MEASUREMENT OF VISUAL EEG SIGNALS STIMULATED BY YELLOW COLOR PHOTONS OF SPECIFIC WAVE LENGTH AT DIFFERENT INTENSITIES

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Abstract:

Electroencephalography (EEG) is a diagnostic tool that records the electrical activity of the brain using numerous electrodes placed on various regions to the scalp, or in special cases on the cortex. The resulting traces are known as an electroencephalogram and represent so-called brainwaves.

There are many types of stimulators (physical, chemical , and mechanical)that are affect the special senses sensitive areas in the brain which are collected as electrical signals. This research is concerned with photo stimulator (yellow color with frequency of ≈ 515 THz that is transmitted by visual nerve and the generated electrical signal waves are recorded by EEG. The sample of the research consists of 18 normal vision volunteers divided equally between males and females. All precautions of wave interference or artifacts that are due to physiological or external electrical source are taken into account and minimized into the ignored level.

The results clearly showed that, the mean relative action potential amplitude recorded from O_2 for males were the same in low and higher intensities ; when intensity was increased than that recorded from O_1, and O_2 channel for females also the same at low intensities then increased with increasing intensity than that recorded from O_1.

The fitting equation of the mean relative action potential amplitude versus the intensity of O_1 and O_2 channels for males are $y = 0.053x^2-3.161x + 47.23$ with $R^2 = 0.969$ and $y = 0.044x^2- 2.619x + 39.19$ with $R^2 = 0.987$, and for females are $y = 0.046x^2 – 2.693x + 39.60$ with $R^2 = 0.894$ and $y = 0.043x^2- 2.483x + 36.59$ with $R^2 = 0.880$ respectively.

To compare the EEG electrical signals that are recorded from O_1 and O_2 channels for males and females, the mean relative action potential amplitudes are higher in males than in females for both channels. The deduced fitting curves for males O_1 channel is $y =0.046x^2 – 2.693x + 39.60$ with $R^2 = 0.894$ and for females, O_1 channel $y =0.043x^2 - 2.483x + 36.59$ with $R^2 = 0.880$ and that for male O_2 channel is $y = 0.044x^2 – 2.619x + 39.19$ with $R^2 = 0.987$ and for female O_2 channel $y = 0.05x^2 – 3.61x + 47.23$ with $R^2 = 0.969$.

Keywords: *Visual, EEG, Photons, Wave length, Brain*

Introduction:

The electroencephalogram (EEG) is an instrument that recording the electrical activity along various regions of the scalp produced by the firing of neurons action potential within the brain (Niedermeyer, 2004). It is a graphic display of the difference in voltages from two sites of brain function recorded over time. EEG can be used to predict abnormal development and aid in the evaluation of nonspecific symptoms such as behavioral disorders, anxiety, or learning disabilities. On the other hand, by the addition of the averaging computer, electrical potential recording has been extended to the whole class of evoked or event related potentials. This improving the clinicians ability to diagnose multiple sclerosis and lesions located in the optic nerve, brain stem, cerebellopontine angle, and spinal cord. Finally EEG can also be used in conjunction with other types of brain imaging (Shamsaei, 2008).

A visual evoked potential (VEP) is an evoked potential caused by a visual stimulus, that are recorded from electrodes that are placed on the back of head and observed as a reading on an electroencephalogram . These responses usually originate from the occipital cortex, the area of the brain involved in receiving and interpreting visual signals (Leslie, 2006; Vaughan,1965and Edmund,2006).

VEP has become routinely used and extremely valuable in both research and clinical evaluation of visual sensory and perceptual processing. The current research focused on EEG signals generated in the visual cortex and recorded by channels connected to O_1 and O_2 since these channels are the most sensitive channels (figure1) for specific photon's wave lengths (yellow color photons of wavelength ≈ 570 nm) at different intensities and to compare the response as EEG signals generated in males and females of the same age groups with normal Visual functions.

