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The effect of light stimulation technology training on brain signals, motor response time, and jump shot accuracy among young basketball players

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ABSTRACT

The purpose of this study was to develop exercises utilizing optical stimulation technology (ST) and determine their impact on some brain signals (EEG), the time of motor responses, and the precision of jumping shots among young basketball players (YBP). By creating one experimental group with a sample of twelve players from the participating clubs in Baghdad, the experimental approach was used. They were chosen at random from their home community with a percentage of 16.6% for the 2020–2021 athletic season. The researcher used lights with a thickness of 0.5 cm that are powered by daytime LED technologies. They run on electricity, and the remote controls them from a distance. They were distributed in the basketball scoring area on the board at specific times. The wires were safely connected, and they did not obstruct the balls path in any way. They were put in place on the field to speed up response times. As a result, the exercises used vision to stimulate the brain. These exercises were performed to their maximum potential using high-intensity interval training, which was carried out for eight weeks in a row, averaging three units per training week, and whose intensity ranged between 85% to 95% of the motor response time (MRT). In conclusion, light ST exercises have a positive role in improving the level of low, medium, and high brain (beta) frequencies, which helps to activate brain work in the motor side of YBP and helps them to improve MRT and the accuracy of shooting from the perimeter.

KEYWORDS

Optical excitation technology; Brain signals (EEG); Basketball

1. INTRODUCTION

Given that the players innate readiness to play is a factor in determining the speed of muscle fibers, scientific evidence suggests that speed training is nervous system training. Thus, working with this type of training requires a good investment in sports technology in the field of light to stimulate young players according to the kinetic pathways to achieve more than one purpose in one action. This calls for attention to harmonize between nerve chemistry and muscle physiology to obtain rapid contractions that achieve the required reaction, and that the recipient of the basketball in the offensive area needs a quick reaction that enables player to conjure up to achieve accuracy by scoring. Since the physiology of sports training does not disregard the players' investment in visual perception by activating their neuromuscular systems through visual stimulation during the training process in order to support the training environment in a way that helps reduce mental distractions that prevent the achievement of accurate corrections.

The human brain needs sensory inputs that make its cognitive functions more active, which leads to instructions for physical movements that sometimes struggle with pharmacological exhaustion, according to their intensity, the signals that improve brain function are divided into three categories by the following: Subthreshold signals are those whose frequency is below the lower amount and cannot, therefore, cause oscillation or a subsequent response, unless they are combined by both time and location.

The second type is the subthreshold signals those whose intensity has attained the lower threshold or minimal level frequency and prompts reactivity and reply late and signals above the lower threshold These signals have a strength greater than the lower threshold and are incapable of causing excitation when there is already excitation in the nervous tissue (Mohammed, 2002).

Also, Complex chemical processes and straightforward electrical charges occur when the body responds to outside stimuli. These reactions are swiftly transmitted in the nerve fibers (axons), accompanied by some other nerve signal, which is then arbitrated by another alert, and so forth. Several millions of such electrical nerve signals are sent from and to the brain, muscles, and glands every second during the conscious as well as unconscious lives of men (Wilmore et al., 2004). In addition, without looking at mechanistic or controlled processing, information processing cannot be discussed. In automated processing, a variety of nerves that light up in response to particular stimuli are employed. A portion of the subject does not require this activity to be dynamically controlled. It is the outcome of sound education.

The stimulus is either sent directly to the appropriate response areas in the brain without extensive processing, or it is organized as a scheme (Al-Fadhli and Al-Bayati, 2010). Thus, non-harmful light of the visual threshold and techniques of daylight hours can be invested in stimulating the brain by influencing the sense of sight to obtain the desired reaction or controlling the reaction and directing it in a targeted direction that serves the specialized game. It is possible to stimulate brain waves, particularly (beta) waves, which include the simultaneous higher frequencies that affect visual sensations and are divided into three types: low (beta) waves (12-15 Hz), medium (beta) waves (15-22 Hz), and high (beta) waves (22-39 Hz). When stimulating the muscle fibers that receive orders from the brain, the single muscle fiber is subject to the all or none principle. The cell movement effort does not appear unless the nerve impulse is able to change the permeability of the motor end plate, resulting in an end plate effort less than the excitation threshold level.

