

# Analysis of Neuro Cognitive Effects on Meditation

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## ABSTRACT

An effort was made to analyze the cerebral electrical activity of fifteen meditators by means of EEG recordings. The Electroencephalogram (EEG) is a physiological electrical signal recorded from the scalp to study the brain function. EEG is recorded before and after meditation inside and outside the pyramid. EEG after Meditation may provide an access to the mental states beyond normal consciousness. It is an attempt to score the meditation course by studying the variation in EEG parameters.

Many of the previous referred papers have no indication of quantitative analysis. Our aim is to do the quantitative and qualitative analysis. We conducted a study of EEG patterns of 15 subjects who were made to meditate under pyramid. The first set of data was taken prior to meditation and the second set of data was taken after the meditation inside the pyramid.. The EEG signal consists of five bands namely, Alpha (8-12 Hz), Beta (12-30 Hz), theta (4-8 Hz), Delta (0.5-4Hz) and Gamma above 30Hz. The EEG is acquired using BIOPAC Student Lab with suitably placed silver/silver chloride electrodes to study the effects of meditation on rhythms of subjects EEG.

## Keywords

EEG, meditation, data acquisition, alpha waves, beta waves, theta waves, delta waves.

## 1. INTRODUCTION

Meditation process reflects a brain state completely differing from the normal consciousness or the sleep states. Meditation usually refers to a state of extreme relaxation and concentration, in which the body is generally at rest and the mind quieted of surface thoughts .Some people use repetitive activities such as deep breathing, humming or chanting to help induce a meditative state. Meditation is being used extensively

in health care in relieving a person from stress and pain. Meditation is known for reducing heart rate and blood pressure of a person. This is practiced as a brief and practical self help stress management strategy. It also helps in the regulation of metabolism by lowering the biochemical byproducts of stress. [1][2]

### 1.1 About Pyramid Valley

Pyramid Valley is located on Kanakapura Road 35Km south of Bengaluru, India. It is located amidst natural rocks, hills and water bodies. It is an ideal place for a person to relax and be one with nature. The main attraction of the Pyramid Valley is the Maitreya- Buddha Pyramid. Maitreya- Buddha Pyramid stands 104 ft tall, within a campus of 40 acre. With a capacity of 5,000 people, it is the World's Largest Pyramid built solely for practicing intensive meditation. It has a base area of 160ft. x 160ft. and is as tall as a ten storied building at 104ft. height.

This Pyramid is constructed on the principles of Giza Pyramid, oriented exactly in the North – South direction, having the golden angle of inclination at 51° 51' and the King's Chamber located at the center at 1/3rd the height of the Pyramid.



**Fig 1: Maitreya- Buddha Pyramid**

## 1.2 Information on EEG bands:

### ALPHA:

Alpha is the frequency range from 8 Hz to 12 Hz, seen in the posterior regions of the head on both sides, higher in amplitude on the dominant side. It emerges with closing of the eyes and with relaxation, and attenuates with eye opening or mental exertion. The posterior basic rhythm is actually slower than 8 Hz in young children.

### BETA:

Beta is the frequency range from 12 Hz to about 30 Hz. It is seen usually on both sides in symmetrical distribution and is most evident frontally. Low amplitude beta with multiple and varying frequencies is often associated with active, busy or anxious thinking and active concentration. It is the dominant rhythm in subjects who are alert or anxious or who have their eyes open.

### DELTA:

Delta is the frequency range up to 4 Hz. It tends to be the highest in amplitude and the slowest waves. It is seen normally in adults in slow wave sleep. It is also seen normally in babies.

### THETA:

Theta is the frequency range from 4 Hz to 7 Hz. Theta is seen normally in young children. It may be seen in drowsiness or arousal in older children and adults; it can also be seen in meditation.

### GAMMA:

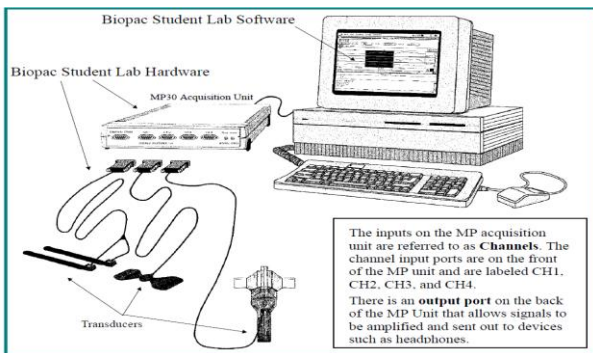
Gamma is the frequency range approximately 30–100 Hz. Gamma rhythms are thought to represent binding of different populations of neurons together into a network for the purpose of carrying out a certain motor function.

