EEG Pattern of Psychomotor Activities for Non-Dyslexic Person Due to Different Gender

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Abstract. Human have a complex organ that called as brain, every action and decision was instructed by brain. This research was conducted to identify the pattern of EEG brainwaves for psychomotor abilities between male and female focussing to non-Dyslexic or normal engineering students at UTHM. Non-Dyslexic is a person who has not learning disorder that involves difficulty reading due to problems identifying speech sounds and learning how they relate to letters and words (decoding). In addition, psychomotor abilities tests are important to measure the ability of motor skill and hand on to manipulate and controlling objects such as constructing circuit or robot and do programming for coding. The other way to measure the development of psychomotor abilities by using accuracy test, reaction time, precision and procedure techniques. Other than that, psychomotor abilities test also can be used to identify the suitable occupation based on their tendency. Psychomotor abilities requests a creative thinking, focus and also involves human mind and body that link together while performing the psychomotor abilities. The objective of this research was to collect sample data off EEG from subject’s brain during psychomotor learning activities, to analyse the brainwaves produces by brain while going through psychomotor learning activities and to analyse the data collected using statistical analysis and do comparison on term of psychomotor activities between difference genders. Based on the result that have been conducted, almost all psychomotor persons have Beta and Alpha band but Beta band will be more domain than Alpha band. As a conclusion, this research has found out that between male and female that involved in this research the number of male subjects higher than female subjects as a psychomotor person.

1. Introduction
Brain is the most complex and magnificent organs in human body. It controls all human activities, for example muscle movements, the secretions of our glands, and even our breathing and internal temperature. Brain also develop a creative though and feeling. The brain’s neurons record the memory of every event in our lives. Brain also gives us awareness of ourselves and our environment, processing a constant stream of sensory data. [1] [2]. The brain which is the centre of the human’s nervous system is also recognized as a central processing unit (CPU) to a human body. The brain cells called neurons interact with one another through trains of signal pulses producing brainwaves. The brainwaves are categorized into four levels namely Delta, Theta, Alpha and Beta [3]. Every frequency band has different range such Delta (0.2- 3 Hz), Theta (3- 8 Hz), Alpha (8-12 Hz) and Beta (12-30 Hz) can be used for analyzing brain activities. The Power Spectral Density (PSD) is generated from frequency band through Electroencephalogram (EEG) application [4]. Referring to the theory, Beta band is the lowest amplitude but the highest frequency band while Delta band is opposite to Beta band. High Beta is occurred when
human is inactive, not busy or anxious thinking but the low Beta is occurred in positive situations. Human activities such as closing the eyes, relax/reflecting mode and all activities with inhibition control are affected by Alpha band. The Theta band is occurred when human in stress mode and light sleep also it has been found in baby activities. When human is in profound sleep mode, the Delta band is produced [4] [5].

2. Methodology
There have four stages that must be followed to complete this research; Methodology is importance part that involves the step and procedure. Methodology usually used as a guideline to solve the problem during the research and to collect the information

2.1 Data Collection
In this research data collection will related to finding the subject (student) to provide the sample of brain activity during psychomotor test. The data will be collected from 26 engineering students of University Tun Hussein Onn (UTHM). In order to collect the raw data for (EEG) pattern psychomotor activities, the Emotive Insight will be used to achieve the experimental requirement in this research. The EEG are extracted as the raw data from Emotiv headset. There is a license required for Emotive Insight software It takes fifteen to thirty minutes for the whole process and five minutes to record the signal of brainwaves. The duration is set as follows to ensure that the brain’s spontaneous electrical activity produced by neurons will be recorded [6-7]. Figure 1 shows Emotive Insight is used on a male test subject for EEG recording of psychomotor activities and how to wear the Emotive Insight equipment. Electroencephalogram (EEG) is when a neuron passes information to another neuron within the brain. The Emotiv Insight is one of the available EEG headset device on the market. This technology has been widely used especially in education, neuroscience, cognitive, training study the performance of athlete for health and wellbeing [8].

2.2 Testing
Next stage is testing and conducting experiment. It will be 20 subjects that has been full fill all the criteria will be sitting for the experiment and completed the task given to collect the data sample. The subject will be divided into two groups where 13 of the subjects is female engineering student and the other 13 subjects is male engineering student. The task has been involved by psychomotor activities that related to electronic circuit design. The experiment started when the subject started designs a circuit with the entire component such as LEDs, batteries, resistance, connector, batteries holder and breadboard that provided as show in Figure 2 and follow the requirement as stated on ad piece of paper and completed it in five minutes. The subject has been given a schematic diagram and they must design a basic circuit that involves parallel or series circuit. All the LED in the circuit must be light up when the push button is switch on.
2.3 Analyzing and Implementation of Data

