

## Processing and analysis of electroencephalography signal to evaluate the effect of sport advertisement on customers

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### ABSTRACT

The purpose of this study was to process and analysis of the electroencephalography signal to assess the effect of sport advertisement on the customers. Forty university student athletes, which were interested and uninterested to the Nike brand were selected (all right handed with 18-25 years old). They were 10 male interested athletic, 10 male uninterested athletes, 10 female interested athletes and 10 female uninterested athletes. When brain waves were registered by the electroencephalography device, Brian mapping software and math analysis used to change information to numeric data. Data analyzing by variant analysis test with Repeated Measures ANOVA and LSD test was done. The results showed that the activity of alpha, beta and theta waves in the interested group had a significant increase. Moreover, the activity of alpha and theta in uninterested group was not significantly different. Results showed that it's possible to find out the effect of sport advertisement Nike brand on brain waves (alpha, beta, delta and theta) by registering the customer's brain waves by electroencephalography. Moreover, by processing and analyzing the signals, we conclude that advertisements increase the amount of analytic and focused thinking, as well as arousal, and can play a significant role into decision making.

**Keywords:** Electroencephalography, Brain waves, Advertisement, Nike brands, Athletes.

### Introduction

Marketing is the art of keeping customers satisfied and involves broad range of business activities to create valuable and continuing communication to meet the needs of customers and get revenue. Today, researchers are investigating the frequency, location and timing of brain activity at a different level of satisfaction to help business, because traditional business marketing methods have limited results[1]. Therefore, business makers have started to research about customers' brains and finding some information about a product, customers' preference and assessing the role of advertisement[2]. New methods have been developed to better understand the decisions and choices the audience. Now, using brain study technology like electroencephalography (EEG), FMR (functional magnetic resonance imaging), eye tracking and imaging of different parts of the brain is provided. Using these technologies for studying the customers' mental action has created the new studying basis by the titles like: Neuromarketing, Neuroeconomic, and Neuro communication[3].

The base of Neuromarketing is neuroscience and its goal is performance the humanity essence by the interdisciplinary research (neurology, psychology, etc.). Neuroscientists are trying to explain the process occurring in the customers' mind by Neuromarketing and trying to analyze the brain waves[4]. The main goal of Neuromarketing is to extract the hidden information from people's brain. Therefore, in Neuromarketing, people do not asked any question, but information is directly extracted[5].

Neuromarketing increasingly developing in many countries, especially in the developed countries. Nowadays there are more than 100 Neuromarketing centers in the U.S and big companies like General Motors, Coca-Cola and Motorola use it[6].

The goal of Neuromarketing is searching customer's brain reactions and in relation to marketing stimulant. So it will be easy to make better the act of marketing activity[7]. Neuromarketing pays attention to this that it can't trust in customers' saying; sometimes they say something about the product that contradicts their purchases[8]. There is a consideration in Neuromarketing that decision making for buying isn't necessarily a logical decision, but this decision making is formed in the depth of the brain and it is the basis of composition of thought, and fillings[9].

Electroencephalography is the first method of nerve imaging. Electroencephalography measures neuron's electronic activity directly by electrodes mounted on the head's skin. The advantage of this measurement is that electrodes can very fast record the brain's electrical activity changes, so it provides a high time clarity [6]. Electroencephalography is a powerful technology for processing the brain wave, and is considered as a method for assessing brain's activity. Electroencephalography electrodes get ion flows from cerebral tissue like voltage and send it to EEG preamplifiers and amplifiers. The characteristic of electrodes in signal registering is very important. Usually Silver Chloride is used on the plates of these electrodes [3].

The main four frequency alpha, beta, delta and theta are in the common grading[10]. Alpha wave are sinus wave that have frequency between 8-13 hertz are seen in the brain's activity normal conditions[11]. The next wave is "beta" that is seen when the person is conscious and doing and processing information[12]. Delta wave have the slowest case see in sleep case and have a frequency between 1-4 hertz [11]. In the delta case, people are passive, inactive and have a low amount of motivation]. The next brain wave is theta. Theta frequency has ranged from 4-8 hertz and highlighted by a deep sleep. In fact, theta wave is in the slow wave range with a sinus rate[13].

Advertisement is a more or less regular attempt for affecting on others thinkings, attitude and behaviors[14]. Paying attention to customers' behavior in selecting and buying products and service is regarded as an important factor for huge factories. Nowadays, sport has been combined with science, economics and art by creating of new social values. Hidden and apparent attractions from this transition motivates emotions and has made same special attitudes among all societies to exercise events[15]. In recent years, sports have been widely used for advertising products, services, and goods[16].