This means that if a stimulus is applied to a single muscle fiber, it will either be affected completely or not at all., (Hassan, 2005). The filaments react to form actomycin when calcium and ATP are present in sufficient amounts, and they also shorten by sliding over one another. The calcium pump releases calcium from the sarcoplasmic reticulum into the sarcoplasm, which then acts to activate and contract the sarcolemma. The electrical excitation is effectively passed along and below the sarcolemma. The arrival of the nerve stimulus to the muscle membrane through the plate of the motor end causes the capillaries to first become excited (the motor unit)., (Ira and Judy ,2008). Also, the ability of the athlete increases as a result of the change in training and its intensity works to stimulate all or most of the fibers in a single muscle. By increasing the number of nerve stimuli, the number of muscle fibers involved in muscle contraction will increase, and accordingly the muscle output will increase when performing rapid and long-term movements (Mohammed, 1997).

The variation in the speed of fiber contraction is due to the different ways in which they catabolize the adenosine triphosphate molecule located in the myosin heavy chain, in order to derive the energy needed for contraction (Lewandowski, 2000). The greatest sufficiency, however, can be achieved when the muscle contracts at a moderate speed; otherwise, or in the absence of a motor output, a significant amount of maintenance heat will be lost during the contraction process, even though no work is done or very little work is done, and so it decreases. Contrarily, a significant amount of energy is expended during a rapid contraction in order to overcome the viscosity of the muscle and the force that restrains it. This reduces the sufficiency of muscle contraction, and the highest effectiveness is attained when the contraction speed reaches 30%, as mentioned., (Al, 2022). Therefore, brain activation will increase the necessary perceptions of the neural impulses issued, especially in the player's perception and visual, and will help prepare his mind to accept or mobilize

the information, store it, and retrieve it in a way that enables or helps the required response to appear. This activation depends on the type and strength of the stimulus or sedative that the player receives. This activation can happen whether it is forced or at the player's own will, but it is impossible to forcibly engage the brain and get the intended results. (Nazar, 2010). It is worth noting that the basketball court is full of influences that may cause mental dispersion to the players, or most of the time as a result of continuous rapid play, as the player experiences a state of psychological or physical imbalance as a result of mental distraction, which is caused by factors in the external environment (Hussein et al., 2023). Also the primary cause of distraction is continuous work and not providing the body and mind with enough rest or calm. As a result, the nervous energy gradually runs out, causing generalized physical fatigue, distraction, and mental stress. The person may also lose interest in continuing his work as a result (Meijman, 2000).

The issue does not go away with mental disarray only insofar as it relates to confusion in the nervous instructions or the neuromuscular control required for accuracy in the fast-paced situations to which the player responds by accurately receiving the ball and directing it to the necessary or appropriate point to achieve accurate shooting, and it is impossible to ignore these chemical processes whose beginning is determined by the stimulating electrical neurons. Release of the (ATP_{ase}) enzyme in the motor unit, changes in the polarity of the sarcolemma membrane, and variations in its electrical conductivity due to the affinity of protein molecules for one another in the muscle fiber. Since the active ATP_{ase} location across the bridge dissociates (ATP) into (ADP) and the phosphorus ion, and they provide the energy necessary to return myosin to its active form (cokeda ^{TM}) in the normal state, and the need for energy stimulates it for a power chain, The ADP and phosphorus ion remain attached to the myosin heads during the subsequent contraction across the bridge while myosin is in the activated state. The process of repeatedly separating and activating the myosin for the sliding filaments in this way requires electrical signals from the brain and continues as long as calcium is present (in its concentration from the increase of 10 M). At this point, the heads of myosin can bind to the other actin unit furthest along the thin filament. When tropomyosin is once again blocked by ATPase and ATP in the sarcoplasm, the muscle fiber relaxes as calcium is transferred back to the sarcoplasmic reticulums calcium pump (Al-Ali and Hussein, 2013). In addition, increasing arousal improves performance, but to a certain extent, where increasing it significantly has a negative effect (Mahjoub, 2001).

