 100 secs showed an enhancement in the brain efficiency. The alpha power showed a rise for a brief period at the prefrontal cortex which indicates reduced anxiety, stress, and increased memory retention, concentration. The alpha power had shown a change in the prefrontal and occipital cortex. The alpha power increased in both the cortices but the change was more pronounced at the pre-frontal site. Increased alpha power in the pre-frontal lobe of the brain points towards an increased neural efficiency of the brain. The pre-frontal lobe is linked to all different types of functional intelligence (verbal, spatial.) the increased alpha power in the occipital lobe is associated with increased tonic alertness and vigilance and internally directed attention. Thus, increment in cognitive performance was supported in the findings. The neural efficiency increased on listening which indicates elevating cognitive abilities directly and enhanced attention indirectly.

Conclusion

EEG studies and various other neuroimaging techniques have helped to study the neural complexities of the human brain. The human can function extraordinarily well on exposure to music. Although very few empirical studies have been done on enhanced activity of the human brain on listening to Hindustani ragas, future studies can explore how listening to different ragas can trigger neuroplastic processes and modification in cognitive processing.

References

1 Bardekar A and Gurjar A. EEG study of ragas and its impact on brain waves,2017,IJIRSET, 6(4): 5188-5194.

2 Gupta A, Bhushan B and Behera L. Short-term enhancement of cognitive functions and music: A three channel model. Scientific Reports, 2018, 1-12.

3 Habibi A and Damasio A. Music, Feelings, and the Human Brain. Psychomusicology: Music,mind and Brain, 2014, 24(1): 92-102.

4 Geethanjali B, Adalarasu K and Rajsekaran R. Impact of Music on Brain Function during Electroencephalography. World Academy of Science, Engineering and Technology, 2012, 66: 83-86.

5 Tiple B, Thomas A. Analysis of Features for Mood Detection in North Indian Classical Music - A Literature Review. International Journal of Research in computer and communication Technology, 2017, 6(6): 181-185.

6 NS Kumar S, krishnamoorthy P, Rao S, et.al. A Study on Effect of Indian Classical Music on Brain Activity Using EEG signals. journal of medical science and clinical research , 2017, 21702-21706.

7 Koelsch, S. Towards a neural basis of music-evoked emotions. Trends in Cognitive Sciences, 2010, 14(3): 131-137.

8 Chatterjee N and Balasubramanian H. The Brain on Music. RESONANCE, 2018, 299-308.

9. Sanyal S, Nag S, Banerjee A ,et.al. Music of brain and music on brain: a novel EEG sonification approach. Cognitive Neurodynamics,2019, 13: 13-31.

10 Warren, J. how does the brain process music . clinical medicine, 2008, 32-36.

Table 1. EEG rhythms

Rhythm	Type of frequencies (Hz)
1. Alpha	8-13
2. Beta	13-30
3. Delta	1-5
4. Theta	4-8