Different articles and researches have been conducted on the effect of advertisement on customers' brain wave. Deppe and colleagues (2005) have done a research using FMRI. Researchers asked 22 participants (12 men with 23 years old average and 10 women with 22 years old average all of them right handed) to decide between two types of disposal product with different commercial brands. Then the changes of customer's brain activity were examined in the present and not presence of the target commercial name by FMRI. Finally, they concluded that about products' preference of commercial name, the activity of the same areas of brain related to memory and logic falls and areas related to processing information, excitations feelings and making decision. Also the results of their research showed that alpha brain activity will be increased only when a favorite brand of a participant is shown[17].

McClure and colleagues (2004) have reported their survey on the customers of two soda companies, Coca-Cola and Pepsi-Cola. The results of their survey showed that tested selected Pepsi when they didn't know which soda they were drinking. But they had two sodas with their title in its own dish, they selected (preferred) Coca-Cola. The survey resulted that when customers see the brand of Coca-Cola an area in their mind would be active that have effects on the taste of soda too. Researchers found that perhaps VMPFC, hippocampus, PLPFC and middle brain affects propriety on the base of cultural and feeling information separately[18].

Schaefer and colleagues (2006) in a research reviewed nerve communications about brand name. The survey showed 14 images from machine producer's slogan to participants, (13 people with 27 years old average all right handed and German) where, 7 slogans were from the agency of machine producers in Germany and Europe which were familiar with the participant's culture. And the next 7 slogans were out of Europe which were unfamiliar with participant's culture in this study. The results of this survey showed that when participant's expose to familiar brands their brain wave activity changes against when they expose to

unfamiliar marks. In general they found that cortex placed in front of head bone has as important role in processing brands[19].

Custdio (2010) researched the activity of alpha wave in two interested and uninterested groups in a brand. First group were interested people in “Sagres” brand and second group were people who were not interested in “Sagres” brand. The results of this survey showed that there was a low distribution of alpha wave in occipital cortex in interested group in "Sagres" brand when watching advertisement video and in uninterested group in Sagres brand, a high distribution from low rhythm of alpha wave in occipital cortex. In fact they observed a significant deference in alpha wave. Finally they concluded that brain structure of the person who doesn't like the brand is less active than person who likes a brand when watching one advertisement[20].

Murugappan and colleagues (2014) in a survey researched to identify the preferred car brands in Malaysia using EEG signals and studied four car brand; Toyota, Audi, Proton and Suzuki in this essay. They showed advertisements as films to persons and measured their brain waves by EEG device. The results showed that people often have more inspiration for Toyota brand vehicles than other brands[21].

Berčík and colleagues (2016) found out that dynamic solutions like dramatic lighting and color causes customers to stay and return to shop again and they said that these factors are simplest and most effective method to attract customer attention to these factors in products that customers are attracted by optic images. So, they concluded that optic appetizers are powerful than other senses and using electroencephalography device and a camera that was recording customers' eye movement they found out that colors like yellow, purple, red, blue and green are very effective in selecting the type of brand[22]. Gupta and colleagues (2017) studied on 18 male and female subjects who aimed to examining brain responses. They made four brands of soap advertising videos to diagnose human behavior in marketing stimuli. They concluded that the alpha wave, more affected by the favorite brand[23].

Hsu (2017) studied the mind of the consumer using Neuromarketing. The results of the study showed that EEG shows the electromagnetic effects of neuronal activities in large parts of the brain at precise time resolution in milliseconds and is faster than FMRI. EEG is used as the most popular and cheapest method for marketing research. In this research, Hsu had good news for marketers, and with the use of Neuromarketing, it could be concluded how participants think about different brands. In the present study, EEG method was used due to low cost and speed of brain wave analysis[24].

Sharma and colleagues (2017) evaluated actual and virtual procedures using eye tracking. The main objective of this study was to investigate the significant differences in behavior patterns of novice and specialist actors (male and female) in eye movement that was performed using eye tracking. The results showed that target diagnosis were almost identical in both groups. But women paid more attention to details than men[25].

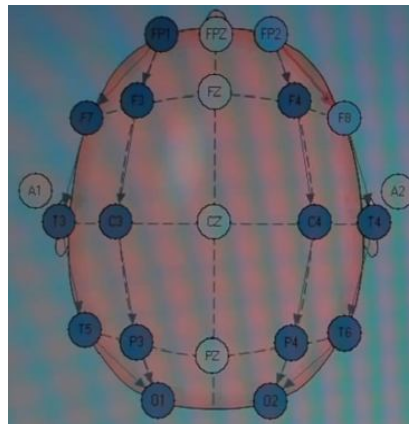
Despite the widespread research on the impact of advertising on the brain waves, no research has found on the effect of sports advertising on the brain wave changes and the decision to purchase by the athletes according to their interest and gender. Therefore, the aim of this study was to examine the effect of sport brand advertising on EEG signals in both male and female athletes.

