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Brain dynamics of athletes in sports science

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Abstract: Understanding the neural mechanism processes that underlie skilled performing are of great interests in sports science to improve sporting performance. One way of understanding the brain processes is to study electrical brain activity using electroencephalography (EEG). A most notorious problem with EEG is that genuine cerebral data is often contaminated by artifacts of non-cerebral origin especially when such artifacts tend to be exacerbated when the subject is in motion, meaning that obtaining reliable data during exercise is inherently problematic. Given the difficulties of recording EEG during movement, researchers have perhaps unsurprisingly explored alternative ways to apply EEG methodologies in the sports sciences. The objective of this research was to explore the brain processing speed of athletes in response to conflicting informatio and to find out the difference in the brain waves of Athletes and Non athletes. Stroop tests was conducted to determine the athletes executive functioning or brain processing speed in response to conflicting information and to measure how well a person's selective attention works. Findings showed that most athlete have a better attention than non – athlete. The dominant brainwave for athlete is Alpha wave with the left brain cortex as the region of interest for attention.

Key words: Component; Formatting; Style; Styling; Insert.

1. Introduction

The purpose of the research was to describe the brainwave pattern of athlete and non athlete group among the undergraduates, and to explore the brain processing speed of the athletes in response to conflicting information. The brainwave would be shown in different bands and sub-bands such as delta, theta, alpha, beta and gamma Differen brain wave frequencies indicates differences in cognitive functioning in different regions among athlete and non athlete. In this research, stroop effect test were conducted to find out the difference in executive functioning or brain processing speed of both groups in response to conflicting information and to measure how well a person's selective attention works. Normally, athletes involved in competition would reach higher frequency of brain wave and this would make them more competitive in given challenges (Harung et al, 2011). Brainwave pattern are related to physical and mental activity and this is supported by research by Colcombe & Kramer (2003) and Kramer &Erickson (2007) who claimed that these activity could improve the cognitive functioning of human brain. Babadi & Forozandeh (2012) research revealed that when people were done with activity such as running, walking, these could help to increase their focus and performance in mental activity. Other study indicates that the left brain cortex is a dominant function of the athletes' group which shows the activation of spatial and creativity.

2. Objective

The main objective to describe the difference in brainwave pattern between Athletes and non athletes and to explore the brain processing speed of athletes in response to conflicting information.

3. Significance of the study

This research will contribute to a better understanding of neural mechanism underpinning the sports performance and its executive functioning helps the researcher to enhance the spatial ability among athletes and non athletes. In addition, more research need to be done on the importance of brain training to regulate the brain and training for attention using EEG neurofeedback device to enhance peak performance**.**

4. Method

This is a quantitative research using quantitative electroencephalogram (qEEG) to record the brain wave signals from the participants.

4.1. Instruments

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QEEG: A neuroimaging technique to record the brainwave from the participants. The participants were given tasks to perform and the brain frequences and waveform were recorded for analysis of different sub-bands.

Stroop test: the test were presented with series of color words. These words appear in different color and sometimes matching the word.

5. Results and discussion

5.1. Demography

Fifty UNIMAS undergraduates from first year and final year volunteered to participate in the research. Twheny five students who were athletes and active in sports were selected verses twenty five undergraduates who were non athlete.

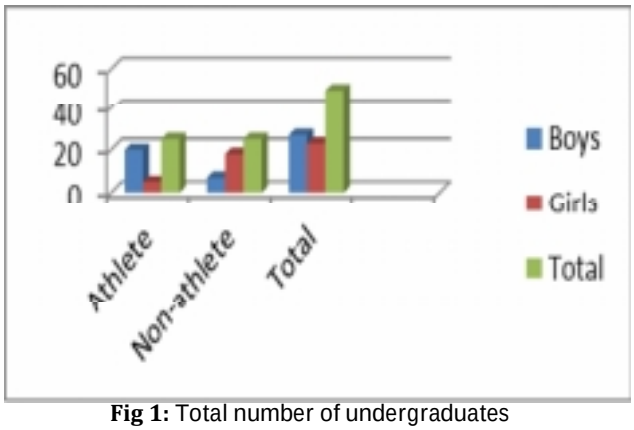

Fig 1: Total number of undergraduates

Table 1: Total number of participants

	Boys	Girls	Total
Athlete	20	5	25
Non-athlete	7	18	25
Total	27	23	50

Fig. 1 and Table 1 above shows the total number of subjects based on gender and group of experiment. Fig. 2 and Table 2 above shows the total of respondent based on age according to gender. Fig. 3 and Table 3 above shows the total of respondent based on races according to gender. Fig. 4 and Table 4 above shows the Education level of the subjects.

