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A RESEARCH VISION

EEG Verification of Relaxation Processes with Tibetan Stimuli

Verificación de Procesos de Relajación con Estímulos Tibetanos con EEG

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ABSTRACT

This paper analyzes the brain activity of people while experiencing the stimulation of Tibetan bowls to induce states of relaxation. With the use of a six electrode BCI-EEG, the brain activity of the participants was recorded during the stimulation with the bowls. Data were collected from the brain waves. The analysis of the data allowed to evaluate the efficacy of the singing bowls inducing relaxation states and their impact on brain activity, as well as to identify specific brain response patterns associated with the stimulation of the singing bowls.

RESUMEN

Este artículo analiza la actividad cerebral de las personas mientras experimentan la estimulación de los cuencos tibetanos para inducir estados de relajación. Con el uso de un BCI-EEG de seis electrodos, se registró la actividad cerebral de los participantes durante la estimulación con los cuencos. Se recolectaron datos de las ondas cerebrales. El análisis de los datos permitió evaluar la eficacia de los cuencos tibetanos para inducir estados de relajación y su impacto en la actividad cerebral, así como identificar patrones específicos de respuesta cerebral asociados con la estimulación de los cuencos tibetanos.

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1. Introduction

Relaxation is a technique that is increasingly used today to combat stress and anxiety, improve sleep quality, and reduce the risk of stress-related illnesses [1], [2]. In this sense, sound stimuli, such as Tibetan and Celtic music, have been used successfully to induce states of deep relaxation [3], [4]. However, despite their wide acceptance and use in clinical practice, the effectiveness of these stimuli in the relaxation process has not yet been precisely determined [5], [6]. In this sense, the general objective of this project is to evaluate the effectiveness of Tibetan and Celtic stimuli in the relaxation process, using EEG verification. EEG verification is a non-invasive technique that allows measuring the electrical activity of the brain in different regions and analyzing brain activity patterns associated with different cognitive processes [7], [8]. In this project, EEG verification will be used to analyze brain activity during exposure to Tibetan and Celtic stimuli, in order to identify specific patterns of brain activity associated with the relaxation process. In addition, the effectiveness of Tibetan and Celtic stimuli in the relaxation process will be compared, in order to determine if there is any significant difference between them. The results of this project can contribute to a better understanding of the neurophysiological mechanisms involved in the relaxation process and to greater effectiveness in the use of sound stimuli as tools for relaxation [9], [10].

2. State-of-the-art

2.1. The human health effects of singing bowls: A systematic review

It was done to demonstrate Tibetan bowls as feasible instruments to have an economical method for the prevention and management of various medical and psychological conditions [11], [12]. Promising evidence for the health benefits of Tibetan singing bowl therapies was identified. Studies should continue to investigate the health effects of singing bowl therapies including robust study designs, appropriate outcome measures, and consideration of clinical significance [13].

2.2. EEG Activity Analysis During a Multisensorial Stimulation Session in a Snoezelen Room

This study demonstrated the usefulness of Snoezelen multisensory therapy in the rehabilitation of patients with brain damage, specifically in subjects suffering from Traumatic Brain Trauma and Cerebral Palsy, by using EEG [14], [15].

2.3. EEG Emotion Recognition Using Attention-Based Convolutional Transformer Neural Network

This model demonstrated high accuracy (98.47 % and 91.90 %) in emotion recognition tasks, surpassing traditional approaches [16], [17]. This approach has significant implications in neuroscience and affective computing.

2.4. EEG-Based Neural Emotional Response to the Vegetation Density and Integrated Sound Environment

This study used Emotiv EPOC X to assess emotional states during audiovisual stimulation, showing that green spaces combined with sound environments enhance well-being [18], [19].

2.5. Analysis of EEG Signals Using Deep Learning to Highlight Effects of Vibration-Based Therapy

A 3D CNN was implemented to distinguish EEG signals during vibration vs. control phases, successfully identifying spectral changes associated with therapy [20], [21].

2.6. Design of a Neurofeedback Training System for Meditation Based on EEG Technology

Real-time neurofeedback using sound stimuli enhanced relaxation levels by 16 %, providing a new tool for meditation practitioners [22], [23].