## **Material and Methods**

The present research is an applied research and uses a semi-experimental research. Statistical community of this research was all of the male and female athlete students in the University of Mohaghegh Ardabili interested and uninterested to the Nike brand. Forty samples were selected (all right handed in 18-25 years). They were 10 male athletes interested in Nike brand, 10 male athletes uninterested in Nike brand, 10 female athletes interested in Nike brand and 10 female athletes uninterested in Nike brand. Athletes were selected among those were active in the University sport teams. Nike's interested and uninterested subjects were identified base on self-declaration. Subjects were signed the consent form for the participation in the research project and completed personal information (gender, marriage, etc.) as well as information about the

medical history, symptoms like headache, dizziness, and head and neck trauma or surgery. None of subjects had history of headache, dizziness, or trauma to the head.

At first, subjects were informed about the goal and procedures in this research and then were asked to attend the clinic to obtain EEG. After co-ordination with athletes, individual interview conducted by the researcher. In this research, the independent variable was Nike brand advertisement and the dependent variable were the brain electrical waves. To perform the test, the scalp was thoroughly cleaned and the electrodes of the device were placed on 21 points (Figure 1). The test was included 3 stages. In the first stage, the brain activity of each subject was initially recorded for 2 minutes in rest and sitting conditions.

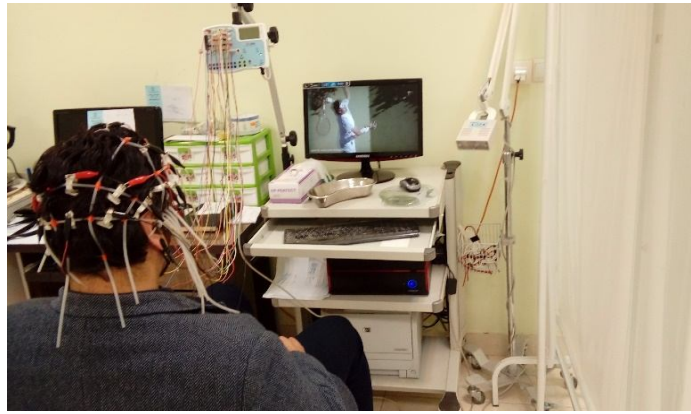


**Figure 1.** Device connected points on the head



**Figure 2.** Recording brain waves in the resting phase

In the second stage, subjects watched advertisement video regarding Nike brand and their brain waves were recorded by the EEG device. This process was exactly done like the first process the difference was that testes were watching Nike brand advertisement (Figure 3).



**Figure 3.** Recording brain waves while playing Nike brand advertising video

In the third stage like the first stage, the observation and recording of the athlete's brain wave done after watching the advertisement using an electroencephalogram. Nike brand advertisement time was 1:35 minute with sound level matched for the subjects.

After collecting data by the electroencephalogram, the Brain Mapping software was used and digital data was analyzed by mathematical analysis and the results showed in charts and Tables. In the processing of EEG signals, FFT (Fast Fourier Transform) technique was used for the spectral analysis of the data; then, data analysis was done using descriptive and inferential statistics. Demographic data analysis was performed using frequency Table and diagrams. In the inferential statistics Shapiro-Wilk test was used to determine the normal distribution of the results. Statistical analysis on all the stages was done using the Repeated Measure ANOVA and LSD post hoc tests.

## Results

The descriptive findings of the subjects are presented in the Table 1 and Table 2.

**Table 1.** Experimental groups

| Groups                             | Number | Percent    |
|------------------------------------|--------|------------|
| <b>Male interested athlete</b>     | 10     | <b>25%</b> |
| <b>Male uninterested athlete</b>   | 10     | <b>25%</b> |
| <b>Female interested athlete</b>   | 10     | <b>25%</b> |
| <b>Female uninterested athlete</b> | 10     | <b>25%</b> |

**Table 2.** The level of education of students

| level of education | Number | Percent     |
|--------------------|--------|-------------|
| <b>BSc.</b>        | 18     | <b>45%</b>  |
| <b>MSc.</b>        | 19     | <b>47%</b>  |
| <b>Ph.D.</b>       | 3      | <b>7.5%</b> |
| <b>Total</b>       | 40     | <b>100%</b> |

