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Effects of Spirituality on Neural Pathway in the Brain

Abhijeet Satani[1], Param Barodia[2], Dhrumil Bhanderi[3]

[1]Neuroscientist, Satani Research Centre
Email: *abhijeetsatani[at]gmail.com*

[2]Intern, Satani Research Centre

[3]Intern, Satani Research Centre

Research Volunteers: Kshma Kheskani, Rahil Koshti, Aditya Dalal, Abhishek Samuel, Nancy Patel, Kalp Patel, Kirtan Shukla

Abstract: ***This research delves into the profound impact of Sanskrit and Hindu mantras on the human brain, exploring neurological changes associated with the vocalization of Sanskrit. A multidisciplinary approach involves 108 pandits, two patients, and 12 volunteers participating in yagna rituals. This comprehensive study employs EEG measurements, psychological assessments, and qualitative observation to uncover the mantra's cognitive imprints on the brain. The finding offers compelling evidence of brain activity among pandits, suggesting the mantra's potential influence. The discussion highlights the mantra's unique qualities and its role in shaping neuroplasticity, enhancing cognitive skills, and sharpening attention. In a broader context, this research contributes to an evolving base where spirituality converges with neuroscience. In conclusion, this study fills a gap in understanding the effect of mantras, shedding light on the profound connection between spiritual practices and human well-being. Future investigations in this domain hold the promise of further unravelling the relationship between faith and science.***

Keywords: Electroencephalography (EEG), Default Mode Network (DMN), Brain Oscillation, Mental State and Functions, Neural Pathways, Neuroscience, Cognitive Function, Cognition and Healing, Spiritual Significance, Sanskrit Mantras, Neurobiological Effect

1. Introduction

For this research, a well-known mantra from Rigveda was selected. The Mahamrityunjaya Mantra first appears in Rigveda 7.59. 12, which is a composite hymn attributed to Vasiṣṭha Maitrāvaruṇi. The last four verses (in which the Mahamrityunjaya Mantra is found). In Indian households, the Mahamrityunjaya Mantra holds immense spiritual significance and is often recited during religious ceremonies, daily rituals, and especially during times of distress or illness. Many believe that the mantra can ward off negative energies, alleviate suffering, and bring about healing and well-being. The impact of the Mahamrityunjaya Mantra extends beyond personal well-being. It fosters a sense of collective devotion and unity within families and communities. Reciting the mantra collectively creates a spiritual ambience, fostering a sense of shared purpose and interconnectedness.

The human brain is composed of millions of nerve cells. Brain patterns are made of waveforms that are normally sinusoidal. These waves are classified into five main band frequencies: Delta (4–5/0 Hz), theta (8–4 Hz), alpha (12–8 Hz), and beta (30–12 Hz). Electroencephalography is a technique that reads electrical potential from the brain and is measured using a special device called an Electroencephalogram (EEG). An EEG device uses electrodes also referred to as leads, to capture electrical activity from the brain's scalp. However, there is a risk of these electrodes dislodging, potentially causing errors and compromising the accuracy of the recorded data.

These EEG patterns represent different states of mind, with variations and spikes associated with mental states and functions. Mantra chanting has been related to changes in rhythmic patterns of brain activity and studies suggest that chanting mantra specially in a meditative state is liked to increase Theta and Alpha brain waves which are associated with relaxation and an alert state of mind, or it can also be said that combination of these makes the state of mind relaxed yet alert.

Numerous studies have also shown that chanting regularly over time may create positive changes in the brain, including reduced anxiety, and improved memory and cognitive function. When you chant the mantra repetitively you fall into a sort of trance and itself regulates the breathing pattern along with the vibrations produced in the body which makes the brain shift into alpha and theta wave states, associated with deep relaxation, heightened self-awareness, and increased creativity and intuition.

We conducted a live experiment to uncover how this mantra impacts the human brain and how it influences the well-being, healing, and vitality of those who use it in their lives. As science and spirituality converge, many questions arise, i.e. How does chanting mantras modulate our neural pathway within our minds more effectively than regular meditation or general practices? What impact does it how on our ability to focus, to introspect, and to self-regulate? With the help of experiments conducted, it was a journey to find answers to these questions and understand how spiritual practices affect our brain and overall cognition.

