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Anxiety Controlling Application using EEG Neurofeedback System

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Abstract

INTRODUCTION: This study aims to investigate the correlation between the oscillations of electroencephalography (EEG) bands and the level of anxiety in a sample of sixteen youth athletes aged 17–21. The research utilizes a mobile EEG system to collect data on EEG band oscillations.
OBJECTIVES: The aim of this research study is to investigate the brain wave oscillations during relaxation, specifically comparing the contrast between eyes open and eyes closed state Electroencephalography (EEG) using a state-of-the-art wireless EEG headset system.
METHODS: The system incorporates dry, non-interacting EEG sensor electrodes, developed exclusively by NeuroSky. In addition, the addition of the ThinkGear module and MindCap XL skull facilitated EEG recording. The aim of the present study was to investigate the effect of eyes open and eyes closed conditions on alpha-band activity in the prefrontal cortex The results showed a statistically significant difference ($p \leq 0.006$); appeared between these two states. The present study examined the relationship between the alpha band of the prefrontal cortex and anxiety levels. Specifically, we examined the relationship between these variables in the eyes-closed condition.
RESULTS: Our analysis revealed a statistically significant correlation, with the alpha band showing a negative slope ($p \leq 0.029$). The present study examines the comparison of data obtained from single-channel wireless devices with data obtained from conventional laboratories The findings of this study show a striking similarity between the results obtained with both types of devices. The aim of the present study was to investigate the specific characteristics of the correlation between electroencephalographic (EEG) alphaband oscillations in the prefrontal cortex in relation to eye position and anxiety levels in young athletes.
CONCLUSION: This study seeks to shed light on the possible relationship between this vibration and individuals' internal cognitive and affective states.

Keywords: EEG, Brain, BCI

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1. Introduction

Advances in neurofeedback technology in the 20th century have proven effective in monitoring physiological characteristics such as heart rate, heart rate, and brain electrical activity [1] Brain -computer interface technology (BCI) technology, particularly neurofeedback, has made great strides in recent years. These technologies include various applications such as prosthetics and control systems, which show promise in medical research [2]

These developments have the potential to enhance the understanding and treatment of rheumatoid arthritis. Moreover, BCI technology has the potential to establish direct communication in altered states of consciousness [3]. This research article examines the ability to train brain wave activity to facilitate access to altered states of consciousness. Altered states of consciousness refer to states of consciousness that are quite different from typical waking states, such as stress, hypnosis, or psychedelic experiences.

The aim of the present study was to investigate the effect of a stimulus on the state of alertness or breathing. Previous research has shown that this type of stimulation has the potential to produce changes in an individual's level of alertness or comfort [4]. Therefore, the aim of this study is to further explore and validate these findings to contribute to existing knowledge in this area. Furthermore, the use of neurofeedback has proven to be highly effective in training individuals with cerebral palsy and paralysis and who rely on brain-computer interface (BCI) systems [5]. Investigating the specific characteristics of EEG tracks that determine relationships between neurofeedback parameters has received considerable attention in the field. The relationship between anxiety and behavior: A comprehensive review Abstract: Anxiety is a common mental illness that affects individuals of various ages and populations characterized by excessive anxiety. Anxiety, a complex emotional state of excitement and feelings of relaxation, arises in response to specific stimuli, which may be psychologically or environmentally induced [6] Anxiety is a psychological phenomenon that is difficulty that arises in response to something perceived as dangerous or frightening. Rahat, I.S. et al. (2023) Investigates deep learning [7] applications in brain MR imaging for glioma analysis, advancing precision medicine through enhanced tumor understanding.

This study examines various manifestations of anxiety, including negative thoughts, excessive worry, restlessness, fear, and hypersensitivity Individuals who exhibit high levels of anxiety tend to exhibit high levels of trait anxiety revealed [8]. Furthermore, these individuals were also found to have high levels of national anxiety in the evaluative condition. The psychosomatic challenge of anxiety has been extensively studied in psychology. It is usually characterized by an increased heart rate, sweating, tremors and other physical symptoms [9].

Researchers have examined a variety of factors. In the present study, an interdisciplinary systematic approach was used to examine the phenomenon of anxiety, with a particular focus on its emergence and reinforcement [10].

This is the main and important point The article provides an overview of existing research studies investigating the relationship between anxiety and changes in brain function [11].

The aim of this review is to summarize the findings of various studies and to highlight the importance of examining this relationship. Analysis of these studies reveals a strong interest in understanding the neural basis of anxiety and possible changes in the brain [12] and how it is influenced by levels of extraversion and neuroticism. The researchers were particularly interested in understanding the interplay between excitation and inhibition in cortical and subcortical brain structures. The findings of this study were documented and are now available [13].