**Table 3.** Shapiro-Wilk test to determine the normality of the data

| Brain Waves        | Time                         | Mean $\pm$ SD    | Statistics | Sig.        |
|--------------------|------------------------------|------------------|------------|-------------|
| <b>Alpha Waves</b> | <b>Before advertising</b>    | 7.34 $\pm$ 2.30  | 85%        | <b>0.49</b> |
|                    | <b>During advertising</b>    | 7.45 $\pm$ 1.92  | 1.15%      | <b>0.12</b> |
|                    | <b>After the advertising</b> | 7/40 $\pm$ 3.27  | 0.55%      | <b>0.81</b> |
| <b>Beta Waves</b>  | <b>Before advertising</b>    | 5.17 $\pm$ 1.20  | 0.61%      | <b>0.73</b> |
|                    | <b>During advertising</b>    | 5.13 $\pm$ 1.11  | 0.71%      | <b>0.67</b> |
|                    | <b>After the advertising</b> | 5/45 $\pm$ 1.06  | 0.74%      | <b>0.62</b> |
| <b>Delta Waves</b> | <b>Before advertising</b>    | 14.15 $\pm$ 7.83 | 0.79%      | <b>0.52</b> |
|                    | <b>During advertising</b>    | 13.19 $\pm$ 3.95 | 1.07%      | <b>0.20</b> |
|                    | <b>After the advertising</b> | 13.78 $\pm$ 3.65 | 1.15%      | <b>0.11</b> |
| <b>Theta Waves</b> | <b>Before advertising</b>    | 11.53 $\pm$ 4.79 | 1.24%      | <b>0.07</b> |
|                    | <b>During advertising</b>    | 9.60 $\pm$ 2.23  | 1.18%      | <b>0.09</b> |
|                    | <b>After the advertising</b> | 8.61 $\pm$ 1.87  | 0.74%      | <b>0.61</b> |

According to the results of Table 3 (Shapiro-Wilk test), it is concluded that the values of the significant level for the research variables are greater than the level of the test. Therefore, all variables had normal distribution and parametric tests were used.

**Table 4.** The results of Repeated measures analysis in Alpha wave before, during and after viewing the advertisement

| Groups                            | (I)<br>Factor | (J)<br>Factor | Mean<br>Difference(I-J) | Sig.  | 95% Confidence Difference |             |
|-----------------------------------|---------------|---------------|-------------------------|-------|---------------------------|-------------|
|                                   |               |               |                         |       | Lower Bound               | Upper Bound |
| Male<br>interested<br>athlete     | <b>Before</b> | <b>During</b> | -0.17                   | 0.001 | -0.23                     | -0.12       |
|                                   |               | <b>After</b>  | -0.11                   | 0.62  | 0.47                      | 0.38        |
|                                   | <b>During</b> | <b>Before</b> | 0.17                    | 0.001 | 0.12                      | 0.23        |
|                                   |               | <b>after</b>  | 0.06                    | 0.71  | -0.42                     | 0.56        |
|                                   | <b>After</b>  | <b>Before</b> | 0.11                    | 0.62  | -0.38                     | 0.47        |
|                                   |               | <b>During</b> | -0.06                   | 0.71  | -0.56                     | 0.42        |
| Male<br>uninterested<br>athlete   | <b>Before</b> | <b>During</b> | -0.02                   | 0.89  | -0.31                     | 0.35        |
|                                   |               | <b>After</b>  | -0.05                   | 0.78  | -0.45                     | 0.37        |
|                                   | <b>During</b> | <b>Before</b> | 0.02                    | 0.89  | -0.35                     | 0.31        |
|                                   |               | <b>after</b>  | -0.03                   | 0.66  | -0.34                     | 0.24        |
|                                   | <b>After</b>  | <b>Before</b> | 0.05                    | 0.78  | -0.37                     | 0.45        |
|                                   |               | <b>During</b> | 0.03                    | 0.66  | -0.24                     | 0.34        |
| Female<br>interested<br>athlete   | <b>Before</b> | <b>During</b> | -0.24                   | 0.001 | -0.35                     | -0.20       |
|                                   |               | <b>After</b>  | -0.09                   | 0.13  | -0.21                     | 0.07        |
|                                   | <b>During</b> | <b>Before</b> | 0.24                    | 0.001 | -0.20                     | 0.35        |
|                                   |               | <b>after</b>  | 0.15                    | 0.22  | -0.11                     | 0.22        |
|                                   | <b>After</b>  | <b>Before</b> | 0.09                    | 0.13  | -0.07                     | 0.21        |
|                                   |               | <b>During</b> | -0.15                   | 0/22  | -0.22                     | 0.11        |
| Female<br>uninterested<br>athlete | <b>Before</b> | <b>During</b> | 0.02                    | 0.71  | -0.19                     | 0.13        |
|                                   |               | <b>After</b>  | 0.04                    | 0.21  | -0.53                     | 0.16        |
|                                   | <b>During</b> | <b>Before</b> | -0.02                   | 0.71  | -0.13                     | 0.19        |
|                                   |               | <b>after</b>  | 0.02                    | 0.34  | -0.64                     | 0.27        |
|                                   | <b>After</b>  | <b>Before</b> | -0.04                   | 0.21  | -0.16                     | 0.53        |
|                                   |               | <b>During</b> | 0.02                    | 0.34  | -0.27                     | 0.64        |

According to the Table 4, the results of repeated measures test were used to examine the difference between the alpha wave activities. Results of the male interested athlete group showed significant difference (0.001). Therefore, we conclude that there is a significant difference between the mean value of alpha waves, before, during, and after viewing advertisement. The results of the LSD, follow-up test in male interested athlete group is higher than during viewing advertisement than before viewing the advertisement. In the male uninterested athlete group, significant level is more than 0.05; therefore, we conclude that there is not a significant difference between the mean value of alpha waves, before, during, and after viewing advertisement. In the female interested athlete group, the significance level is 0.001. As a result, we conclude that there is a significant difference between the mean value of alpha waves, before, during, and after viewing advertisement. The results of the LSD, follow-up test also show that in a female interested athlete group, the mean of alpha waves is higher during viewing advertisement than before and after viewing advertisement. In the female uninterested athlete group the significance level is 0.818, so, there is not any significant difference between the mean value of alpha waves, before, during, and after viewing advertisement.

