



Analysis of Silence and Meditation using EEG

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Abstract: Swami Veda Bharati (2018) brings one back to the source of silence known as infinity. Silence is from where we came into being, and from that same silence is where we shall dissolve into at the end. In India, it is believed that one's education begins in the womb where there is absolute silence and outside of that is noise. Some practices done to experience silence are hiking in the mountains, enjoying a scenic view, sitting quietly and even taking a vow of silence. One can touch the force of silence every second (SVB, 2018).

Swami Rama says that meditation is a distinct process allowing the mind to attain a state of consciousness through a specific technique thereby creating physical, mental, spiritual and therapeutic benefits. In meditation, the mind becomes one pointed and allows one to be rid of mental distractions, rapid thoughts and preoccupations. This helps the mind to stop mental processes like worrying, planning, reasoning, and thinking. Silence and meditation relieve mental tension, re-establish mental harmony, promote physical, mental and spiritual health.

Researchers, such as Khare, Deolindo and Huang, performed experiments over that past decade using EEG as a tool to scientifically measure the effects of silence and meditation on the physical and mental health of their subjects. The results of their experiments showed that there were increased alpha and theta brainwave frequencies of meditators when compared to those who did not practice meditation, which correlated positively with reduced stress levels, anxiety, and depression.

Index Terms - Silence, meditation, EEG, alpha brainwaves, theta brainwaves

SILENCE AND MEDITATION

Swami Veda Bharati (2018) brings one back to one's Source or Origin (infinity), he emphasizes that one originates from silence, that one is born from the silence of the mother's womb and at the end of life one re-enters into that silence. When three souls are united as one (mother, father and foetus), the first globule of conception of the foetus is formed in the interior silence of the mother's womb, the mother is not only one's physical mother as she is united with that mother who is the golden womb (the Hiranyagarbha, the Guru). In the womb the formation of subtle rays of awareness gradually begins, subtle images of past life experiences begin, memories of

previous enlightenments begin to come forward, all of one's actions and moments of silence of the divine is known. Then, gradually the external sounds of the parent voice of the mind penetrate that interior silence of the golden womb and the awareness of divine absolute silence begins to change. The fetus becomes confused with these internal and external sounds and gradually loses its awareness of the absolute divinity with these constant sounds.

The Himalayan Yogis, and other traditions, believe that a child's education begins three years before conception takes place. And the completion of its education is at the end of the nine months of pregnancy inside the mother's womb. Everything after this is noise, then one becomes uneducated taken away from their true nature, to become educated in the external world. One's journey throughout this noisy life ends when the instruments of the brain that create the noise cease to function and enters into absolute silence. Those who are noisy fear to enter that silence called death. One emerges from silence, and one merges into silence and re-enters the origin of silence, one never forgets where one came from, Hiranyagarbha, the absolute silence. Silence is our beginning and our end.

In the physical mother a fetus develops week by week until its full term. If the development of the foetus is observed one will see that in five weeks the fetus looks like a tadpole, with just the brain, spinal cord and heart (Kate Marple 2019 www.babycenter.com). At five to eight weeks the brain begins to develop rapidly. The brain is the main controller of the functioning of all the organs in the body. Anything that affects the brain affects the entire body Ramasamy Mariappan and M Rama Subramanian (2019). As the fetus brain develops in the womb, subtle rays of awareness begin to form and very subtly samskaars begin to appear. Therefore, the changes in the development of the brain will affect the entire foetus. It is important for a pregnant woman to be in an environment that gives positive vibration to her unborn.

One may go on a long hike or an excursion in the mountains and after some time of trekking something dawns on you silently and you decide to sit, relax and enjoy the nice quiet scenery. Without any awareness you begin to enjoy the quiet peaceful flowing streams, rivers, trees, wind blowing gently touching your face going through your sweaty head giving a feeling of coolness on the head and skin. At that moment one forgets that it is one's inner silence that is the calling. One's origin, one's end. One is touched by this force of silence every second. Can one measure one's capacity and qualifications in terms of silence, how deep is one's silence or how shallow is one's silence? For some people it is possible but for the others who cannot, the practice of Meditation is recommended. What is meditation? According to Swami Rama who hails from the Himalayan Meditative Tradition (1992), "Meditation" the word is used in numerous ways, there is a great misunderstanding of what exactly is meditation and how it is practiced.