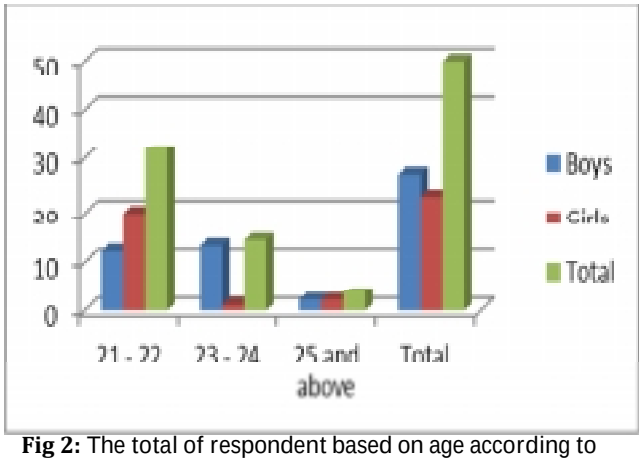

Fig 2: The total of respondent based on age according to gender

Table 2: The total of respondent based on age according to gender

	Boys	Girls	Total
21 - 22	12	20	32
23 - 24	13	1	14
25 and above	2	2	4
Total	27	23	50

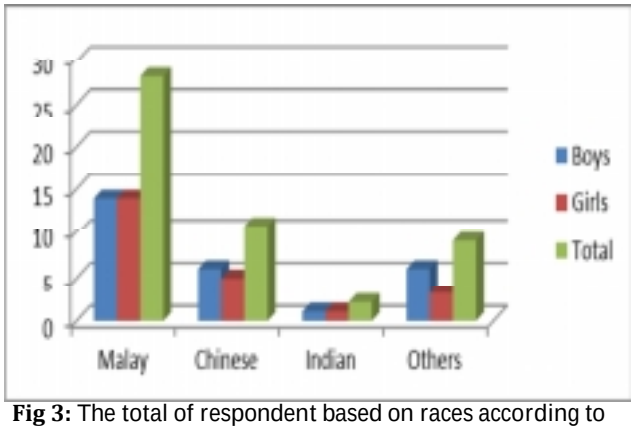

Fig 3: The total of respondent based on races according to gender

Table 3: The total of respondent based on races according to gender

	Boys	Girls	Total
Malay	14	14	28
Chinese	6	5	11
Indian	1	1	2
Others	6	3	9

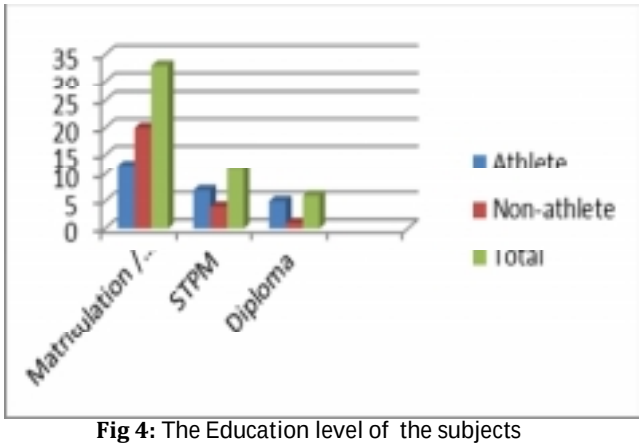

Fig 4: The Education level of the subjects

Table 4: The Education level of the subjects

	Athlete	Non-athlete	Total
Matriculation / Foundation	13	20	33
STPM	7	4	11
Diploma	5	1	6

5.2. Difference of brainwaves athletes vs non-athlete's

The findings are presented visually in graphics and tabular forms. The analysis shows the differences of brainwave pattern among athlete and

non – athlete based on attention using qEEG (look at Table 5)

Table 5: The Differences of Frequency of Brainwave Pattern among Athlete and Non-Athlete

Type of Brainwave	Athlete (Hz)	Non-Athlete (Hz)
Delta	1.2 – 1.8	1.3 – 2.1
Theta	4.5 – 5.4	4.6 – 5.4
Alpha	8.5 – 12.3	8.6 – 10.7
Beta 1	15.4 – 17.1	14.4 – 15.9
Beta 2 (Gamma)	22.9 – 24.5	22.5 – 24.5

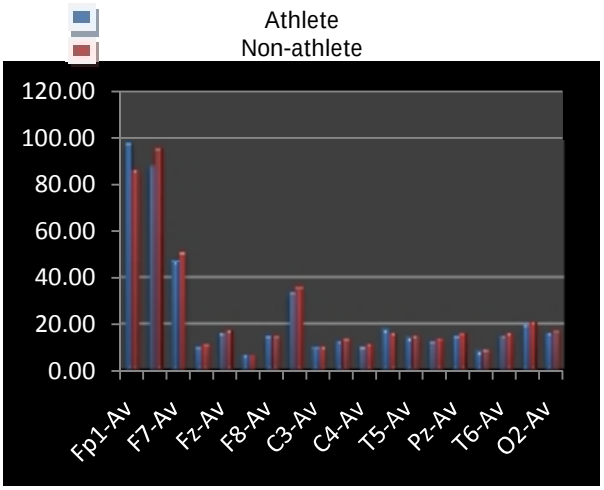

Fig 5: DeltaWave**,** Differences of Brainwave Pattern between both group from 19 Electrodes

