ELECTROENCEPHALOGRAPHY (EEG) APPLICATION ON QUANTIFYING EMOTIONAL INTELLIGENCE DURING MEDITATION

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ABSTRACT: Humans have two distinctive quotients that need to be considered such as Emotional Quotient (EQ) and Intelligence Quotient (IQ). Emotional quotient is also known as Emotional Intelligence (EI) which can be defined as the ability of a person on how they understand themselves and handle their emotion, as well as understanding society around them. Quantifying EI is an issue that has attracted various field of work. This manuscript aims to investigate the relation of EI in meditation using the human electroencephalogram (EEG) device. Low-cost 16 electrodes Emotiv Epoch neuroheadset was used in this study. A stimulus on a Quran recitation audio-visual was setup as the meditation intervention. The EEG signal obtained from this experiment showed that the Power Spectral Densities (PSD) of alpha brainwaves on the right frontal lobe were gradually reduced when the subjects are watching and listening to the Quran recitation's video. Hence, the negative feelings were reduced which indicated that the participants are emotionally stable. This finding may suggest that humans are prone to relax when the Quran is being recited repeatedly. This finding further confirms that Quran recitation correlate with the self-awareness and self-regulate attributes of EI. Additionally, differences in response were observed from the male and female subjects.

KEYWORDS: *Emotional Intelligence; EEG; Quran recitation; Human Emotion*

1.0 INTRODUCTION

Quantifying Emotional Intelligence (EI) has been an ongoing study among many researchers. Salovey and Mayer [1] invented the term 'Emotional Intelligence' and they describe it as "a form of social intelligence that involves the ability to monitor one's own and others' feelings and emotions, to discriminate among them, and to use this information to guide one's thinking and action" [1]. EI is generally classified into four core skills and pair up into two main competencies which are personal competence and social competence [2]. There are two types of emotions, which are simply put, the positive and negative. Joy, optimism and all good feelings generally fall under positive, while negative emotions can be related to anger, anxiety, sadness, fear and other bad feelings [3]. All those emotions are playing a role to manipulate a person's EI whether they have low EI or high EI. It is not easy to quantifying someone EI because not all people are expressing their emotions and feelings through their face and other method that we can do is by looking on their brain activities. Therefore, we can measure emotions by using Electroencephalogram (EEG) where it is the most suitable method to be used for the measurement of human brain behavior.

This research focused on quantifying the human EI and their emotional pattern on EEG and the activity of the brain lobes. Therefore, this research intends to explore and investigate the relation between emotions and the brain's electrical activities while listening to the Quran recitation. This research will focus on the EEG frequency alpha band and its cognitive relation to the brain lobes related to EI. Based on the previous study, to indicate the emotion in brain by EEG, the best approach is to look at the frontal lobes, which is an indication of emotion [4-5]. Besides, other research finding found that frontal lobes give a good accuracy comparing with the other lobes [5] and frontal asymmetry has been studied extensively in individual differences research on emotional and motivational processes [6-7]. Furthermore, brain has a different pattern and activities where the pattern of resting EEG activation recorded in the frontal areas was significantly associated with EI [8]. The greater resting left frontal activation shows individuals with higher EI and the greater resting right frontal activation shows individual with lower EI [8].

EEG applications in meditation or perhaps relaxation for example music listening has found that human tends to be in a relax state [9-10]. However, other research findings found that the alpha magnitudes generated while listening to Quran recitation was higher which means a person was in relax and alert condition [11-14]. A person tend to be more relax by listening to Quran recitation compared to hard rock and classical music and Quran recitation could become a tool for meditation, where it can reduces stress and brain can be in resting state [15]. The increases in right frontal alpha asymmetry from baseline to the stressful speech condition were associated with vigilance to angry faces and avoidance of happy faces [16].

2.0 METHODOLOGY

2.1 Experiment Flow

In this experiment, an audio-visual setup of Quran recitation video is used as stimuli. Then, the subject is prepared and the EEG device is placed on subject's head. Before the placement of the Emotiv on the subject's head, the electrode must be wet by dropping it in a saline solution and make sure the subject's head is free from any gel or pomade. After that, the subject is instructing to watch the stimuli to trigger their emotion and electrical signal in their brain. Then, the raw EEG signal is recorded accordingly by using Emotiv Test Bench software. Afterward, artifacts that infect EEG signal are removed by using EEGLAB. This EEG data is analyzed to be extracted the significant features. Alpha wave and Power Spectral Density (PSD) at frontal lobe are observed. Figure 1 illustrates the summarization of the whole process involved in this experiment.