Some say that meditation means to think or contemplate, others say it is daydreaming and fantasizing. Swami Rama says meditation is none of these things. Meditation is a different and distinct process which allows the mind to be brought to rest, thus attaining the state of consciousness. This state is differentiated from the waking, dreaming and deep sleep states. In meditation one is fully awake, alert and the mind is clear, relaxed and focused inward. Meditation is the same as medical and medicate, it implies attending to something, to the body, breath and mind. In meditation, one is focused on the dimensions of oneself, one's deepest

innermost layers, which are more profound than thinking, analysing, daydreaming, or memories or emotions. Meditation requires inner awareness that is quiet, concentrated, and relaxed which results in a restful body with improved physical health and a quiet mind. With the aforementioned benefits, an increase in joy, happiness, clarity, completeness and awareness can be achieved. As much as one enjoys these results, one will experience the release of negative physical and mental health symptoms of stress.

Meditation also provides therapeutic benefits by aiding in reduced muscular tension, relaxing the autonomic nervous system and providing freedom from mental stress. Its benefits also extend to the immune system by reducing its reaction to stress and strain (Swami Rama, 1992). Meditation also improves one's quality of sleep and rejuvenates the body and mind. It is a systemic way of enhancing one's inborn tendencies in life. For example, writers, thinkers (philosophers) and poets can develop their intuition and become more creative.

Psychosomatic diseases that originate in the mind and is influenced by one's thoughts and emotions. It is recognised by scientists that these diseases cannot be cured by orthodox medicine, conventional medicine or by psychotherapy because it originates in the mind and one's emotional reactions. To restore good health external therapy alone is not sufficient. Meditation helps to develop one's inner strength, determination to deal with the challenges of life effectively and it makes one self-reliant. Swami Rama (1992). But what is the process of meditation?

To begin the process of Meditation one has to let go of one's tendencies to think, analyse, recall. Problem solving, let go of past events and future expectations, by asking the mind to let go. By doing this one helps the mind to slow down its rapid chain of mental activities, like thoughts and feelings. Replacing it with inner awareness and attention. Meditation is a focused one- pointed attention, quiet, effortless and awareness. One let go of one's mental distractions, preoccupations, rapid thoughts, and anything related to the waking state of consciousness. This is done by allowing one's mind to concentrate on one subtle element or object that will draw one to inner attention. This helps the mind to stop other stressful mental processes like worrying, planning, reasoning, and thinking. Meditation is not thinking or analysing problems, it is not fantasizing or daydreaming it is not letting the mind wander of aimlessly, it is not an internal conversation or argument with ourselves and it is not one's ability to increase one's thinking process. It is not about emptying one's mind, it is not hypnosis or autosuggestion, it is not a religion, this is impossible anyway.

When one has attained a state of meditation, some symptoms are the body becomes perfectly still and quiet, doesn't move, shake, tremble or twitch, there is an unusual joy and happiness. Having attained this state one is ready to begin with the breath to enter the next state of meditation. Breath awareness is important in the practice of meditation. One's breath should flow smoothly, deep to one's capacity, silent, continuously without any pauses, jerks or irregularities. One's body should be still, with one's head, neck and trunk aligned for the breath to flow smoothly and freely.

One may be given an internal device that will help the mind to concentrate, a sound is used and sometimes an image. Depending on the individual frame of mind this sound may be external or

subtle. In meditation these sounds are called mantras, it has powerful effects on the mental faculty. Concentrating on a mantra, a word, a phrase, a set of sounds or a syllable or one's breath helps one to let go of non-beneficial distracting fluctuations in the mind-field. Om, Shalom and Amen are used to keep one's mind focused (it is a focal point given to the mind). All great spiritual traditions use sound syllables to help and guide one on the spiritual path, to deal with the mind and an appropriate syllable is given. Powerful and effective results is obtained by the aspirant, when the syllable is given by an adept of a genuine meditative tradition.