Examination of this hypothesis in this study showed that qEEG data obtained from a single-channel wireless EEG system remained consistent and exhibited correlation with mood underlying physiological findings in young athletes. EEG) oscillations should be examined for possible presence and the possible relationship between anxiety levels should be investigated further [24-26].

2. Methodology

2.1. Participants

The aim of the present study was to analyze electroencephalography (EEG) recordings of a sample of sixteen young athletes, aged 17 to 21 years (M = 18.29, SD = 1.21) Current findings NeuroSky Think Gear (USA) single-channel wireless EEG for recording electrical activity at Fp1 and Fp2 locations -Obtained using the system The present study includes the use of a scalp ring device called "MindCap XL" manufactured by Titan Commerce, Germany use These devices are commonly used in neurobio-management, especially in sports studies and various other applications (see Figure 1).

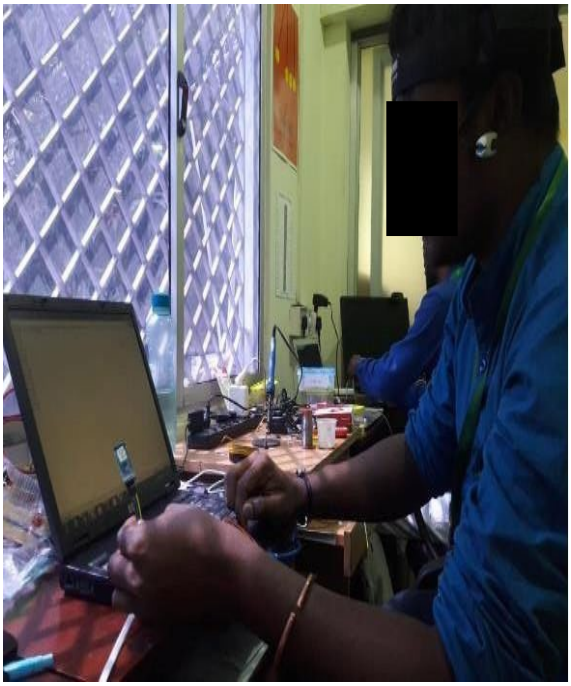

Figure 1. MindCap XL and ThinkGear module.

Integrated with NeuroSky ThinkGear technology, the MindCap XL is a well-designed headset with a unique side and face mounting system, which facilitates seamless integration of sensors and Bluetooth radios in this review, the the ear electrode in the left ear served as the neutral site. The present study introduces a novel device designed to facilitate the collection and transmission of electroencephalography (EEG) data.

This new device uses Bluetooth technology to establish a wireless connection between the device and the researcher's computer, allowing for easy data transfer [17] Due to the fact that it is common practice to electrode will be used in the Fp1-Fp2 areas of the prefrontal cortex for the inspiration The prefrontal cortex is closely associated with behaviour and aspects of personality traits.

A recent study used the NeuroSky single-channel EEG device to accurately measure overall mental concentration in football players It is widely accepted that this device is effective in capturing electroencephalography (EEG) signals, and providing insight if it is valuable in terms of cognitive behaviour [18] in particular the study presented findings that cognitive measures still had no effect on eye blinking, which is a normal physiological response.

This finding drives the development and validation of an anxiety screening tool: a comprehensive review. Abstract: Researchers used the Sports Competitive Anxiety Test (SCAT) to assess the level of competitive anxiety experienced by athletes, and this article provides a comprehensive review of its development and validation. The Self-Report for Childhood Anxiety Traits (SCAT) is a widely used instrument in psychology to assess the level of anxiety in individuals [19] Developed by researchers; the SCAT is a comprehensive 15-item questionnaire aimed at capturing individual aspects of experienced anxiety were developed. The primary goal of the SCAT is to provide reliable and valid measures of anxiety traits in children and adults. The SCAT has been used extensively in both research and practice, and the validity of the test is supported by empirical studies showing significant relationships between test scores and a range of general concerns it is consistent with it [20].

Data collection is an important step in any research study because it provides the foundation. The present study examines the potentials recorded in the prefrontal cortex by a novel method involving the use of two dry electrodes placed in the frontal-polar area (Fp1-Fp2) according to the International 10-20 electrode pattern transfer about shows him up. Wireless systems are used [21, 22].

The aim of this study was to investigate the feasibility and effectiveness of this method for measuring prefrontal cortex potentials. The use of dry electrodes and the NeuroSky Thinkgear system provides a sensitive and noninvasive method for recording brain activity in this particular brain region [23].