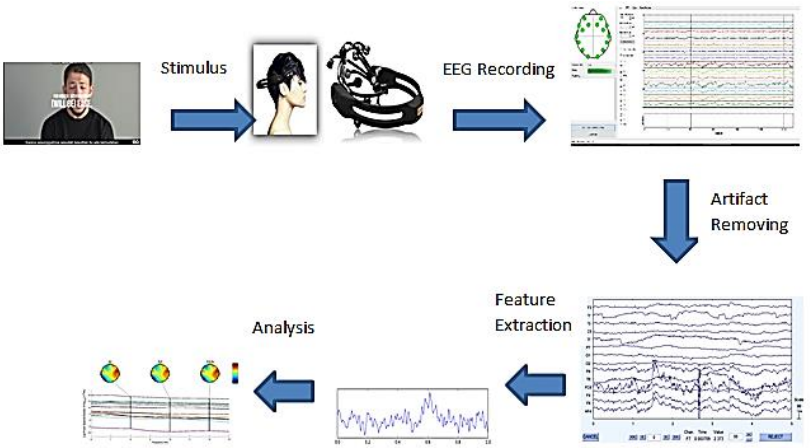

Figure 1: The summarization of the whole process involved in this project

2.2 Subject

Five healthy subjects from Malaysia-Japan International Institute of Technology (MJIIT) were chosen to participate in this experiment where three of them are males and two subjects are females. In addition, all the subjects also are free from any disease and medication. Then, the experiment was conducted in a room with an air-conditioner (24 ^{0}C). In this experiment, it took twenty minutes to complete all the set of videos.

2.3 Experiment Stimulus

Figure 2 shows the arrangement of the stimuli in one experiment session. For this experiment, video of surah Al-Inshirah with its meaning was used as the stimulus. Silence and brown noise were added before the surah to make subject calm and lower their brain activities. The purpose of this experiment is to quantify the EI and what happens to the brain activities during the recitation of the surah. It was played three times for each subject to observe their activation pattern at frontal lobe.

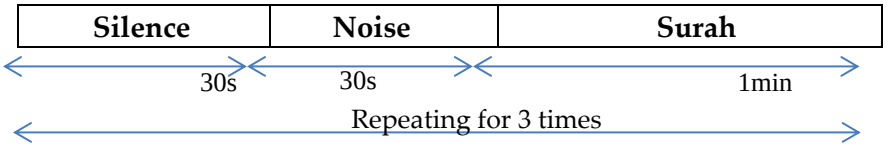

Figure 2: Arrangement of the stimuli in one experiment session [14]

2.4 Experiment Tools

A 16 electrodes Emotiv EPOC+ headset was used in this experiment. Figure 3 shows the device and component used. The location of electrodes on the scalp are based on the international 10/20 system as indicated in Figure 4. All 14 electrodes were recorded but only 8 frontal electrodes were observed which are AF3, F7, F3 and FC5 electrodes are represent left frontal hemisphere while FC6, F4, F8 and AF4 electrodes are represent right frontal hemisphere.

Figure 3: (1) Manual user, (2) Emotiv EPOC+, (3) USB charger, (4) USB wireless, (5) 16 Electrodes and (6) Saline solution

Five types of software used in obtaining and analyzing the data, specifically:

i. Windows live movie maker;
ii. Camtasia 9;
iii. Emotiv Control Panel and Emotiv Testbench;
iv. EEGLAB;
v. Microsoft Excel.

Windows live movie maker is a movie editing software used to edit and design the stimulus in this experiment. Next, Camtasia 9 is used to record specific time event during stimulus played and recording the brain signal simultaneously.

Emotiv Testbench runs as an acquiring system of EEG data. Before recording the data, Emotiv EPOC+ control panel will check the signal connection contact of impedances at each sensor's location. Figure 4 shows the control panel viewed where green color means the signal is in good condition.

Figure 4: Emotiv EPOC+ and the electrode placement viewed by the control panel

Afterward data were collected by using Emotiv Test bench software and a 128Hz sampling rate was chosen. After recording was done, EEGLAB was used. Data recorded from Emotiv testbench were converted into .edf file and uploaded into EEGLAB for the next process such as filtering, segmenting, artifact detection, averaging, and baseline correction.