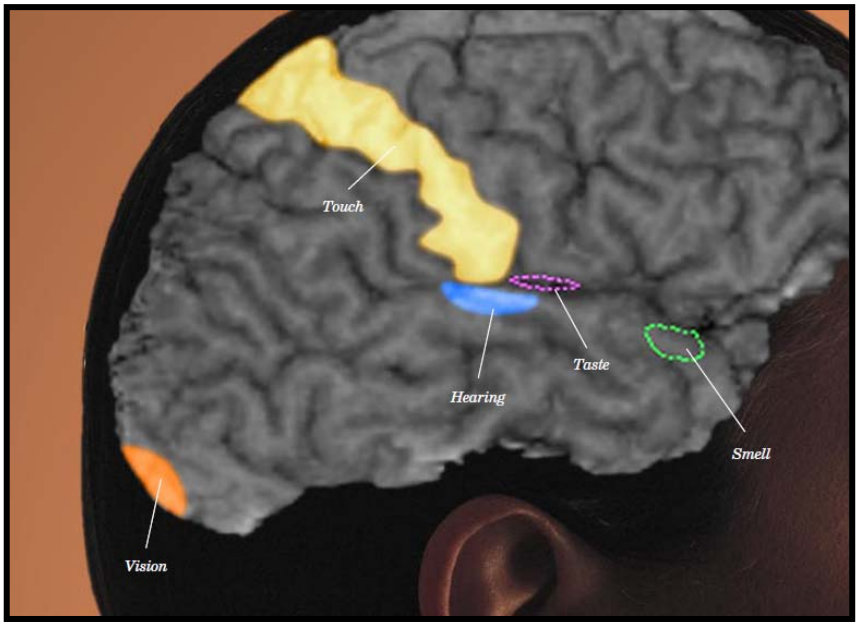

Figure 1: Showing the five senses activate separate areas of the cerebral cortex (Edmund,2006).

Materials and Methods:

1- Equipments and Tools:

EEG system used in the present study was KT88 Digital EEG and Mapping System Automatically recording EEG Unit, with 16 EEG leads and 2 ECG leads with an ability of Automatic measurement of multifunctional flash light of USB port and manual or automatic control. The International Standard Electrode placement (10/20) method was used.

The electrodes pick up the signals from the head surface, amplifiers bring the microvolt into the range where they can be digitalized accurately, and converter changes the signals from analogue to digital readings which are displayed and stored in the computer monitor system.

2- Subjects and Techniques:

Subjects 18 subjects under test were divided into two groups, nine normal males and nine females and with an age range between (25- 28) years.

Each subject was sitting on a comfortable chair; their eyes were opened and looking forward to the screen of the computer. All electrodes were fixed on the scalp through the net work connecting channels from these channels O_1 and O_2 electrodes were selected (Edmund,2006). It is worthwhile to mention that these areas are the most sensitive through which light stimulating parameter (photons of certain intensities and frequencies) are received by retina and transmitted through visual nerve as electrical signal to these symmetrical areas to be recognized. Then a stimulating power spectrum produced through which the mean relative power spectrum can be determined (the ratio of the power spectrum after exposure to that before) at different frequencies (yellow color photons of frequency $\approx$ 515 THz) and at different light intensities (26.1, 32, 33.2, and 36 lux) for subject's in a completely dark room and the eyes are opened as well as the distance between subject eye and computer screen was 2 cm.

Results and Discussion:

The results of the current study showed that the amplitude of artifacts can be quite large relative to the size of amplitude of the cortical signals of interest. This is one of the reasons why it needs a considerable experience to correctly interpret EEGs clinically. Some of the most common types of physiological artifacts include: Eye induced artifacts (includes eye blinks, eye movements and extra-ocular muscle activity), EKG (cardiac) artifacts, EMG (muscle activation)-induced artifacts, and Glossokinetic artifacts ...etc .

The physiological artifacts were controlled by asking the subject under test to stop all the voluntary activities that may generate unwanted

electrical signals that makes distortion to the real signal that we want to deduce. Other generated physiological artifacts may due to external chemical ,physical, and mechanical stimulators that affect specific sense and cause the firing of Electrical signals which interfere with the real electrical signal to be record. These signals can be minimized either by stop the cause or to be sure that there is no external stimuli.