## 2. DATA ACQUISITION

Recording is done using BIOPAC with a 4 channel Data acquisition system, A/D conversion of 24 bits, sampling frequency of 256 Hz, inbuilt filter setting options and self calibration mechanism. The data acquisition system can be connected to a personal Computer via USB. The SS2L electrodes and transducers which receive the signals employ sensors that allow the software to communicate with the subjects. SS2L leads having electrodes were connected to channel 1 of BIOPAC [1].

### 2.1 Data Acquisition Electrode Placement

Three electrodes were placed on the subjects scalp. The first electrode was placed on the ear lobe (ground), second on the occipital lobe (negative) and the third on the parietal lobe (positive).

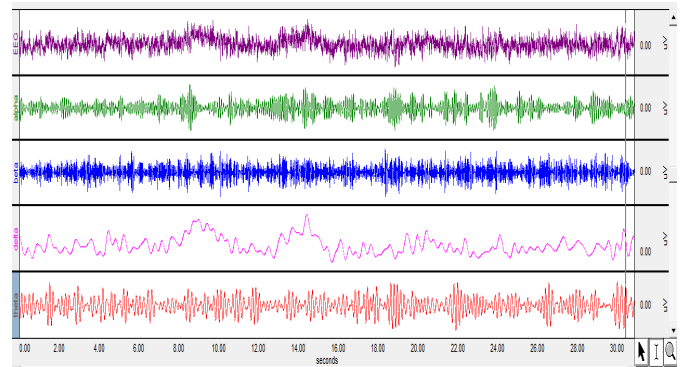
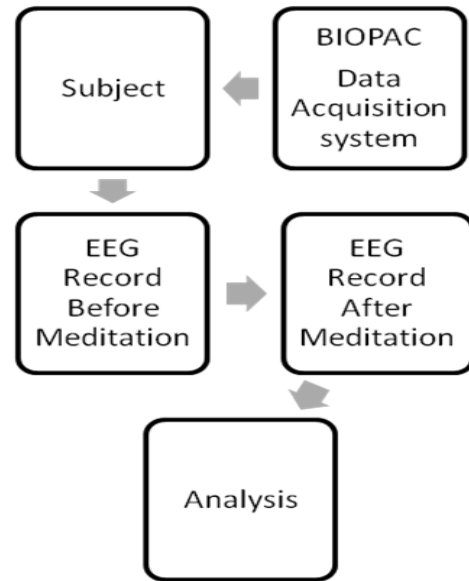


**Fig 2: BIOPAC Data Acquisition System**

## 3. RECORDING SYSTEM SETUP AND METHODS

Fifteen subjects were considered in the age group from 19 -45 yrs, both male and female. The setup consisted of a PC, BIOPAC Student Lab using 24 bits A/D converter, headphones and suitable disposable pre-gelled EEG electrodes.

Subjects were made to meditate for twenty minutes inside the pyramid valley, after which the EEG is recorded using BIOPAC. During the recording process subjects were made to relax with their eyes closed and the readings were taken for 30seconds. The electrodes were secured to their positions using a swimming cap. The room was kept quite to help the subject relax mentally. First the calibration procedure was carried out to establish the hardware's internal parameters such as gain, offset and scaling. Calibration is critical for optical performance. Then the recording of the EEG signal was done. This procedure was followed for each of the subjects, both before and after meditation at the pyramid valley.