Some requirements for meditation that one should know are, how to relax the whole body, how to sit in a steady and comfortable meditative posture (asana), how to make one's breath flow, gently, smooth, rhythmic, silent, serene and subtle. Also, one should know how to witness the objects traveling through the mind-field. One has to know how to inspect the quality of one's thoughts and know how to use those thoughts that are positive and helpful for one's growth and development. And one should know how to remain centered, balanced and undisturbed in any situation, good or bad. Meditation and its practice are done in silence, both silence and meditation go together, when silence is practiced meditation flows easily and when meditation is practiced silence dawns. (Swami Rama)

Mariappan and Subramanian (2019) investigated "The Cognitive impact of Yoga Meditation and mental health Parameters using an electroencephalogram (EEG) machine" and they found that yoga meditation provides relief of mental tension, re-establishes mental harmony, and promotes physical, mental and spiritual health benefits when practiced regularly. This study has shown that there is a relationship between conscious meditation, the brain and the heart. If one were to practice deep meditation, one would find that it has a direct impact on the power of the mind and mental health. With these experiments, it was seen that the brain and mind have direct control of the heart and with the practice of mindful meditation, one's physical health is impacted positively. These results were determined by scanning and recording the brainwaves (alpha, beta and theta brainwaves) of the subjects in order to analyse their mental health during long meditation practices. In addition to utilizing EEG readings, the heart rates, respiration rates and blood pressure values were recorded and analysed. During mediation, it was found that alpha-theta brainwave activity was predominant.

Mariappan and Subramanian (2019) experiments supported results found in previous research in recent years which agree that the effects of meditation have shown to reduce blood pressure rates and symptoms of ulcerative colitis,

Advancements in modern scientific (instruments) technologies such as MRI, EEG and fMRI now equip researchers with the ability to measure function ability and neural activity directly, before and after meditation. These new technologies have allowed researchers to intricately examine the brain with respect to meditation practices and have shown that there was a significant increase in grey matter concentration in the brain. This evidence proves that there is a relationship among meditation, the brain, the heart and physical activities which was measured through brainwave activity.

Other related studies on meditation have confirmed that meditation has numerous benefits like reducing stress by lowering stress hormone, improved physical and mental health, memory, attention, relieve depression and anxiety, reduces heart diseases, enhances energy, strength, fitness, make breathing easier and more. It also verified benefits like improved balance of the physical, cognitive and emotional states. In other words, it can be used as a preventative and conventional medicine to aid one's physical and mental health. Some research supports a few minutes of daily meditation keeps the doctor away.

Saidatul et.al, (2011) emphasized the importance of utilizing EEG to study the behaviors of the brain. In this study, they show an integrated system to detect brain changes in conditions of mental stress and relaxation. A quantitative analysis of an EEG was carried out and the measured EEG properties were computed through power spectral density (PSD). The PSD uses Fast Fourier Transformation (FFT) Welch's method to calculate spectra and a neural network classifier was used to classify relaxation and mental stress conditions.

Ahani et. al., (2013) used spectral analysis to analyze data collected for EEG and respiration which were viable for meditation. They believed that mindful meditation can be used to reduce stress levels of older individuals. Signal processes methodology was assessed using the EEG and respiration signals in meditation under controlled conditions. Thirty- four (34) subjects were analyzed after 6 weeks of meditation intervention. Spectral analysis was used for evaluation. It was observed that there were differences in the brainwave frequencies of alpha, beta and theta brainwave frequencies. EEG was used for collecting respiration signals, with higher accuracy. Spectral analysis was used to analyze the data collected. It was concluded that EEG and respiration are viable for meditation. Also, Kora et.al., (2021) studied" the effects of Yoga and Meditation on brainwave frequencies with respect to physical and mental health", with their results demonstrating the importance of physical and mental health benefits through Yoga and Meditation. The EEG machine was used to measure brainwave frequencies of Yoga and Meditation. Brainwaves are classified into three main categories, preprocessing, feature extraction and classification.

Huang and Lo (2009) applied the use of the EEG machine to compare 20 Zen meditators for 40 minutes in the experimental group and 23 subjects in the controlled group at rest (relax) for 40 minutes. This experiment conducted spectral analysis for the initial, middle and final 5-minute intervals of Zen Meditation. It was discovered that there was a significant increase of alpha brainwave frequencies in the frontal area of the brain (8 -10 Hz) and occipital beta power was found during meditation with an average increase of theta power. The subjects in the controlled group showed no significant change. It was concluded that Zen Meditation affects the electrocortical activity in the brain thereby influencing changes of brainwave activity.

Kaur and Singh (2015) believed that a positive increase neurophysiological activity as a result of meditation can be explained by behavioral and psychological changes which prompted their research on current scientific studies in meditation, by measuring its effects on brainwave activities using EEG. Recent research has provided evidence in support of meditation and its impact on reducing anxiety and depression resulting in one's psychological well-being. More

research is required with other designs with consideration on personality characteristics, to avoid negative effects, large sample size and randomized control trials.