**Table 5.** The results of Repeated Measures analysis in Beta wave before, during and after viewing the advertisement

| Groups                            | (I)<br>Factor | (J)<br>Factor | Mean<br>Difference(I-J) | Sig.  | 95% Confidence Difference |             |
|-----------------------------------|---------------|---------------|-------------------------|-------|---------------------------|-------------|
|                                   |               |               |                         |       | Lower Bound               | Upper Bound |
| Male<br>interested<br>athlete     | <b>Before</b> | <b>During</b> | -0.38                   | 0.003 | -0.92                     | -0.26       |
|                                   |               | <b>After</b>  | -0.51                   | 0.002 | -1.08                     | -0.16       |
|                                   | <b>During</b> | <b>Before</b> | 0.38                    | 0.003 | 0.26                      | 0.92        |
|                                   |               | <b>after</b>  | -0.14                   | 0.39  | -0.34                     | 0.21        |
|                                   | <b>After</b>  | <b>Before</b> | 0.51                    | 0.002 | 0.16                      | 1.08        |
|                                   |               | <b>During</b> | 0.14                    | 0.39  | -0.21                     | 0.34        |
| Male<br>uninterested<br>athlete   | <b>Before</b> | <b>During</b> | 0.38                    | 0.12  | -0.11                     | 0.52        |
|                                   |               | <b>After</b>  | -0.25                   | 0.18  | -0.64                     | 0.17        |
|                                   | <b>During</b> | <b>Before</b> | -0.38                   | 0.12  | -0.52                     | 0.11        |
|                                   |               | <b>after</b>  | -0.63                   | 0.002 | -0.91                     | -0.34       |
|                                   | <b>After</b>  | <b>Before</b> | 0.25                    | 0.18  | -0.17                     | 0.64        |
|                                   |               | <b>During</b> | 0.63                    | 0.002 | 0.34                      | 0.91        |
| Female<br>interested<br>athlete   | <b>Before</b> | <b>During</b> | -0.21                   | 0.001 | -0.32                     | -0.21       |
|                                   |               | <b>After</b>  | -0.08                   | 0.71  | -0.48                     | 0.19        |
|                                   | <b>During</b> | <b>Before</b> | 0.21                    | 0.001 | 0.21                      | 0.32        |
|                                   |               | <b>after</b>  | 0.13                    | 0.52  | -0.44                     | 0.21        |
|                                   | <b>After</b>  | <b>Before</b> | 0.08                    | 0.71  | -0.19                     | 0.48        |
|                                   |               | <b>During</b> | -0.13                   | 0.52  | -0.21                     | 0.44        |
| Female<br>uninterested<br>athlete | <b>Before</b> | <b>During</b> | 0.33                    | 0.08  | -1.12                     | 0.64        |
|                                   |               | <b>After</b>  | -0.31                   | 0.12  | -0.16                     | 0.73        |
|                                   | <b>During</b> | <b>Before</b> | -0.33                   | 0.08  | -0.64                     | 1.12        |
|                                   |               | <b>after</b>  | -0.65                   | 0.003 | -0.79                     | -0.33       |
|                                   | <b>After</b>  | <b>Before</b> | 0.31                    | 0.12  | -0.73                     | 0.16        |
|                                   |               | <b>During</b> | 0.65                    | 0.003 | 0.33                      | 0.79        |

According to the Table 5, the results of repeated measures test were used to examine the difference between the beta waves activity in a male interested athlete group showed no significant difference between the mean values of beta waves, before, during, and after viewing advertisement ( $p=0.042$ ). The results of the LSD test,

follow-up test also show that in a male interested athlete group, the mean value of beta waves is higher before and during viewing advertisement than after viewing advertisement. In male uninterested athlete group, there is a significant difference between the mean value of beta waves, before, during, and after viewing advertisement (P=0.002). The results of the LSD, follow-up test also show that in a male uninterested athlete group, the mean value of beta waves is higher after viewing advertisement than during viewing advertisement. In female interested athlete group, there is a significant difference between the mean value of beta waves, before, during, and after viewing advertisement (P= 0.001). The results of the LSD, follow-up test also show that in a female interested athlete group, the mean value of beta waves is higher during viewing advertisement than before viewing advertisement. In female uninterested athlete group, there is a significant difference between the mean value of beta waves, before, during, and after viewing advertisement (P=0.003). The results of the LSD, follow-up test also show that in female uninterested athlete group, the mean value of beta waves is higher after viewing advertisement than during viewing advertisement.