2.5 Data Analysis

Data were analyzed using the Fast Fourier Transform (FFT) to transforms the EEG signal into the frequency domain. The function of FFT in this experiment is to examine the similarities of the complex raw EEG to sine waves that consist of certain pure frequencies. The more similar the signal to the sine wave, the larger the matching score for the brainwave. It means that if the raw EEG data were completely identical to the sine wave, FFT would return a perfect matching score. The equation of FFT is shown as

$$X(f) = \int x(t)[\cos(-2\pi ft) + j\sin(-2\pi ft)dt] \quad (1)$$

Power Spectral Density or also known as PSD is used to measure the power signal at distinct frequencies [17]. PSD is a frequency-domain plot of power per Hz versus frequency. Then, Fast Fourier Transform (FFT) is used in order to implement this PSD analysis as it will be used for PSD computation. For this project, Alpha power will be estimated by using this analysis and PSD data can be extracting from EEGLAB.

3.0 RESULTS AND DISCUSSION

This experiment shows that the brain wave activities were changed during the stimulus event. Two frontal lobe hemispheres were observed to see the brain wave activities during the Quran recitation. According to [16], emotion can be identified by looking at the frontal lobe. Increased the right frontal activity will lead to a negative emotion, while the increased left frontal activity will lead to a positive one.

Figures 5(a) and 5(b) shows the result of average PSD data for male and female subjects. From the graph, we can observe which hemisphere of the frontal lobe was more active during the Quran recitation. The red color represents the PSD at right-frontal lobe while the blue color represents the PSD at left-frontal lobe. As we can see, the visual of the PSD on the right side frontal lobe is higher than left side frontal lobe.

Based on Figure 5(a), the PSD at the right side frontal lobe decreased as the event repeated. It means that through Quran recitation, negative feelings can be reduced and the subjects become relaxed. While in Figure 5(b) the results showed that PSD can increase and decrease, which means unbalance as the event repeated. What we can conclude here is that, males and females brain activities are differing in to handling their feeling [15].

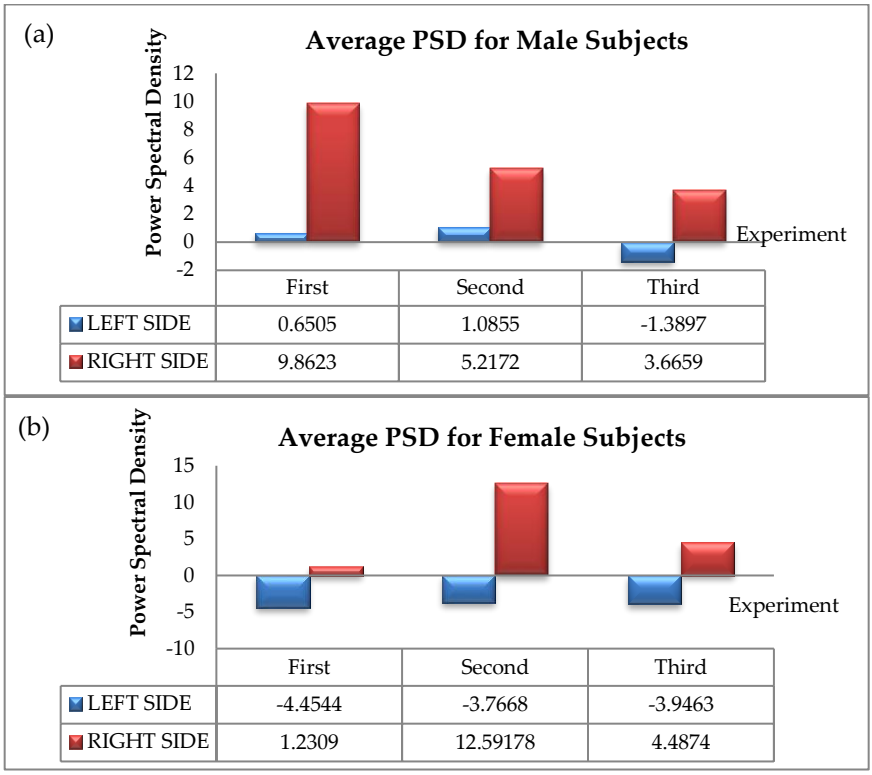

Figure 5: (a) Average PSD for male subjects and (b) Average PSD for female subject