According to Posner (1989), human attention was located in Fp1. In Figure 5, it is indicated that athlete (represent as a blue color) has a better attention than non-athlete in Delta wave. Which means, when taking a rest, most athletes are really in a relax mood (normally in deep sleep) and they are not thinking too muchon how to reduce the tension and get prepared for their performance (Zainuddin & Zulkapri, 2010).

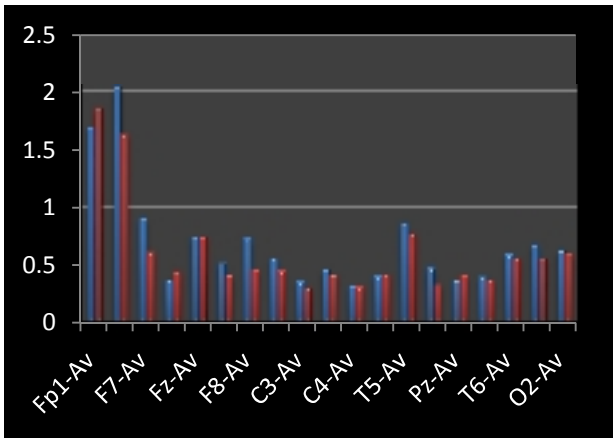

Fig. 6: Theta wave

However, Theta wave (refer to Fig. 5) is more dominant in non athlete. This is because, according to Crews (1991), normally athletes are not visualizing their performance but they are arranging their strategies to assure that they can have a peak performance. The findings shows that the athletes are in high state of consciousness and are fighting for the real success (Guskiewicz et. al., 2004).

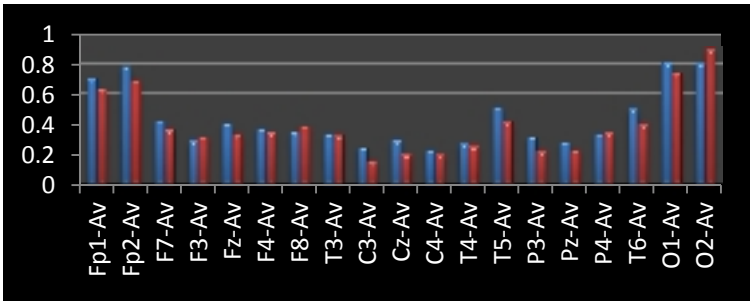

Fig. 7: Alpha Wave

According to Fig. 7, athlete has a better attention within the high frequency of Alpha wave where this kind of wave is helpful in support of peak performance among athlete (Crews, 1991). This can conclude that athletes are remaining calm and relax while facing their challenge so that they can focus on their target. According to Drew (2008), alpha brainwave is associated with a completely relaxed body and mind from all of tension and nervousness.

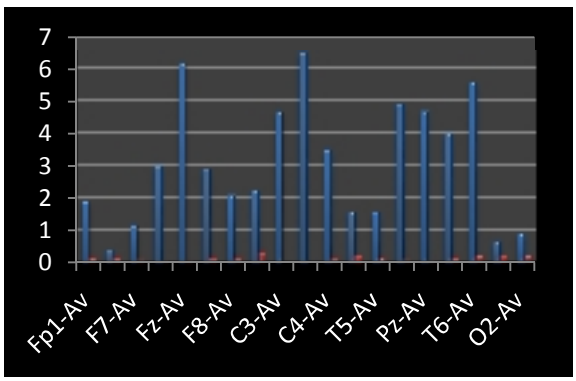

Fig. 8: Beta 1 Wave

Beta wave (Fig. 8) in athletes showed that they are really alert and has a higher consciousness with the environment surround them. According to Zainuddin and Zulkapri (2010), athlete involved in fighter sport such as taekwondo are good in strategizing their tricks on their opponents.

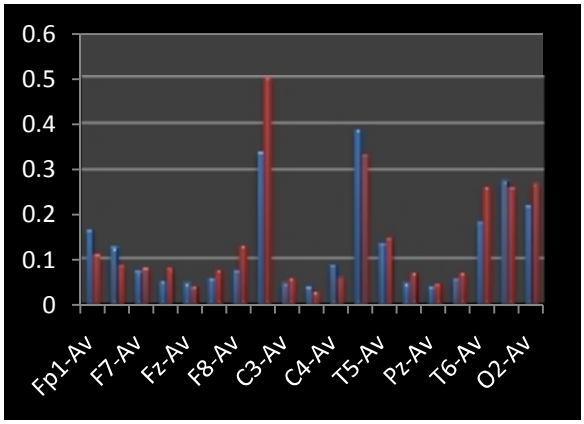

Fig. 9: Beta 2 Wave

Beta wave 2 (Gamma wave) in Fig. 9 showed that athlete has a high frequency of brainwave where it is proven that athlete has a better attention than non-athlete in Fp1. Therefore, according to all of the result in this research, we can conclude that athlete actually has a better attention than non– athlete.