**Table 6.** The results of Repeated Measures analysis in delta wave before, during and after viewing the advertisement

| Groups                            | (I)<br>Factor | (J)<br>Factor | Mean<br>Difference(I-J) | Sig. | 95% Confidence Difference |             |
|-----------------------------------|---------------|---------------|-------------------------|------|---------------------------|-------------|
|                                   |               |               |                         |      | Lower Bound               | Upper Bound |
| Male<br>interested<br>athlete     | <b>Before</b> | <b>During</b> | 3.81                    | 0.09 | -6.41                     | 7.12        |
|                                   |               | <b>After</b>  | 4.13                    | 0.13 | -6.04                     | 12.31       |
|                                   | <b>During</b> | <b>Before</b> | -3.81                   | 0.09 | -7.12                     | 6.41        |
|                                   |               | <b>after</b>  | 1.32                    | 0.31 | -3.14                     | 6.92        |
|                                   | <b>After</b>  | <b>Before</b> | -4.13                   | 0.13 | -12.31                    | 6.04        |
|                                   |               | <b>During</b> | -1.32                   | 0.31 | -6.92                     | 3.14        |
| Male<br>uninterested<br>athlete   | <b>Before</b> | <b>During</b> | -1.01                   | 0.14 | 2.12                      | 7.14        |
|                                   |               | <b>After</b>  | -3.61                   | 0.04 | 0.93                      | 10.17       |
|                                   | <b>During</b> | <b>Before</b> | 1.01                    | 0.14 | -7.14                     | 2.12        |
|                                   |               | <b>after</b>  | -2.42                   | 0.03 | 0.96                      | 4.18        |
|                                   | <b>After</b>  | <b>Before</b> | 3.61                    | 0.04 | -10.17                    | -0.93       |
|                                   |               | <b>During</b> | 2.42                    | 0.03 | -4.18                     | -0.69       |
| Female<br>interested<br>athlete   | <b>Before</b> | <b>During</b> | 3.93                    | 0.67 | -7.74                     | 8.11        |
|                                   |               | <b>After</b>  | 6.15                    | 0.16 | -7.93                     | 2.12        |
|                                   | <b>During</b> | <b>Before</b> | -3.93                   | 0.67 | -8.11                     | 7.74        |
|                                   |               | <b>after</b>  | 2.22                    | 0.12 | -1.14                     | 5.64        |
|                                   | <b>After</b>  | <b>Before</b> | -6.15                   | 0.16 | -2.12                     | 7.93        |
|                                   |               | <b>During</b> | -2.22                   | 0.12 | -5.64                     | 1.14        |
| Female<br>uninterested<br>athlete | <b>Before</b> | <b>During</b> | -2.89                   | 0.11 | -1.94                     | 6.83        |
|                                   |               | <b>After</b>  | -5.21                   | 0.03 | 1.12                      | 9.61        |
|                                   | <b>During</b> | <b>Before</b> | 2.89                    | 0.11 | -6.83                     | 1.94        |
|                                   |               | <b>after</b>  | -2.31                   | 0.04 | 0.74                      | 3.93        |
|                                   | <b>After</b>  | <b>Before</b> | 5.21                    | 0.03 | -9.61                     | -1.12       |
|                                   |               | <b>During</b> | 2.31                    | 0.04 | -3.93                     | -0.74       |

According to the Table 6, the results of repeated measures test were used to examine the difference between the delta waves activity in a male interested athlete group showed, the significance level is 0.006. Considering that significant level is higher than 0.05, we conclude that there is not a significant difference between the mean value of delta waves, before, during, and after viewing advertisement. In male uninterested athlete group the significance level is 0.041. Considering that significant level is less than 0.05,



we conclude that there is a significant difference between the mean value of delta waves, before, during, and after viewing advertisement. The results of the LSD, follow-up test also show that in a male uninterested athlete group, the mean value of delta waves is higher after viewing advertisement than during and before viewing advertisement. In female interested athlete group the significance level is 0.134. Considering that significant level is higher than 0.05, we conclude that there is not any significant difference between the mean value of delta waves, before, during, and after viewing advertisement. In female uninterested athlete group the significance level is 0.039. Considering that significant level is less than 0.05, we conclude that there is a significant difference between the mean value of delta waves, before, during, and after viewing advertisement. The results of the LSD, follow-up test also show that in female uninterested athlete group, the mean value of delta waves is higher after viewing advertisement than during and before viewing advertisement.