In addition to artifacts generated by the body, many artifacts originate from the environmental. Movement by the subject, or even just settling of the electrodes, poor grounding of the EEG electrodes can cause significant 50 or 60 Hz artifact, depending on the local power system's frequency. A third source of possible interference can be the presence of an IV drip; such devices can cause rhythmic, fast, low-voltage bursts, which may be confused for spikes (Barry,1965 and Iwasaki, 2005).

The mean relative action potential amplitude recorded from O_1 and O_2 for males and females volunteers are showing in tables (1) and (2)and in figures (1) and (2). As the figures indicate, the mean relative amplitudes that are recorded from channel O_1 is different from that recorded from channel O_2 for both males and females. This difference is decreased at intensity 32 lux then increased with increasing the intensity. The fitting equation of the mean relative action potential amplitude versus the intensity of O_1 and O_2 channels for males and female were $y = 0.053x^2-3.161x + 47.23$ with $R^2 = 0.969$ and $y = 0.044x^2- 2.619x + 39.19$ with $R^2 = 0.987$, and $y = 0.046x^2 – 2.693x + 39.60$ with $R^2 = 0.894$ and $y = 0.043x^2- 2.483x + 36.59$ with $R^2 = 0.880$, respectively.

To compare between the EEG electrical signals that are recorded from O1 and O_2 channels for males and females, we found that the mean relative action potential amplitudes are the same at low intensity (26.1 Lux) and higher in male than in females for both channels at other intensities (Figures 3 and 4). The deduced fitting curve for males O_1 channel is $y =0.046x^2 – 2.693x + 39.60$ with $R^2 = 0.894$ and for females, O1 channel is $y =0.043x^2 - 2.483x + 36.59$ with $R^2 = 0.880$ and that for male O_2 channel is $y = 0.044x^2 – 2.619x + 39.19$ with $R^2 = 0.987$ and for female O_2 channel $y = 0.05x^2 – 3.61x + 47.23$ with $R^2 = 0.969$.

It can be concluded from the results of the current study that male's visual area is more sensitive for yellow color than that for females for both channels (O_1 and O_2), and both males and females are more comfortable to yellow color at an intensity of (32 Lux). This means that some intensities is more comfortable than others for same color, specially yellow color since it has been noted in Holy Quran that bright yellow color is impresses the viewers.

Table (1): The mean relative action potential recorded from O_1 and O_2 Channels of male subjects.

	Intensity (Lux)	Mean Relative action potential of O_1 Channel	Mean Relative action potential of O_2Channel
Males	26.1	1.205	1.28
	32	0.935	0.838
	33.2	1.489	1.617
	36	2.658	2.915

Table (2): The mean relative action potential recorded from O_1 and O_2 Channels of female subjects.

	Intensity (Lux)	Mean Relative action potential of O_1 Channel	Mean Relative action potential of O_2Channel
Females	26.1	1.196	1.181
	32	0.95	0.931
	33.2	2.166	2.108