Likewise, the repetition must always be while the nervous system is in a state of required excitement (Al-Din, 2000). According to the academic researcher who specializes in the physiology of sports training, the majority of players in the Iraqi basketball league need to increase their level of

ball receiving speed and shooting accuracy, so this phenomenon constitutes the research problem. The purpose of the study is to develop exercises utilizing optical ST and determine their impact on certain brain signals (EEG), the speed of motor responses, and the accuracy of jumping shots among YBP. Additionally, the research samples jumping-related shooting accuracy and MRT (Taresh & Alwan, 2022).

2. METHODS

If the experiment involved one independent variable and one dependent variable, multiple independent variables, or multiple dependent variables, the researcher used the experimental research methodology, which is defined as the strategy in which we classify and control an independent variable to see its effect on a dependent variable, while observing and interpreting the resulting changes (Al-Mahdi, 2019). According to the current study's hypothesis, its independent variable, and the logic of the methodological steps order, the study selects an exploratory approach with an experimental group that was governed by pre- and post-tests.

2.1. Sample

The research community is represented by the players of the Baghdad Governorates youth basketball league for the sports season 2020/2021, represented by each of the clubs participating in this league, which are: Electrical Industries, Housing, Sulaikh, Air Force, and Civil Defense. Of the 72 players distributed among these clubs, the research sample was randomly selected from Sulaikh Club, which numbered 12 players, with a rate of 16.667% from this community.

2.2. Instruments and procedures

To create a positive and successful learning environment, the trainer must understand that technology is a helpful tool for him, not a replacement, and that it is complimentary to the educational media and learning resources he/she creates (Obeid, 2010). The researcher used lights with a 0.5 cm thickness that operate with daytime LED technologies. They are electrically powered and the remote is used to control them from a distance. They are allocated to locations inside the basketball scoring area on the scoreboard. The wires are connected securely and do not obstruct the balls path.

They are also placed on the field to increase reaction times, and as a result, the exercises involve the use of sight to stimulate the brain. They are extreme exercises that were in the manner of high-intensity interval training, the intensity of which ranged between 85-95% of the time of motor response speed, and for a period of 8 consecutive weeks, at a rate of 3 units per one training week, and the researcher used EEG devices to measure some of the brain signals (EEG). Electroencephalography: It is a non-invasive method of recording the electrical activity of the brain along the scalp in hertz (penetrating electrodes are used in special applications). A typical clinical EEG recording usually takes 20-30 minutes, plus preparation time, and it usually includes recording through electrodes on the scalp, as all the low (beta) waves, medium (beta) waves, and high (beta) waves were measured as shown in Figure 1. The Nelson test was used for the motor response in the unit of measurement of the second, and the accuracy of aiming from jumping was tested for fifteen attempts, with the maximum score for the test being 30 degrees, as shown in Figure 2.