**Fig 3: Shows the recording setup and EEG recorded after 20 minutes of meditation**

## 4. STATISTICAL ANALYSIS

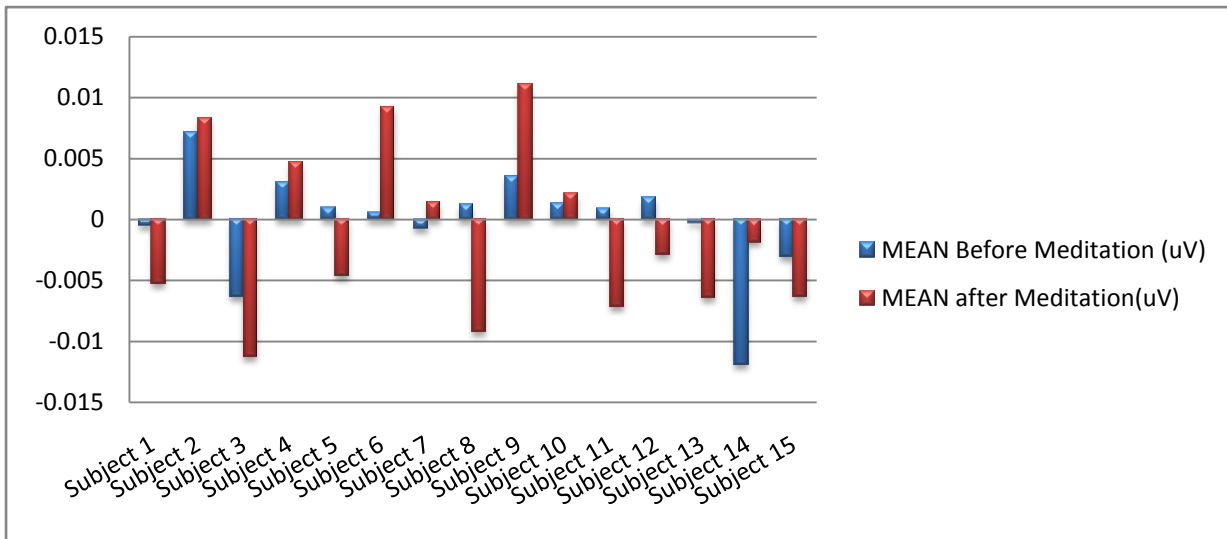
Statistical analysis is carried out in Time domain, Using BSL Pro software. Two parameters mean and Standard deviation was studied. [3]-[5]

Mean: Mean is the average of set of readings.

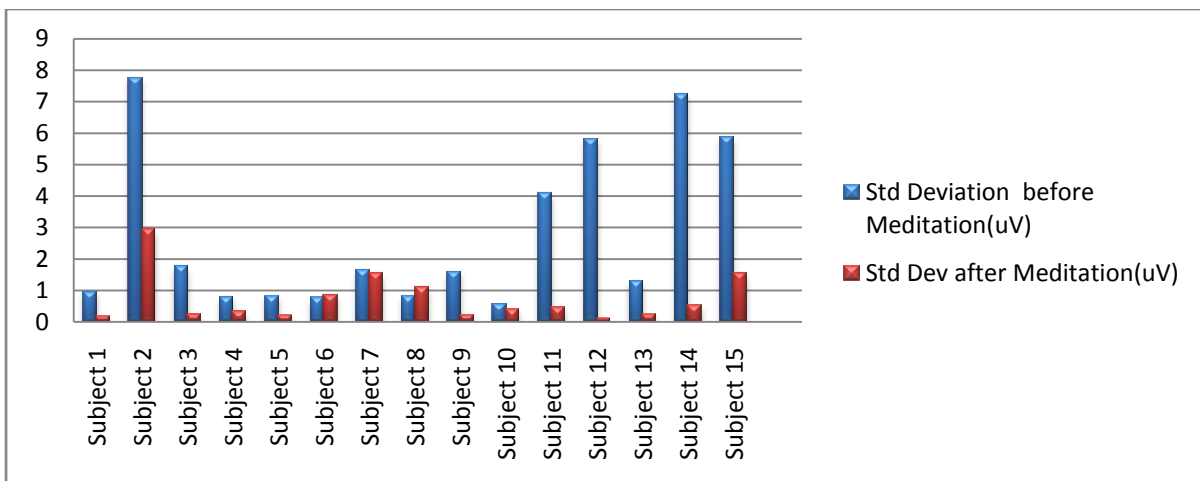
$$\bar{X} = \frac{\sum_{i=1}^n X_i}{n}$$

Standard Deviation: Standard deviation is a statistical measure of spread or variability. The standard deviation is the root mean square (RMS) deviation of the values from their arithmetic mean.