Khare and Nigam (2000) performed experiments on “30 subjects normal and healthy who practiced meditation and 10 subjects, normal and healthy who did not practice meditation” with the aid of EEG to perform brainwave analysis. A significant increase of Alpha wave activity was prominent, and voltage was increased in those who were meditating as compared to the controls who did not do any meditation. An increase in alpha brainwaves indicated a relaxed state of mind while an increase in alpha voltage correlated to decreased mental activity. It was shown that the practice of meditation with good coherence led to “good homogeneity, uniformity and an increased orderliness of the brain” (Khare and Nigam, 2000). These results prove that stresses of modern life can be relieved by relaxing or meditating. Achieving complete mental and physical relaxation is possible by practicing ancient procedures of relaxation and meditation. Khare and Nigam (2000) stated that “the presence of alpha frequency is directly related to decreased metabolism in brain”. Diaphragmatic breathing activates the alpha activity produced in meditators, unlike thoracic breathing. In most meditational methods the breath becomes the object of awareness. Khare and Nigam (2000) stated that meditation develops the right hemisphere of the brain, which is associated with 10 abilities. EEG scans found that the synchronization of brainwave patterns occurs during meditation which coincides with good coherence between both hemispheres of the brain. This coherence represents the bringing together of logic and intuitive functions of the brain and shows “uniformity of frequency and amplitude” in brainwave scans, from all parts of the brain. Upon completion of the meditation practice, alpha brainwaves persisted even after the subjects have opened their eyes. It was concluded that this synchronization of brainwaves and increased alpha wave activity, as a result of meditation, positively enhances one’s mental health in terms of self-confidence, empathy, sense of well-being and cognitive functions.

Deolindo et. al., (2020) explored “a critical analysis characterizing meditation through the Electroencephalogram”. This study found that meditation has potential benefits to both mental and physical health. Like many experiments discussed in this paper, EEG was used as a tool to observe, record and analyse subjects during meditation in healthy people.

Meditation is comprised of many practices, various styles and forms. Some ancient practices that are carried out in present day are “Buddhist meditation, Yoga, Tai Chi and Qigong”. Due to the positive effects of meditation, these practices have increased significantly. Stress reduction, promotion of well-being, regulation of emotions, attention control and cognitive performance. The scientific community has taken an interest in this area. Adequate scientific methodology and instruments have been used. Meditation has many methodological challenges because it encompasses subjective features (personal feelings). With no universal definition for meditation, difficulties lie with methods of quantifying the benefits of these practices from a scientific aspect. However, there are initiatives carried out to deal with this issue, for example, Deolindo, et.al., (2020), utilizes the electroencephalogram (EEG) as an assessment tool to measure meditation. The benefit of using EEG includes but is not limited to its non-invasiveness and relative low-cost allowing it to be used in clinical practice extensively. EEG signals emit

countless signal processing approaches that can be used to analyse the phenomenon of meditation. One of the primary features Hans Berger discovered in EEG was the alpha wave emanating from the occipital area, during eyes closed in meditation. The EEG detects and records the electrical signals on the scalp thereby providing a “direct and robust” measurement of the synchronized activity of myriad neurons in the brain.

When the resultant electric field emits electrical activity through the biological tissue, the farther away the source of current, the greater the reduction of the amplitude of a signal, electric current or other oscillations and the greater the coverage area called volume conduction. This allows for each EEG electrode to measure the activity from its surrounding area and from distant cortical areas and other electric sources. The source is seen to affect multiple electrodes hence making the interpretation of EEG oscillatory challenging. It emphasized that EEG patterns that look alike cannot be used to infer that subjects have the same mental state. EEG signals change in real time with millisecond precision. Many neurons have a controlling influence on brain activity which makes it difficult to be detected by the EEG instrument, however, these can be observed with a low frequency. EEG waves have a higher power in which the frequencies range from 1 to 30 Hz. These frequencies are divided into bands, but the literature related to general boundaries is not in consensus, leading to some proposals being made to establish the boundaries by considering the specificities of every person. The most common ranges are “Delta (0 – 4 Hz), Theta (4 -8 Hz), Alpha (8-14 Hz), Beta (14-35 Hz) and Gamma (35-45 Hz)”, some studies take into consideration frequencies up to 200Hz as Gamma.

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