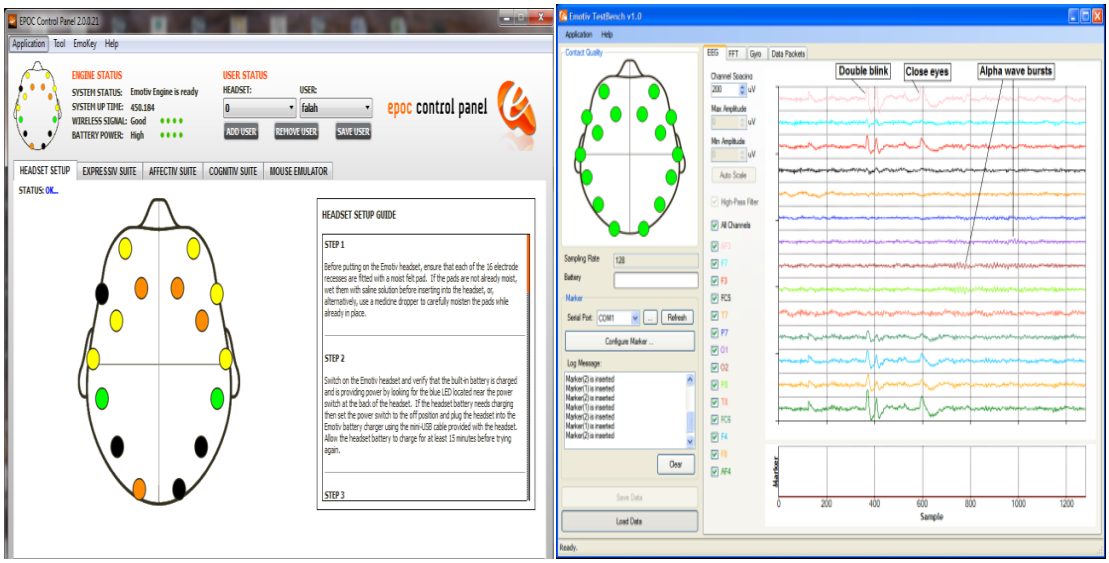

Figure 1. Image of the EEG signal analysis interface

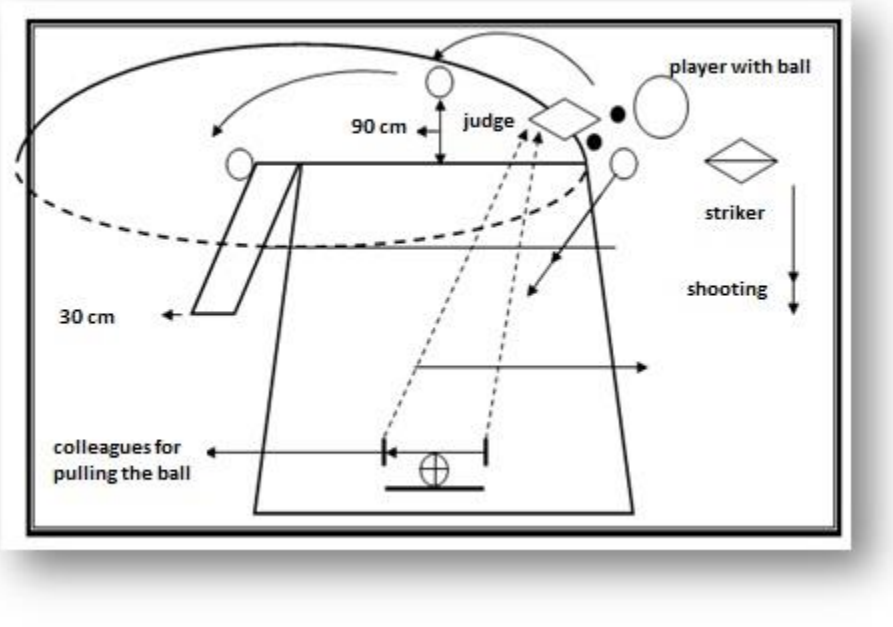

Figure 2. The Jumping Shooting Accuracy Test

2.3. Statistical analyses

After pre-testing the research sample, the exercises were completed within the allotted time. For each variable under investigation, pre-tests and post-tests were conducted, and data for the pre- and post-tests were gathered and processed by the SPSS system to derive each percentage value, the arithmetic mean, the standard deviation, and T-tests.

3. RESULTS AND DISCUSSION

The results of this research are presented in two tables. Table 1 presents the results of the pre-tests, while Table 2 shows the results of the pre-tests and the post-tests. Also, in this section the results presented in these two tables are discussed.

Table 1. Results of the pre-tests

Tests	Unit	Sample	Mean	SD	p
Low beta waves	Hertz	12	11.83	0.835	0.322
Medium (beta) waves	Hertz	12	16.08	1.24	0.229
High beta waves	Hertz	12	22.42	1.782	0.622
Response time	Hertz	12	4.31	0.181	0.392
Jump shot accuracy	Hertz	12	16.75	2.417	0.115

Table 2. Results of the pre and post tests

Tests	Pre-test		Post-test		Mean Differences	Deviation of Differences	t	p
	Mean	SD	Mean	SD				
Low beta waves	11.83	0.835	14.58	0.669	2.75	0.866	11	0.000
Medium (beta) waves	16.08	1.24	20.58	1.24	4.5	2.236	6.971	0.000
High beta waves	22.42	1.782	35.67	0.985	13.25	2.137	21.475	0.000
Response time	4.31	0.181	3	0.122	1.304	0.212	21.295	0.000
Jump shot accuracy	16.75	2.417	27.58	0.669	10.833	2.368	15.85	0.000