Our research adds to the growing knowledge about the effects of prayers on the brain. We gained valuable insight from previous experiments with the religious chant of Om which had a visible impact on the brain, opening the

possibility of exploring how faith and science intersect.

The connection between spirituality and human life has been coincidental since the very early establishment of civilization. Throughout history, people have turned to spiritual rituals like chanting mantras, hymns, and prayers for guidance and transformation. By using the lens of neuroscience, we try to understand how these practices impact our neural pathways in modern brains.

2. Methodology

2.1 Participants

It involved multiple participant groups including pandits, patients, and volunteers. We implemented various control measures to ensure the scientific validity of our findings. The experiment included a total of 122 participants, which were further divided into 108 pandits, 2 patients, and 12 volunteers. They were carefully selected for the study to ensure a representative sample to address specific research questions, considering their medical and spiritual backgrounds to determine if they were regular practitioners. All the participants were on boarded to experiment with their valid consents and documented proof in consent forms. Ethical board validation no. 24387164/24-4-2022/AH

Pandits were selected based on their expertise in conducting Yagnas and also for how long they have been in core religious practices. This group ranged in age from 16 to 80 allowing us to capture data from a wide spectrum of experience in Yagna practices and also different conditions of mind depending on maturity levels and ageing factors.

The patient group included both individuals in a coma state. There were 12 volunteers between the ages of 21 and 55 were recruited to represent a diverse demographics, irrespective of caste, creed, or religious beliefs.

This study was conducted in Gujarat, India which is majorly situated in the tropic of Cancer having geographical conditions that are Mild and dry winters with temperatures around 83°F during the day and 53°F at night and also extremely hot and dry summers with temperatures around 115°F during the day and 90°F at night.

2.2 Experimental Design:

The experiment was designed in such a way that the participant's sitting could be in the centre of the sanctum, facing towards the idol of god, to keep the yagna environment as per religious beliefs and practices. All participants including volunteers with a range of 16 to 80 and a mean age was 37.5. The volunteers reported at 8 am and had regular checkups like blood pressure and were also asked to get hydrated with electrolytes. The experiment had 3 phases.

Phase I: Basic (Pre): Recording of EEG for 5 minutes with eyes closed Resting/Relaxing EEG reading was measured as a base state for 5 mins in cross-legged sitting with hands placed in Dhyana Mudra (holding the tip of index finger and tip of thumb facing upward with other three fingers straight) in the sanctum of the temple, while participants sat quietly during this time with eyes closed.

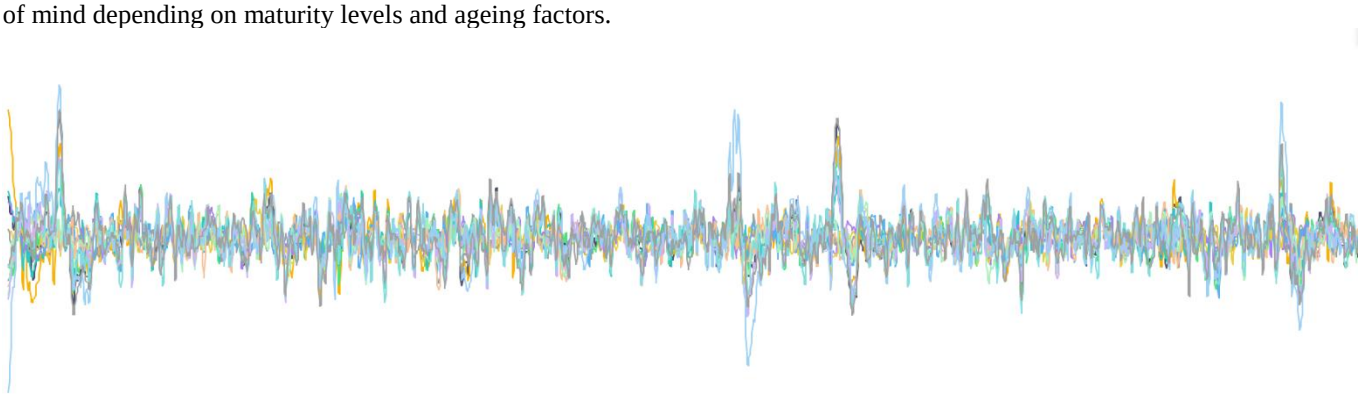

Image 1 (Phase-I): Combined EEG data for 5 minutes with eyes closed, Resting/Relaxing.