36	**3.165**	**2.995**

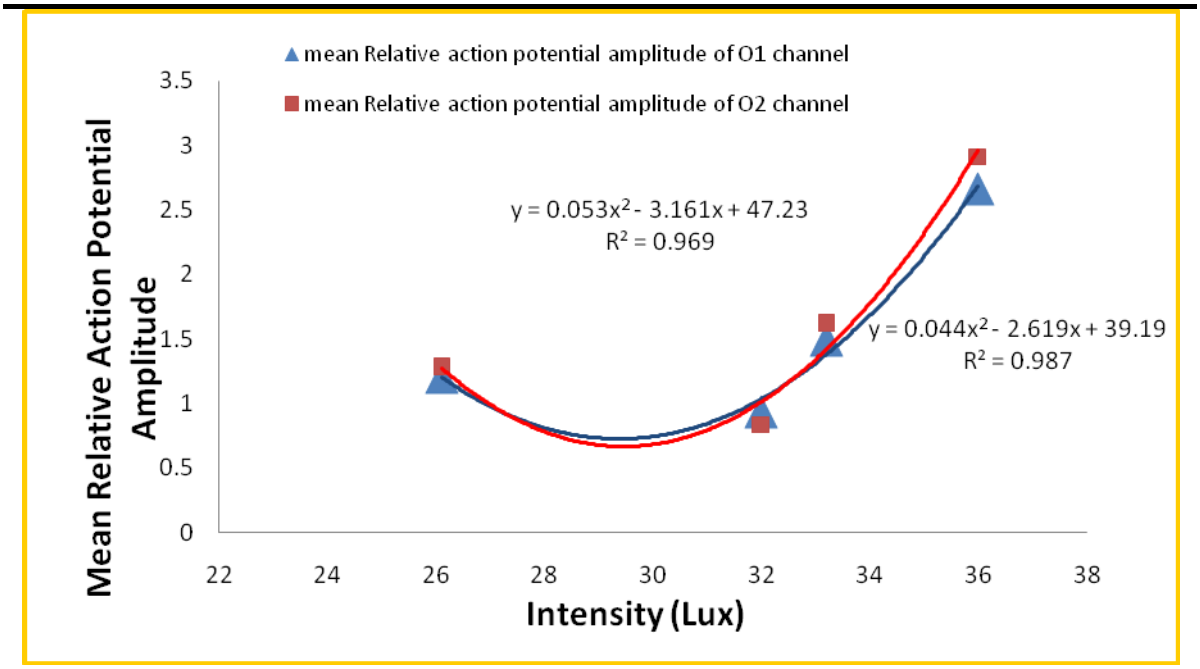

Figure (1): The relation between the intensity of yellow color (Lux) and the mean relative action potential amplitudes for males of O_1 and O_2 channels.

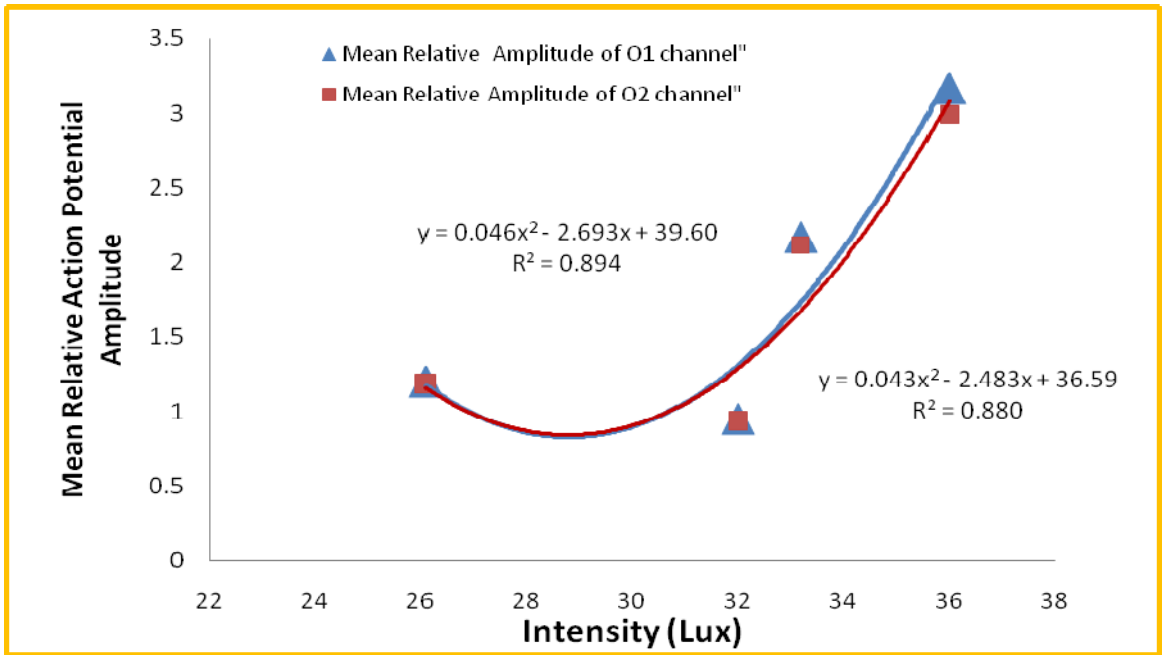

Figure (2): The relation between the intensity of yellow color (Lux) and the mean relative action potential amplitudes for females of O_1 and O_2 channels