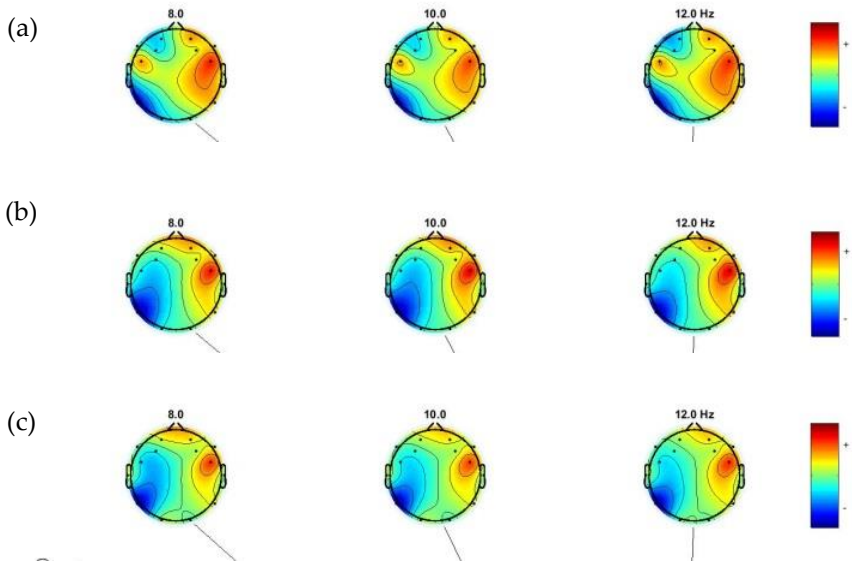

Figure 6: (a) First experiment, (b) Second experiment and (c) Third experiment of channel spectra and maps topographic results for male

The topographic maps in Figure 6 show three types of alpha frequency values which are 8Hz, 10Hz and 12Hz. Red color means alpha wave at that region is strong and blue color represents the weak signal of alpha frequency band. It can be seen as the red color at the right frontal lobe decreases in Figures 6 (a)-(c).

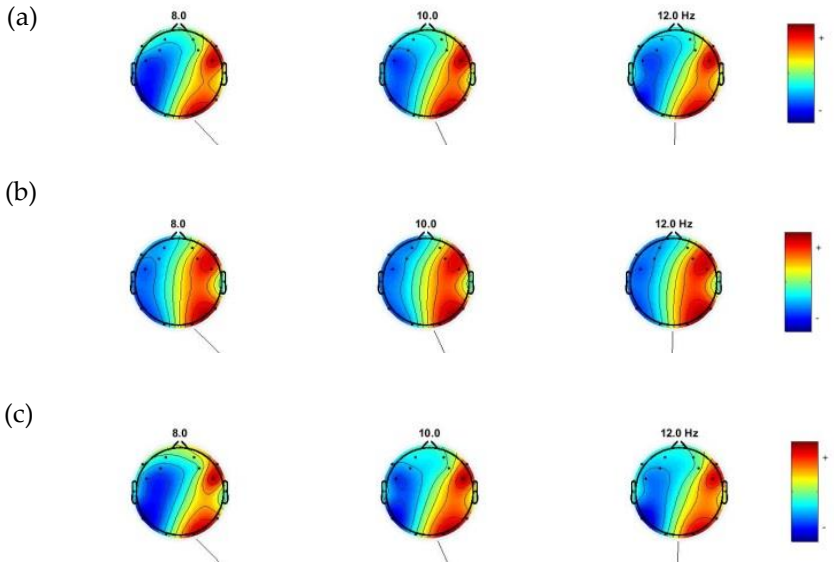

Figure 7: (a) First experiment, (b) Second experiment and (c) Third experiment of channel spectra and maps topographic results for female

The topographic maps in Figure 7 show three types of alpha frequency values which are 8Hz, 10Hz and 12Hz. It can be seen that the red color at the right frontal lobe was unstable which indicated by the increase of color intensity from Figures 7(a)-(b) while decreasing in Figure 7(c).

4.0 CONCLUSION

Results from the experiment concluded that there is a significant relation of Quran recitation and EI. Further results identified that the pattern of male and female emotion being different. Although the female subjects' results show an unbalanced power density, their brain activities spectrum, however, did reduce which confirmed the reduction of negative feelings. The experiment results further showed that the alpha wave at the right frontal lobe is active but is reduced

gradually when the subjects were instructed to listening and watching a Quran recitation's video with meaning.

Analysis from the topographic map displays various activities of the brain lobes and waves. Repetition of the Quran recitation experiment illustrate that the participants are emotionally stable. This finding may suggest that humans are prone to relax when the Quran is being recited repeatedly. Hence, through Quran recitation, emotional intelligence attributes such as self-awareness and self-regulation can be quantified, which indicates its potential in meditation practice. Further research work on investigating various parameters of the brain waves and bigger sampling size may contribute better strength on quantifying the EI during Quran recitation.

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