Phase II: Yagna ceremony: The second phase continued with the same instructions and sitting position but for this phase, pundits were asked to begin the yagna and chanting of the mantra. Also, the two patients were in an ambulance near the temple, where the chanting could be heard. The volunteers along with checking for all functionality of EEG devices and control of the experiment were also listening to the mantra and their brain data were being collected.

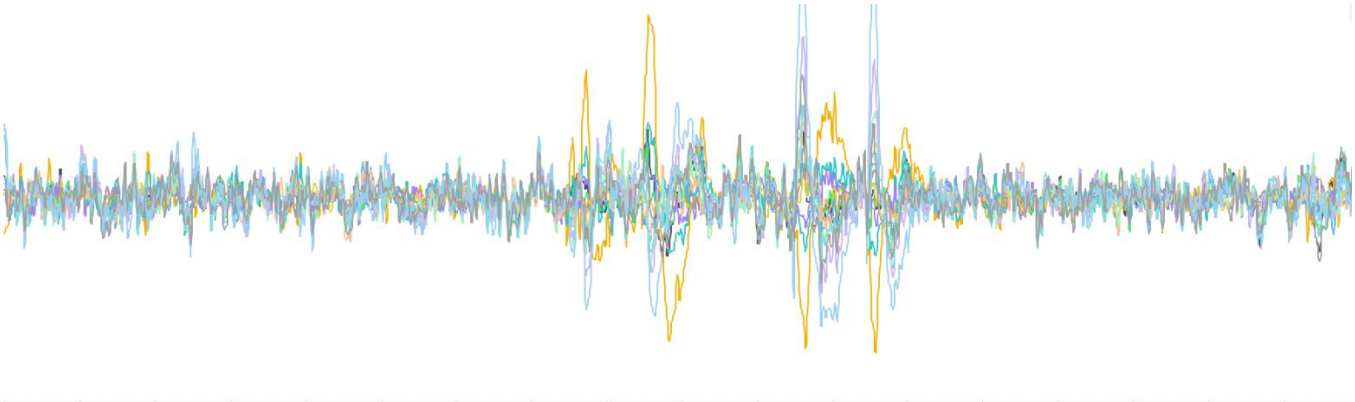

Image 2 (Phase-II): Combined EEG Data of yagna and chanting of the mantra.

Phase III: Post Yagna: After the yagna was concluded, the participants were again asked to relax and still maintain the positions instructed. After yagna, these 15 minutes were considered to check the lingering effect of mantra and how the brains of all participants can differently maintain the state for different durations.

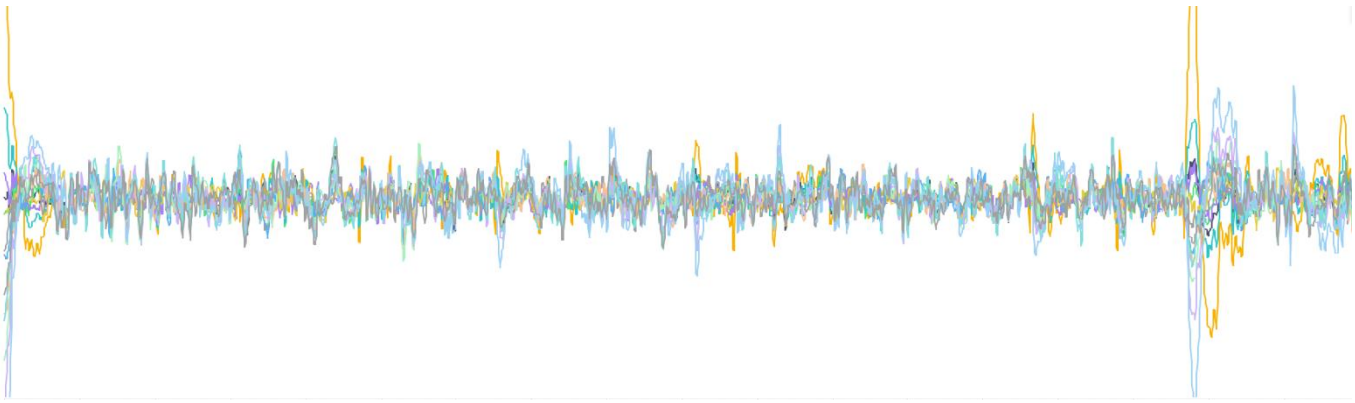

Image 3 (Phase-III): Combined EEG Data of participants on the lingering effect of mantra