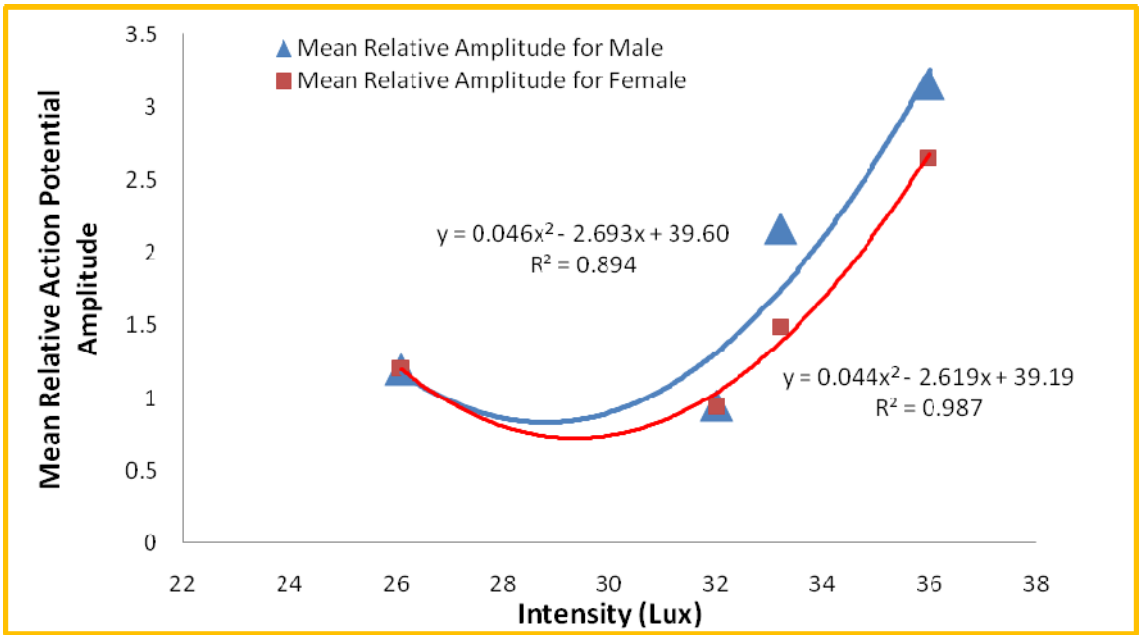

Figure (3): The relation between the intensity of yellow color (Lux) and mean relative action potential amplitudes for males and females of O_1 channel.