Every single electrode in qEEG showed the different function of cognitive skill within the human attention is located in Fp1. Most of athlete has a higher frequency in every wave while doing a task. Therefore, athlete has a better attention than non athlete.

Besides that, according to Babadi and Faroozandeh (as cited in Carlstedt, 2008), the dominant function of the brain among the athlete is left brain cortex which is Fp1 is located. Therefore, hypothesis for this research is rejected.

5.3. The differences of scores mark in cognitive task (stroop effect)

Table 6: Mean for stroop effect test

Class	Name and font same	Name and font different
Athlete	573.09	596.99
Non-athlete	714.25	759.57

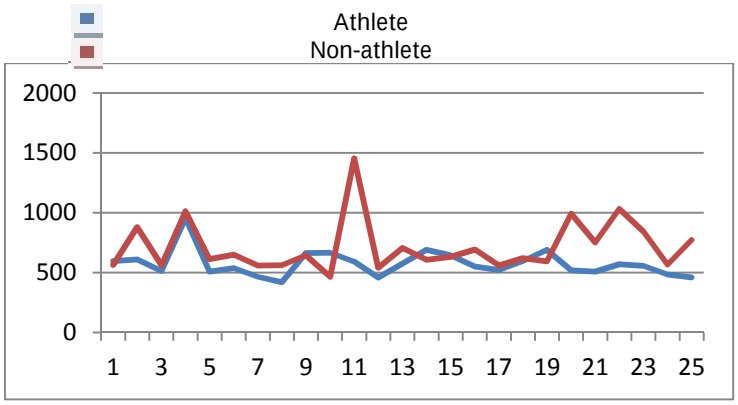

Fig 10: Color with the same font

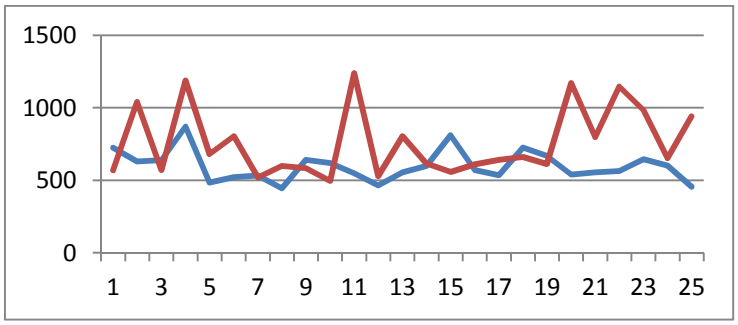

Fig 11: Color with the different font

Based on Fig. 10 and Fig. 11, athlete showed better level of attention within the lowest mark for Stroop Effect test. According to Stroop (1935), it is interesting when respondant need to respond to the color and not to pay attention on word where most of the subjects are commonly confused. However, it is different to athlete where in this research, group of athlete represent better result than non-athlete group. Therefore, hypothesis for this research is rejected.

5.4. Related research findings

According to Guskiewicz et. al. (2004), there are large number of athlete that participates in a variety of sport level such as school, college, university, group of age and ability. Every type of sport bring

different effects and while performing the tasks, they help the athletes to focus and build up their attention especially in competitive and fighting sports . In sport such as taekwondo, wushu and many more, athletes have to plan their strategies much better to optimize their performance to win the competition. within their alertness and attention to the environment surround them. This findings supported the research by Drew (2008) where "normally athlete need to be calm before having a tournament and do not think much while performing the tasks because attention to surrounding especially to the opponent are helpful to reduce nervousness and tense. Besides that, Zainuddin and Zulkapri (2010) mentioned that, athlete normally reach the alpha wave (11Hz – 13Hz) to increase their focus and awareness while performing.

6. Conclusion

Based on observations on the mind behavior of the athletes, most athletes have a better attention than non – athlete due to brainwave pattern recorded by qEEG. While doing the task (Stroop Effect test) the lowest score that respondant obtained indicates as a better attention they give and in this research athlete has a lower score between 573 to 596 marks compared with non-athlete that has a score between 714 to 759 marks. However, without concentration on environment, athlete would not be able to gain the highest score where this can be related with environment that can be once of factor that influences the athletic performance (Pratt, 2007). Therefore, the dominant brainwave pattern for athlete is Alpha wave and the dominant region of interest is the left brain cortex (attention is on Fp1).

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