The results of this study will contribute to our understanding of the prefrontal cortex and its potential applications in various fields, such as neuroscience and cognitive psychology [24] The factors considered in this study represent a breakthrough which is technologically remarkable To date, no other EEG sensor has developed with this non-contact material [25]. In addition, slow electroencephalography (EEG) signals were effectively amplified by 8000x to improve visual acuity [26].

The sampling rate of the EEG signals was set to 512 Hz, ensuring high quality and accuracy of data representation [27]. In this study, a standard fast Fourier transform (FFT) was performed on the filtered signal [28,29]. In addition, the frequency domain of the signal was carefully checked for noise and artifacts, using NeuroSky's proprietary algorithms [30,31]. Previous studies provided evidence for various methods and statistical analyses.

3. Result

In this study, Spearman's rho was used to test the correlation between electroencephalogram (EEG) rhythm and Sport Concussion Assessment Tool (SCAT) data Analyzes were performed considering non-normal distributions, according to Shapiro-Wilk test was significant ($p<0.01$).

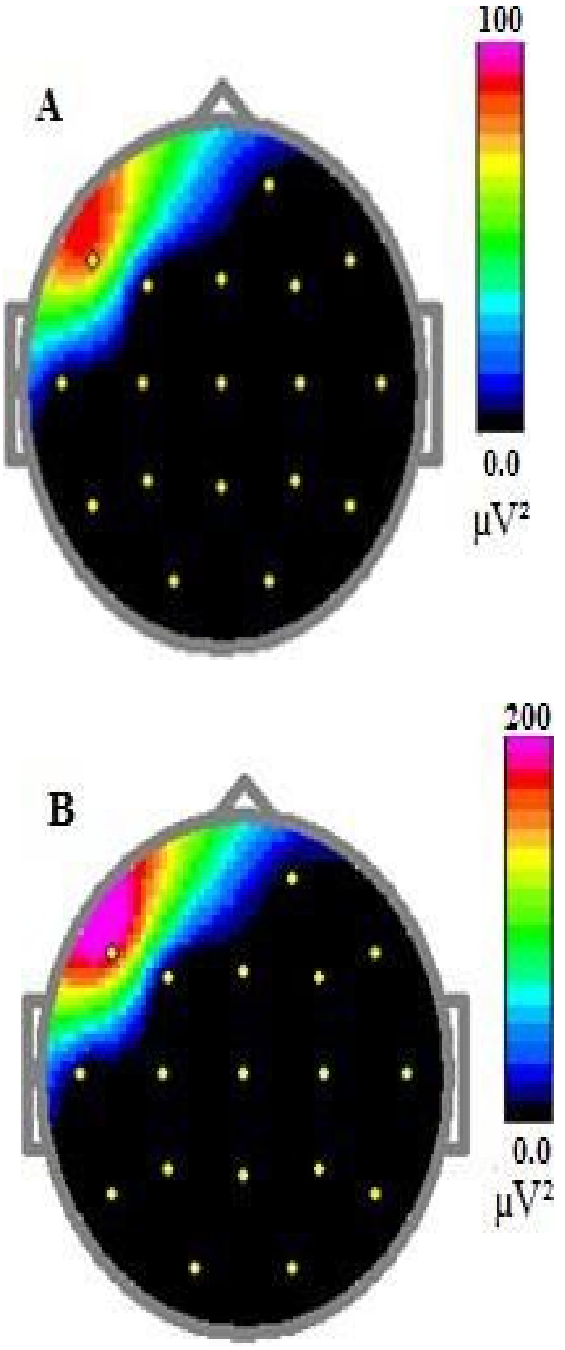

Figure 2. Grand averaged topographic scalp maps depicting differencesbetween EO (A) and EC (B) conditions to EEG alpha band.

The study focuses on analyzing the distinct features and properties of bands exhibited by these two systems. By examining the band characteristics, this research aims to contribute to the study. In this study, the non-parametric Wilcoxon signed-rank test was employed to assess the significance of the results, given the absence of a normal distribution.

Rhythm Rhythm	Mean **(EO)**		
	Mean **(EO)**	SD **(EO)**	Mean **(EC)**
Delta	51.27	47.5	45.79
Theta	53.89	37.6	60.44
Alpha	58.90	29.3	118.99
Beta	98.9	34.0	86.09
Gamma	32.55	7.43	35.07

Table 1. Wilcoxon test to EEG bands between EO and EC.