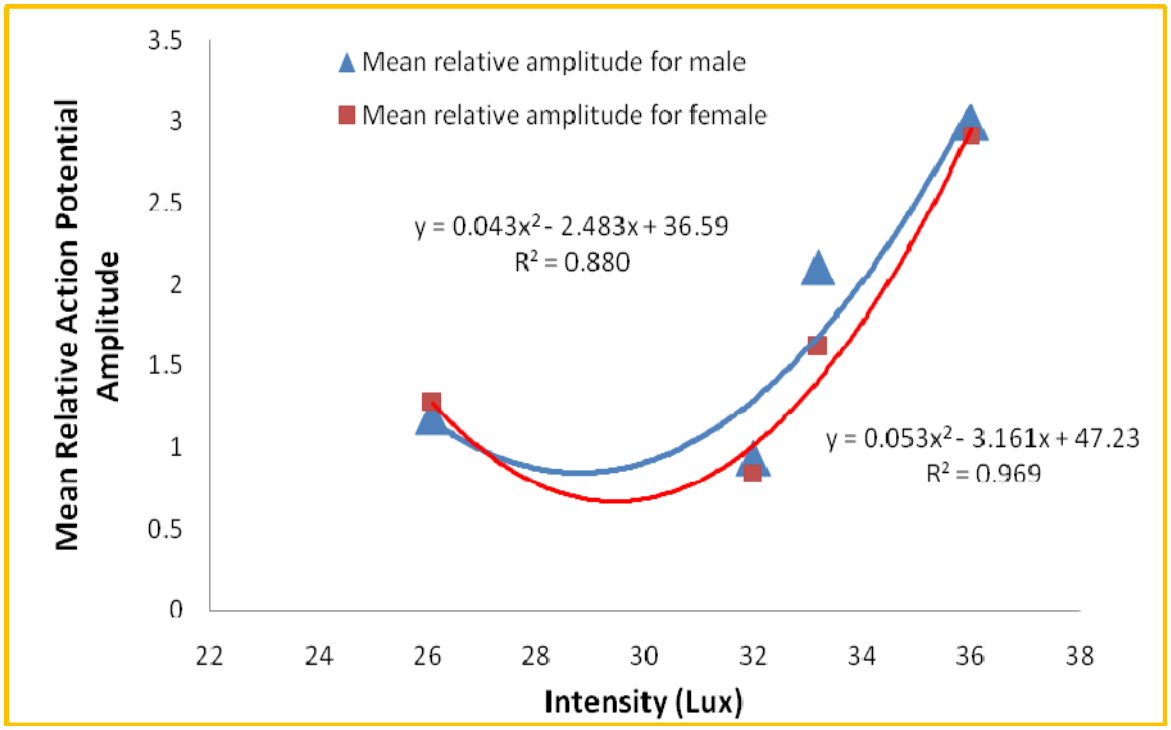

Figure (4): The relation between the intensity of yellow color (Lux) and mean relative action potential amplitudes for males and females of O_2 channel.

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هەلسەنگاندنا نەخشە شەپولێن ئەلکتریکی یێن مەژی ل جهێ هەستیار بو بیناهیێ بکارئینانا دریژیا شەپولێت فوتونا زەر بو چرییێت جودا جودا

پوختە

کارەبا هێلەشیکاریا مەژی جورە پیڤانەکە بو فەسلەجا دەمارا بکارئینانا جەمسەرێت دئێنە گرێدان ل سەر کلوخێ سەری یان ژی هندەك جارا ل سەر پیستێ سەری.

ئەنجامێت هیلەکاریێ ئەوێت ئێنە ناسکرن ب (EEG)یان ژی دبێژنێ شەپولێت مەژی. کارەبا هێلەشیکاریا مەژی دئێتە بکارئینان بو وان نەخوشا ئەوێت نەخوشییێت مەژی هەین کو ئاریشە هەین د ساخلەتێن خو یێن دەرونی وەکی نەشیانا وان بو فێربینێ یان ژی دان و ستاندنەکا نورمال د ناڤ جڤاکیدا دبنە بارگرانیەك ل سەر جڤاکی .

ئەڤ ڤەکولینە یێ هاتیە کرن بو تومارکرنا شەپولێت EEGبو کەنالێت (O_1, O_2) ئەوێت گەلەك هەستیار بو دریژیا جودابیێت شەپولێت فوتونا زەر بو چرییێت جودا جودا وتێنە بەراوردکرن ل گەل شەپولێت EEG بو هەردوو توخمێ نێرو میێا بو گروپێت ژیێ وا نێزیکی ئێك .

سامپلێت دەست نیشانکرن بو ڤێ ڤەکولینێ پێك دێن ژنەهـ نێر و وەکی وان مێ ئەوێت خو بەخش ژیێ وان دناڤبەرا ٢٥–٢٠ سال هاتنە دەست نیشانکرن بو تاقیکرن سەر بێتە کرن .

دئەنجامدا کارتێکرنا ماتە ووزێ ئەوا هاتیە تومارکرن ژ کەنالێ O_2 , بو توخمێ نێر وەك ئێکە د چرییێن نزم دا ودئێتە زیدەکرن دگەل زێدەکرنا چرییێ ژ کەنالێ O_1 و هەر وەسا بو بو توخمێ مێ.