The research samples levels of low, medium, and high brain (beta) frequencies, which aid in stimulating motor memory, have improved, according to the results of Table 2, and the researcher credits this to the use of exercises utilizing light ST and the effectiveness of nerve impulses that increased the efficiency of neuromuscular work. This is supported by the findings of the shortcoming in MRT, which is dependent on the effectiveness of the receptors on the one hand, i.e., the sense of sight and the speed of instructions, and this improvement played a role in enhancing the spatial accuracy through the improvement in the table of the findings of the accuracy of aiming from jumping under the pressure of escalating the motor response speed. The researcher was careful to control the appropriate timing, type, level, and color of the lighting without exaggerating in order to enable the young players to control the stuttering. The lighting was not distracting from performance and did not exceed visual acuity. This was due to the correct and appropriate organization of the game and skill specifically on the one hand and for the young players on the other. This is what aided in the emergence of these results, which were consistent with one another and presented a logical fact in this field, as when the image of the objects that we look at is focused on these cells that alert them, it results in electrical currents that pass through threads of nerves to the back of the eye, and here They all gather together to form the optic nerve that carries the waves to the brain and protects the eye from exposure to a lot of harm. It is concealed within the orbit, a large cave. Additionally, a hypothalamus, which resembles pillows, rests on the eyeball, shielding it from the danger of painful head shocks. Regarding its exposed surface, it has an appropriate, movable cover that is simple to move—the eyelid. Their exposed surface is washed by a saline fluid, which then drains into the nose via the tear ducts. We refer to those as liquid tears because they spill over the lower eyelids edge as

their secretion grows. The muscles in his eyes allow the eye to rotate within its socket only slightly (Goldberger & Gerney, 1986). It also helps aids in expanding the players' perceptions and horizons by transcending the boundaries of time and space, and moving their senses, minds and thinking to environments other than their local environment (Fattouh and Sharkasi, 1997).

Additionally, sight plays a crucial role in teaching and practicing gymnastics skills because it is the eye that receives energy and transforms it into physiological and nervous manifestations, which in turn help develop motor skills and a proper understanding of the order in which skillful performance should be performed (Basir, 2004).

Furthermore, the player can continue to perform well in the event of mental fatigue by using the process of cognitive activation, compensatory effort, and changing the rules of performance, through the use of information repeatedly and renewed at the same time, in addition to that, the use of knowledge rules that require less mental effort (Hassan, 2006). Similar to this, when levels of fatigue are low, the person will sustain the level of performance, and at this level, he is both engaged and active to stimulate an increase in the level of performance, as well as not experiencing any fatigue. When fatigue levels are high, performance levels begin to decline (Saed, 2005).

Accordingly, because it guides consciousness toward the pertinent stimuli so that they are within the grasp of the senses, attention is directly tied to thinking and observation (Alwan, 2022). which is the partnership between the environment and the player (Ratib, 2000). Moreover, repetition aids in ignoring outside stimuli while performing the activity, strengthening the relationship between the brain and the muscles. This succession of exercises helps to subject the body to change, resulting in an increase in strength and athletic ability. (Brenda and Lee, 2007). The ability to perform with minimal physical exertion represents the body's vital systems' capacity, as well as the development and change that occurred from the players training through tests, as it is a useful and crucial factor to know the athletes physical and functional ability in physical performance (Amin, 1999).

4. CONCLUSIONS

YBP levels of low, medium, and high brain (beta) frequencies are positively impacted by the light ST exercises, which help to activate brain activity in the motor side of the brain. Also, training with light stimulus technology aids in addressing YBP slow MRTs. The use of light excitation technology was also effective to improve jump shot accuracy in YBP. Therefore, light stimulation technology training is beneficial for brain signals, motor response time, and jump shot accuracy in young basketball players.

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All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

CONFLICTS OF INTEREST

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