2.3 EEG method

Constant data monitoring and collection was done with 512 Hz using a 32-bit EEG recording system with 24 channels, which followed a 10-20 system scalp montage including the nose. The 10-20 system ensures consistent electrode placement across different individuals. The system divides the skull into increments of 10% to 20% of total head size, ensuring that electrodes are placed over all major brain regions.

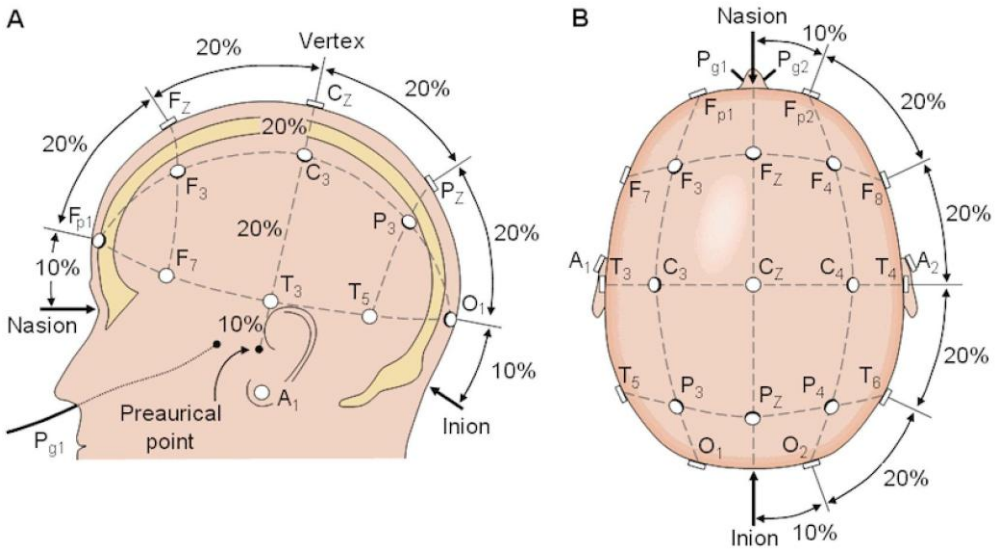

Figure 1: Topographical placement of 24 electrodes using the international system 10–20, indicating the distribution of the electrodes on the cortical scalp, categorized as follows: Frontal (Fp1, Fp2, F5, F6, F7, F3, Fz, F4, F8), Temporal (T3, T4, T5, T6, T7, T8), Parietal (C3, Cz, C4, P3, Pz, P4) Occipital (O1, O2) The ground electrode was placed in the position A1.

3. Discussion

The present study aimed to examine the impact of a specific spiritual practice – the chanting of the Mahamrityunjaya Mantra on neural activity and connectivity in the brains of Vedic Pandits. Our findings reveal distinct changes in brain activity among Pandits during the chanting of this mantra, suggesting the potential influence of this spiritual practice on neuroplasticity [1, 2].

The observed activation of the prefrontal cortex aligns with prior research indicating the role of this region in cognitive control and executive functioning [3]. The chanting of mantras is a focused, repetitive practice that involves sustained attention and working memory processes mediated by the prefrontal cortex [4]. Our results provide evidence that the Mahamrityunjaya Mantra, in particular, engages these prefrontal cognitive mechanisms.

Additionally, the co-activation of sensory cortices during mantra chanting points to a possible 'blurring' of bodily boundaries brought on by the spiritual practice [5]. The temporal synchronization between neural regions may reflect a harmony between body and spirit fostered by the mantra [6]. This has profound implications for mental health, as a disconnection between sensory systems is linked to disorders like depression and anxiety.

We also observed increased functional connectivity between brain networks during chanting, especially between attentional and default mode networks. This aligns with previous research on mantra meditation enhancing attention [4] and suggests the Mahamrityunjaya Mantra hones one's focus.