بەراورد کرن د ناڤبەرا نێر و مێ دا خویا کر کو توخمێ نێر گەلەك هەستیارترن بو رەنگێ زەر ژ توخمێ مێ بو هەمی تاقیکرنێ روناهییێ د هەردوو کەنالا دا .

تقييم تخطيط الاشارات الدماغية في منطقة الرؤيا المحفزة باستخدام فوتونات اللون الاصفر معين الطول الموجي وبكثافات مختلفة

الملخص:

يعتبر تخطيط الدماغ كهربائياً مقياساً لتغير النشاط الكهربائي الفسلجي العصبي المستثار طبيعياً (ارادي او لا ارادي) او متاثراً بمحفز خارجي والمسجل على شكل موجات كهربائية باستخدام اقطاب معدنية تربط على فروة الرأس أو في حالات خاصة على اللحاء وهذه الموجات تختلف ترددتها باختلاف قوة المحفز ونوعيته فيزيائياً كان , كيميائياً , أو ميكانيكي والتي تظهر الاستجابة لها في المناطق ذات العلاقة بالتحسس على شكل فرق جهد كهربائي.

هذا البحث يهتم بالمحفز الفيزيائي الضوئي للون الاصفر احادي التردد (515 THz ≈)وتسجيل مدى الاستجابة له من قبل المستلم في الشبكية ونقله عبر العصب البصري ومن ثم الاستجابة من قبل منطقة الرؤيا في الدماغ التي تسجل بواسطة (EEG).

عينة البحث مكونة من (١٨) متبرع سليمي حاسة الرؤيا مقسمين الى تسع ذكور وتسعة اناث وأعمارهم تتراوح بين ٢٠-٢٥ سنة , كل احتمالات تداخل الموجات الكهربائية المتداخلة مع الاستجابة للمؤثر سواءً كانت تداخلات فسلجية ارادية او لا ارادية أو بتأثير اشارات كهربائية في المحيط الخارجي او المنظومة الكهربائية للفحص قد اخذت الاحتياطات لحذفها او لإيصالها لمستويات الاهمال.

اوضحت النتائج بان معدل الازاحة لفرق الجهد الكهربائي النسيي الفاعل لقنوات تسجيل محفز الرؤيا (لفوتونات اللون الاصفر) المسجلة في القناة (O_2) لمجموعتي الذكور والإناث متساوية عندما تكون الشدة قليلة ومن ثم تزداد مع ازدياد الكثافة الضوئية للفوتونات مما هو مسجل في القناة (O_1) وان معادلة العلاقة بين المعدل النسيي لإزاحة فرق الجهد (Y) مقابل الكثافة الضوئية (x) للقناتين اعلاه للذكور وعلى التوالي هي $y = 0.053x^2-3.161x + 47.23$ مع $R^2 = 0.969$ و $y = 0.044x^2- 2.619x + 39.19$ مع $R^2 = 0.987$ وللاناث هي $y = 0.046x^2 - 2.693x + 39.60$ مع $R^2 = 0.894$ و $y = 0.043x^2- 2.483x + 36.59$ مع $R^2 = 0.880$.

وللمقارنة بين الاشارات الكهربائية المسجلة من القنوات (O_1 & O_2) الذكور والإناث فقد وجدنا بان المعدل النسيي للإزاحة لفرق الجهد الفاعل ولكلا القناتين هو اعلى في الذكور منه في الاناث ولكافة الكثافات الضوئية للون الاصفر المستعمل في البحث وهذا يدل بوضوح بان مناطق الرؤيا عند الذكور هي اكثر تحسساً لهذا اللون من الفوتونات مما هو في الإناث. معادلات العلاقات النموذجية للذكور ولكلا القناتين على التوالي كانت $y =0.046x^2 – 2.693x + 39.60$ مع $R^2 = 0.894$, $y = 0.044x^2 – 2.619x + 39.19$ مع $R^2 = 0.880$, بالنسبة للإناث وعلى التوالي هي $y =0.043x^2 - 2.483x + 36.59$ مع $R^2 = 0.880$, $y = 0.05x^2 – 3.61x + 47.23$ مع $R^2 = 0.969$.