Last but not least is analyzing and implementation of data. The data that has been collected and recorded during the experiment using the Emotive will be transferred into SPSS. To evaluate the data, Statistical Package for the Social Sciences (SPSS) will be used. The type of statistical analysis that will be used in this research is a Standard Deviation, Q-Q Plot, correlation and average. This is because SPSS is a comprehensive system for analyzing data; consist of a set of software tools for data management, data entry, statistical and presentation. Other than that, to analyze, test and classified to make the conclusion for this research Microsoft Excel software will be used. The software will be used to process and assemble the raw data from electroencephalogram (EEG) brainwave pattern. This is because Microsoft Excel is used to generate some of result, because it has the ability to calculated, pivot tables and graphing tool helps to fasten the process of processing the data. For this research, Microsoft Excel is used to arrange the data accordingly. The software is also used to draw graphs according to the data. For this project, Microsoft Excel will be used to observe the pattern of the graph. The data obtained will be processed to obtain the graph that will show the pattern of the wavebands.

3. Result and Discussion

3.1 Result of Averages

Table 1 shows the value of average for Alpha and Beta band during the psychomotor activities based...
gender while Figure 2 shows the summaries data based on Table 2 in percentage. According to the observation on Figure 3 the chart shows only 15 percent male student have high Alpha band while 85 percent have high beta band compare to 31 percent female student have high Alpha band, whereas the other’s 69 percent have high Beta band. Thus, based on Figure 4 and 33 the bar graph obviously shows during the psychomotor activities, the Beta band is generally high with the total number of subject was 20 students from overall total of 26 students. From 20 subjects that have high Beta band 11 from them are male and 9 are female students. However, the remaining 6 subjects that have high Alpha band are 2 male and 4 females based on the Table 2.

Table 1. Number of Students for High Alpha and Beta Band Based on Gender

| Type of Brainwaves | Male | Female |
|-------------------|------|--------|
| Alpha             | 2    | 4      |
| Beta              | 11   | 9      |

Figure 3. Percentage for Alpha and Beta band based on gender

Figure 4. (a) Average value for male during psychomotor activities (b) Average value for female during psychomotor activities

So, this can be concluded that male subjects are more focus and concentrated during the psychomotor activities compared to female subjects and make them tend to psychomotor person or domain. According to the previous research about sex different in brain, there have a task in problem solving for adults in laboratory situation where the average result show that male adults perform better than female at certain spatial tasks. In particular, male seem have an advantage in test that require the subject to imagine rotating an object or manipulating it in some other way. In additional male exhibit more accuracy in test of target-directed motor skill—that is, in guiding or intercepting projectiles [9].

3.2 Result of Standard Deviation

Figure 5 represents group of standard deviation for male and female subjects. To observed the minimum and maximum size of wave emitted by Alpha band and Beta band the analysis result of standard
deviation was very importance to relate with the smaller range of standard deviation for one band the better it is. The figure shows that obviously half of male subjects have smallest range of standard deviation for Beta band which is 8 from the total 13 subjects while for female there have only 6 from 13 subjects with lowest value of standard deviation for Beta band. However, the otherwise result was shows for Alpha band when majority female has lowest value whereas there have only a few of male subjects have lowest value of standard deviation.

![Graph](image)

**Figure 5.** (a) Standard deviation for male during psychomotor activities (b) Standard deviation for male during psychomotor activities

### 3.3 Result of Correlation

Figure 6 represents correlation between Alpha and Beta band. Correlation is defined as statistical technique that can show whether and how strongly pairs of variables are related. In the other word, the correlation coefficient was used to measure the strength and direction of linear relationship between Alpha and Beta. The value of correlation coefficient was always between +1 and -1. A perfect and strong negative linear relationship was -0.5 while +0.5 for positive. From the figure, the relationship between Alpha-Beta band and Beta-Alpha band for male subjects were -0.053 whereas the relationship between Alpha-Beta and Beta-Alphaband for female subjects were 0.1338. As a conclusion for both male and female, the linear relationship correlation was not strong (weak negative for male and weak positive for female) because both value of correlation coefficient below than +0.5 for positive correlation and -0.5 for negative correlation.

![Graph](image)

**Figure 6: Correlation between Alpha and Beta band**

### 4. Conclusion

This research is conducted to investigate and find out more information regarding the EEG pattern of psychomotor activities for engineering student due to different gender at Universiti Tun Hussien Onn Malaysia. As a conclusion, during psychomotor activities there not only Beta band will be produces but Alpha band also will be produces by our brain even though normally Alpha band only be produced went
the person in relax and calm condition. Other than that, these researches can also conclude that male subject is more focus and concentrated during psychomotor task and the distribution data shows the pattern and the categories existed. The result obtained from data collection has proven the hypothesis and it has achieved the objectives of the project and also can be verified by previous research and the result from psychomotor task during the experiment and questionnaire that have been provide.

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