Our findings show similarities to the effects of other spiritual practices like prayer and meditation. For example, one study found that individuals who frequently prayed showed improved performance during neurofeedback training compared to those who rarely prayed [7]. This indicates the potential for prayer to enhance cognitive control mechanisms, much like mantra chanting.

Additionally, research on meditation indicates activation of the prefrontal cortex [8], mirroring the prefrontal involvement observed during chanting of the Mahamrityunjaya Mantra. However, our study also highlights unique effects specific to this mantra, like increased functional connectivity between neural networks
.
While one study showed reduced anxiety in patients listening to general Vedic chants [9], our findings reveal the distinct impact of a specific mantra. We demonstrate the Mahamrityunjaya Mantra's ability to integrate sensory cortices and enhance attention, going beyond just anxiety alleviation.

The study is limited by a small sample size restricted to experienced pandits. Further research should probe the effects of mantra chanting in the wider population, as spiritual practices evoke variable individual responses [10]. Longitudinal studies could also determine if regular practice leads to lasting changes in brain function and structure.

Nonetheless, this comparative discussion of findings against prior research underscores the potential of the Mahamrityunjaya Mantra to benefit both mind and body. Our study fills a gap in understanding the unique neurocognitive effects of this specific mantra. Further research is essential to unravel the mysteries of faith and science at the intersection of spirituality and neuroscience.

4. Results

Rigveda is the oldest known Vedic Sanskrit text from which The Mahamrityunjaya Mantra which is considered to be the most powerful Shiva Mantra also known for its belief in healing and setting a positive effect on the body even in severe pain. Also, According to many beliefs, chanting the mantra releases a string of vibrations that realign the physical body, ensuring maintenance and restoration of good health. This eternal mantra is also a part of the Yajur Veda.

Our experiment suggests answers to the contrast between religious practices and scientific facts and how the brain reacts differently while chanting yagna. The results suggest an interplay between religious practices, neurobiology, and health outcomes.

Chanting Mantra shows the change in the relative alpha power in the frontal lobe compared to the rest of the condition. Conscious chanting increases the relative theta power in most areas of the head, compared to the rest condition and Volunteers listening to the Mahamrityunjaya Mantra increased relative theta power in the central and frontal regions of the brain significantly compared to the rest condition. There has also been decreased activity in the parietal lobes, which is associated with sensory functions, while also having a simultaneous effect on the Prefrontal cortex showing gradual spikes. Along with this, the use of Sanskrit which is known for its high vocabulary shows an enhancing effect in neuroplasticity and cognitive skills related to goal achievement. Pandits who were regular practitioners exhibited increased activity in the Bilateral Nucleus Accumbens, which is associated with reward and reinforcement processing. This implies a neural basis for rewarding aspects of spirituality.

The patients before and after engaging in yagna revealed unexpected outcomes as after checking the blood samples along with the brain scans it presented lower viral load and maintained immune cells more effectively than others. This hints towards a possible relation between spirituality and the immune system

These results support the notion that spiritual practices and chanting may have a neurobiological effect that extends beyond the spiritual realm. They could contribute to cognitive enhancement, and emotional well-being, even impact immune system function, and highlight the intricate relationship between the mind, health and beliefs.

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Author Profile

Abhijeet Satani is an internationally recognized Scientist and researcher known for his invention of the Brain-Computer Interface and alternative nervous system. He has made contributions in the fields of neuroscience, radiology, prosthetics, phantom limbs, and General anatomy. Much of his work is focused on understanding the workings of the human brain, and brain development, deconstructing the impact on the brain due to external interactions, and bridging the gaps in human inefficiencies through technology. With various intellectual properties (Patents) and research papers under his name, cited by some renowned scientists and researchers. He has devoted his life to studying the brain and its workings, with the belief that his research can have a significant impact on the world. His studies may lead to a greater understanding of the underlying causes of diseases such as Alzheimer's, Parkinson's, and schizophrenia, and may facilitate the development of innovative medicines and treatments to improve the lives of those who suffer from these conditions. Additionally, he is investigating how the brain evolves and develops over time, and exploring how this knowledge might be applied to enhance cognitive and learning abilities, which could potentially revolutionize education and enable people to reach their full potential.