**Table 7.** The results of Repeated measures analysis in Theta wave before, during and after viewing the advertisement

| Groups                            | (I)<br>Factor | (J)<br>Factor | Mean<br>Difference(I-J) | Sig   | 95% Confidence Difference |             |
|-----------------------------------|---------------|---------------|-------------------------|-------|---------------------------|-------------|
|                                   |               |               |                         |       | Lower Bound               | Upper Bound |
| Male<br>interested<br>athlete     | <b>Before</b> | <b>During</b> | 3.16                    | 0.002 | 1.02                      | 5.83        |
|                                   |               | <b>After</b>  | 4.87                    | 0.12  | -2.14                     | 9.84        |
|                                   | <b>During</b> | <b>Before</b> | -3.16                   | 0.002 | -5.83                     | -1.02       |
|                                   |               | <b>after</b>  | 1.71                    | 0.31  | -2.93                     | 6.41        |
|                                   | <b>After</b>  | <b>Before</b> | -4.87                   | 0.12  | -9.84                     | 2.14        |
|                                   |               | <b>During</b> | -1.71                   | 0.31  | -6.41                     | 2.93        |
| Male<br>uninterested<br>athlete   | <b>Before</b> | <b>During</b> | 1.08                    | 0.21  | -0.56                     | 2.33        |
|                                   |               | <b>After</b>  | 1.03                    | 0.18  | -0.19                     | 2.12        |
|                                   | <b>During</b> | <b>Before</b> | -1.08                   | 0.21  | -2.33                     | 0.56        |
|                                   |               | <b>after</b>  | 0.04                    | 0.07  | -0.51                     | 3.91        |
|                                   | <b>After</b>  | <b>Before</b> | -1.03                   | 0.18  | -2.12                     | 0.19        |
|                                   |               | <b>During</b> | -0.04                   | 0.07  | -3.91                     | 0.51        |
| Female<br>interested<br>athlete   | <b>Before</b> | <b>During</b> | 1.01                    | 0.34  | -0.57                     | 2.62        |
|                                   |               | <b>After</b>  | 1.15                    | 0.23  | -0.44                     | 2.48        |
|                                   | <b>During</b> | <b>Before</b> | -1.01                   | 0.34  | -2.62                     | 0.57        |
|                                   |               | <b>after</b>  | 0.14                    | 0.48  | -0.64                     | 1.14        |
|                                   | <b>After</b>  | <b>Before</b> | -1.15                   | 0.23  | -2.48                     | 0.44        |
|                                   |               | <b>During</b> | -0.14                   | 0.48  | -1.14                     | 0.64        |
| Female<br>uninterested<br>athlete | <b>Before</b> | <b>During</b> | 2.45                    | 0.07  | -0.41                     | 5.51        |
|                                   |               | <b>After</b>  | 4.52                    | 0.08  | -0.49                     | 8.73        |
|                                   | <b>During</b> | <b>Before</b> | -2.45                   | 0.07  | -5.51                     | 0.41        |
|                                   |               | <b>after</b>  | 2.07                    | 0.14  | -0.65                     | 3.61        |
|                                   | <b>After</b>  | <b>Before</b> | -4.52                   | 0.08  | -8.73                     | 0.49        |
|                                   |               | <b>During</b> | -2.07                   | 0.14  | -3.61                     | 0.65        |

According to the Table 7, the results of repeated measures test were used to examine the difference between the theta waves activity in a male interested athlete group showed, the significance level is 0.034. Considering that significance level is less than 0.05, we conclude that there is a significant difference between the mean value of theta waves, before, during, and after viewing advertisement. The results of the LSD, follow-up test also show that in a male interested athlete group, the mean value of theta waves is higher before viewing advertisement than during viewing advertisement. In male uninterested athlete group the significance level is 0.415. Considering that significant level is more than 0.05, we conclude that there is not

a significant difference between the mean value of theta waves, before, during, and after viewing advertisement. In female interested athlete group the significance level is 0.178. Considering that significant level is more than 0.05, we conclude that there is not a significant difference between the mean value of theta waves, before, during, and after viewing advertisement. In female uninterested athlete group the significance level is 0.083. Considering that significant level is higher than 0.05, we conclude that there is not a significant difference between the mean value of theta waves, before, during, and after viewing advertisement.

## **Discussion and Conclusion**

The purpose of this study was processing and analyzing the electroencephalography signals to evaluate the effect of sport advertisement on athletes. Results of this research showed average alpha frequency activity in male interested athlete and female interested athlete group was higher during viewing advertisement than before viewing advertisement, but there was no significant difference in the male uninterested athlete and female uninterested athlete group. The results of this part of research is parallel with findings of McClure and colleagues (2004), Michael and colleagues (2004) Deppe and colleagues (2005), Michael and colleagues (2006), Patrícia and colleagues (2010) and Ashutosh and colleagues (2017) but is not consistent with Sharma and colleagues (2017). In fact, by these results we can say that brain alpha frequency in a person who is interested is more active unlike a person who is uninterested in a brand during viewing an advertisement. Alpha waves as a bridge, connect the consciousness and the unconscious, while enjoying the surroundings, the dominant wave is alpha. In alpha mode, we reach the creative side of the right hemisphere of the brain, and in this position the brain is in a state of tranquility. Hence, our thoughts, feelings and activities are creative, and the turmoil and distraction are reduced, and more images are saved to memory. Many successful artists and athletes consciously take their place in alpha mode for better performance.