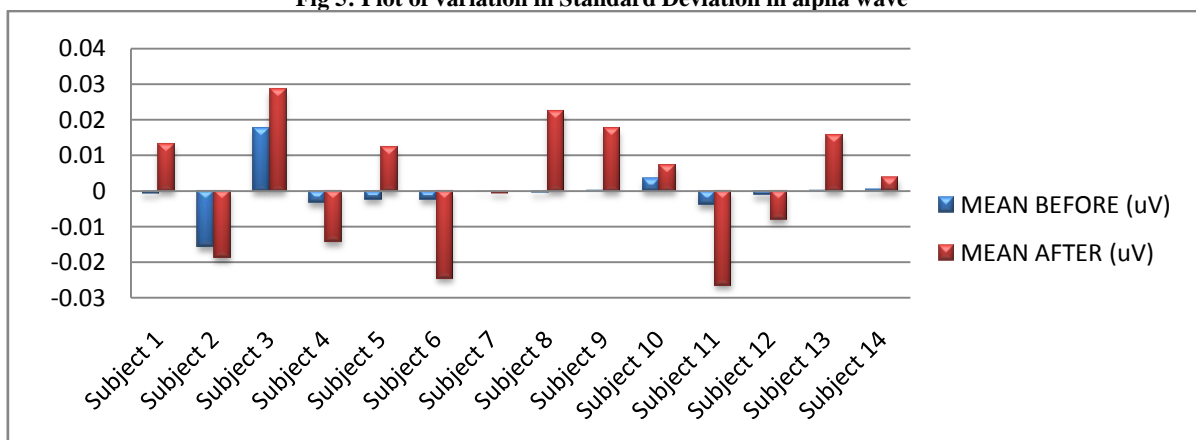
## 5. RESULTS



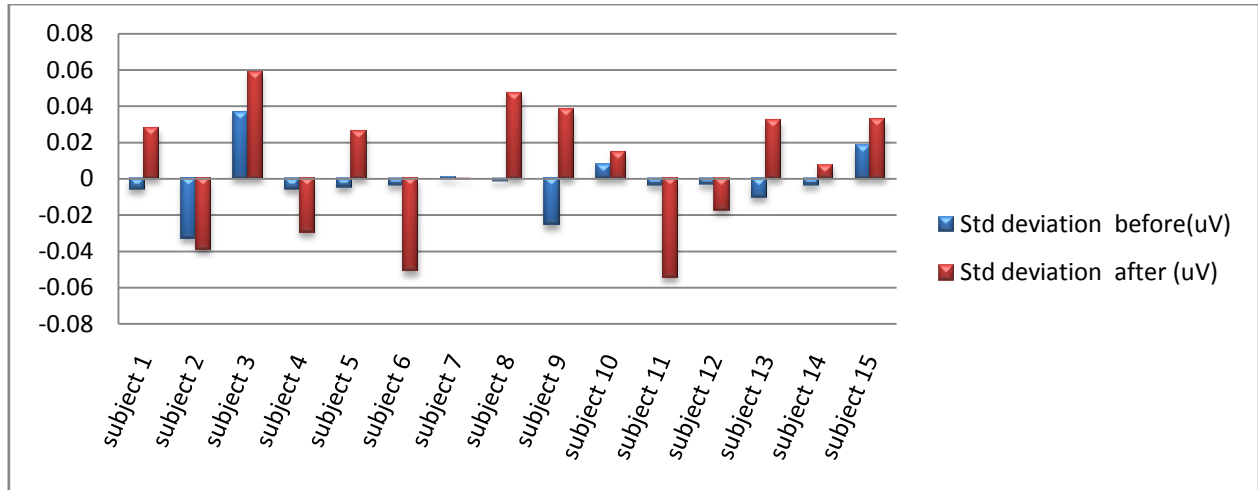
**Fig 4: Plot of variation in mean of Alpha wave**



**Fig 5: Plot of variation in Standard Deviation in alpha wave**



**Fig 6: Plot of variation in Mean of theta wave.**



**Fig 7: Plot of variation in Std Deviation of theta wave**

## 6. CONCLUSION

The variation in mean and standard deviation of Alpha and theta waves are Analyzed.

From the analysis we observed that the Mean value of alpha wave for thirteen subjects showed an increase whereas two subjects showed a decrease After Meditation. That is 86.67% of the subjects showed an increase while 13.33% of the subjects showed a decrease in alpha activity. The amplitude of theta parameters for 14 subjects showed an increase which accounts for 93.34% while 1 subject showed a decrease which accounts for 6.66%. Also amplitude of delta shows an increase of 73.34% and a decrease of 26.67%. Thus increase in the Alpha and Theta parameters showed the suggestive of relaxation after meditation.

Scope and Advantages of Meditation from the literature are; the mental exercise of meditation is especially beneficial for people with high blood pressure. Indulging in meditation helps the body fight against chronic diseases, like arthritis. Meditation lowers the risk of high cholesterol levels and cardiovascular diseases. Those who meditate on a regular basis develop immunity against various kinds of allergies. Meditating improves the flow of air to the lungs. It may also increase the lung capacity, if done on a regular basis. Meditation provides significant relief from various breathing problems, like asthma. A person who indulges in meditation, regularly, has a better control on his/her mood swings and behavior. In this analysis four channel data acquisition system is used. For better analysis 16 channel data acquisition system with 10-20 electrode system can be used. Larger numbers of subjects need to be studied to define these changes further. [6][7]

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