4. Discussion

Testing the reliability of the NeuroSky ThinkGear test: A research perspective Abstract: The NeuroSky ThinkGear test is a widely used tool in neuroscience and cognitive psychology. It measures brain wave activity and makes use of qEEG data, which is a common practice in assessing and analysing brain functions.

The stability of the quantitative electroencephalogram (qEEG) derived from the ThinkGear system has been found to be a potentially reliable biological marker. The findings of our research study indicate that the observed differences between the variables under investigation are deemed to be statistically significant. Upon the initiation of visual perception, a notable decline in the strength of alpha oscillations was observed, concomitant with the emergence of faster oscillations characterized by reduced amplitude.

The investigation of the transition between closed and open eye states holds potential as a valuable indicator of alpha rhythm reactivity and has the potential to serve as a means of reporting on the overall resting state activity of the human brain to medical professionals. The present study aims to investigate the potential impact of eye position (open vs. closed) on the values obtained using NeuroSky Think Gear. This research seeks to explore whether there is a significant difference in the measured factor when comparing these two eye positions. The findings obtained from the utilization of single-channel wireless system equipment have exhibited outcomes that closely align with

the measurements obtained through conventional laboratory-based systems.

Hence, it is evident that the ThinkGear chip possesses the capability to discern variations in the aforementioned characteristic. In the state of EO (eyes open), the functional systems of the brain undergo a reconstruction process that leads to the perception of information as "exteroceptive". This stands in contrast to the state of EC (eyes closed), during which attention is primarily directed towards internal cognitive processes.

The present study investigates the presence and processing of interoceptive information within the human brain. Interception refers to the perception and awareness of internal bodily sensations, such as heartbeat, respiration, and hunger. This research aims to explore the existing knowledge and understanding of interoceptive information within the brain. Hence, the findings of this study indicate that the topological arrangement of the brain, as determined by its spectral power, undergoes dynamic transitions in response to changes in the modes of information processing associated with the opening or closing of the eyes.

Researching the relationship between alpha oscillations and anxiety: A comprehensive review of existing data Abstract: The aim of this research article is to provide a comprehensive review of existing data on the relationship between alpha oscillations and anxiety. Alpha oscillations, which are muscle oscillations in the 8–12 Hz frequency range, have been included. The present study examines the potential for widespread use of simplified electroencephalography (EEG) technology in the healthcare industry, particularly in the assessment and monitoring of anxiety levels.

The present investigation has provided empirical evidence supporting a significant correlation between the alpha band of the electroencephalogram (EEG) in the frontal cortex and anxiety levels among young athletes. Numerous studies have reported that individuals with high levels of anxiety exhibit diminished activity in the alpha rhythm, alongside increased power in both the slow (delta) and fast/high-frequency (beta) brain waves, when compared to individuals with low anxiety levels.

Specifically, we examine how the power of the alpha rhythm is associated with the severity of anxiety symptoms. This research aims to contribute to the existing literature on the interplay between the alpha rhythm and anxiety, shedding light on potential negative associations between these variables.

This review article presents a study investigating the effectiveness of wireless EEG devices for neural responses in the treatment of anxiety. The study focuses on the relationship between mechanical efficacy and alpha rhythm and EC status, using statistical analysis to determine the significance of this relationship in this study we investigate the use of EC status data from the alpha band of single-channel EEG devices serves to monitor anxiety levels.

Furthermore, the present study significantly contributes to existing knowledge of the potential relationship between alpha oscillations and neurofeedback. Several studies have provided empirical evidence in support of the aforementioned conclusion, and one notable study focused on the prefrontal cortex. In recent years, interest in studying heterogeneity approaches in data analysis has increased. It was noted that a single data source does not provide an important way to assess the potential of heterogeneity mechanisms.

5. Conclusion

Thus, the findings of this study suggest that portable devices have the potential to serve as viable alternatives to traditional static EEG recording systems in analysing changes in EEG oscillations and moreover, these portable devices are effectively used to analyse brain activity -may be for various purposes The present study provides empirical evidence supporting the use of single-channel quantitative electroencephalography (qEEG) data in behavioural research for. Furthermore, these findings contribute to existing knowledge about schizophrenia and extend current understanding of this mental health condition.

Furthermore, young athletes were found to exhibit a stronger correlation between alpha rhythm strength and anxiety levels with their eyes closed, especially when alpha rhythm strength increased, and anxiety levels decreased. This study seeks to shed light on the complex interactions among these variables and possible relationships with one's mental experience, often referred to as the world's "middle" NeuroSky ThinkGear module and MindCap XL discovered tools potential for neurofeedback interventions targeting the closed eye (EC) conditions include anxiety-management and altered alpha-band activity.

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