On the other hand, as alpha frequency is usually associated with the individual's creativity and thinking, and also has a positive relationship with the cognitive function and especially the persons memory and indeed, its high performance boosts creativity, attention thinking, and storage of images seen, as well as enjoying and recreation overcoming is with the alpha wave, It is suggested that adverts advertised for people interested in specific brand, should consider the alpha frequency and its activity. So, the advertisement increased the alpha frequency wave activity, and the mind of the viewer is involved and thinking about it. By increasing the activity of the alpha wave, the amount of attention, thinking and keeping in mind also increases and as a result, the impact of advertising also increases. For example, the use of the propaganda method prompts both the user and the consumer to think about buying a product and to know about the opinions of other about the product. This position of the brain can be created by very mild and relaxing tunes, and led to optimal performance, reduction of anxiety, positive thinking and higher education. The reason for the inconsistency with Sharma's research is probably the device used because the eye tracking device like EEG cannot handle this details.

The average beta frequency activity in the male interested athlete group during and after advertising was higher than before the advertisements. In the female athlete group, it was higher than before viewing the advertisements. The activity of this frequency was in the male uninterested athlete group and female uninterested athlete group was higher after viewing advertising than during viewing the advertising. Considering that so far no research has been done on the effect of advertising on the impact of beta frequency in forehead cortex comparison with the pre-investigation is not possible. Beta waves are produced by the cortex, in beta state; our focus is on the activities of the left hemisphere of the brain. Beta waves are produced by the cortex, in beta state, our focus is on the activities of the left hemisphere of the brain. Considering that the beta frequency is associated with higher-level cognitive processes, complex mental actions (discussing, speaking, etc.), complex scientific calculus, analysis and thinking, problem solving, or focused thinking [11]. Therefore increasing its activity during viewing advertising and after

viewing the ads seems to increase the amount of convergent analysis and focused thinking, as well as stimulation, and play a significant role in decision making. In this position, the brain is active and is in a state of normal consciousness. Since the activity of these waves was also activated in the uninterested group of the special brand, it is suggested that the promotional films use this kind of brainstorming effect of songs and pictures of dance. As the video advertising is twice as much as the written ads, It is suggested that advertisements should be made that engage the mind of an individual.

The results of the study showed that Delta frequency activity was not significantly different between male and female athletes who were interested in before, during and after the advert, but the average activity of these waves in the male uninterested athlete group after viewing advertisement was higher than before and during advertisement. The results of this part of the study are consistent with the findings of Depp and colleagues (2005). Findings of Depp and colleagues research showed that, Delta frequency activity is higher in uninterested groups than interested ones during viewing advertisements. In the present study, among male and female athletes of the Nike brand, Delta frequency activity has increased after broadcasting ads. Delta is the slowest brain wave that a person has in a delta state, involuntary, unattractive, has a small amount of arousal; it seems that the activity of this wave in uninterested athletes (male and female) should be more than interested athletes (male and female). As the neglect and stimulation of broadcasting ads (distribution of Nike brand advertising in this research) was higher in uninterested athletes than interested athletes, which increasing this wave activity is foreseen in a group of athletes who are not interested in the Nike brand.

The results of the study also showed that theta frequency activity was not significant in the male uninterested athlete, female interested athlete, and female uninterested athlete before, during and after viewing advertisements. But these waves activity in male interested athlete group was higher before viewing advertisements than during viewing ads. Part of the research results from the viewpoint that theta frequency activity was not significant in the male uninterested athlete, female interested athlete, and female uninterested athlete viewing advertisements, are consistent with the findings of Patrícia and colleagues (2010). The results of research by Patrícia and colleagues showed that there was no significant difference in the activity of theta waves during and after the viewing of advertisements among interested and uninterested and this difference was not significant in the present study as well. Theta's position is mainly caused in the temporal and sore region of the brain and excellent learning, mind reprogramming, creative thinking are of theta wave functions. Since usually theta frequency activity is associated with low anxiety and increasing behavioral attitude as well as active memory; it seems that low activity of this wave in male interested athlete, to Nike's sports ads that are waiting for favorite ads or brand, is lower during viewing ads. Songs and pictures are very slow and usually at a slow pace, it can create this position in the brain.

Considering the importance of advertisement in the sport marketing and developing of the sport management industry, it is suggested to the researchers to use experimental tools such as electroencephalography, eye tracking or a combination of several devices to find principal and affecting waves to provoke the decision of purchasing, and make an increasing development in the economic sector. Results showed that we can understand the effect of sports brand advertisement on the customer's brain waves (alpha, beta, delta, and theta). In addition, by analyzing these signals we can wisely make a conclusion that advertisement increases analysis, concentrated thinking and provocation and it can have a great role in people decision making.

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