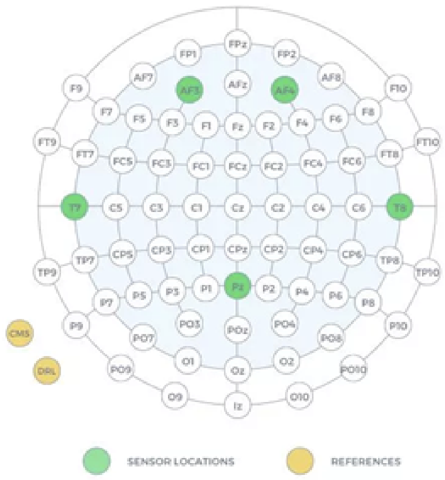
2.7. EEG Dynamics of Experienced Zen Meditation Practitioners

This study revealed that Zen practitioners showed increased alpha and beta power during meditation, suggesting neuroplastic changes due to long-term practice [24], [25].

3. Methodology

Initially, the Emotiv Insight was turned on and connected via Bluetooth to the EMOTIVPRO software, which would help with obtaining the electroencephalographic data. These 5 electrodes that the device has will be located on the head of the test subject as shown in Figure 1.

Figure 1: Location of INSIGHT electrodes



Source: Own.

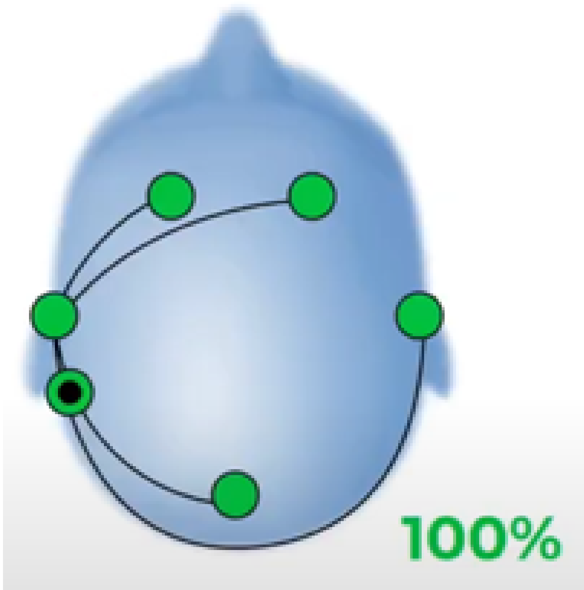
After understanding the location of the electrodes, each of them was lubricated with a conductive gel which is used to improve the conduction of electrical signals between the electrodes and the subject's scalp. The conductive gel helps reduce impedance and ensure better quality of the signals recorded during the EEG (Figure 2).

Figure 2: INSIGHT Location with the test subject

Source: Own.

Once the Emotiv was in a suitable way, the aim was to have a signal quality of above 85 % so that the Insight could take the data in an adequate way, as shown in Figure 3.

Figure 3: Contact quality of EMOTIV-INSIGHT at the nervous terminations



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Having this contact, the sample was taken with the recording of the Tibetan bowls for a total of 10 minutes to obtain complete and reliable information that would help in the understanding of the data that will be presented and analyzed in the following section.

4. Results and analysis

In the following section, measurements related to the EEG brain patterns of 5 subjects, all exposed for a period of 10 minutes to Tibetan bowl stimuli are shown. Figure 4 shows the results found for one subject. The results of the remaining four people can be seen in Annex 1.

Figure 4: Brain pattern in five regions at the head skull

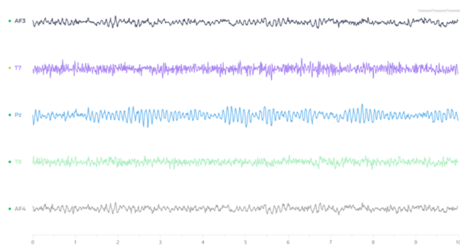

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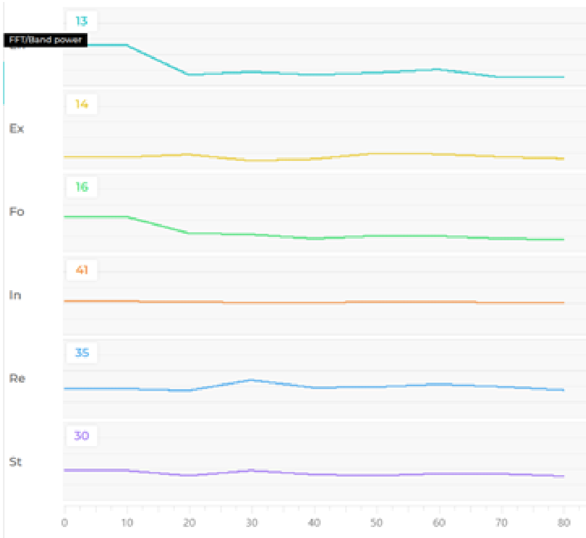
Figure 5 describes the emotional states associated to the waveforms shown in figure 4.

Figure 5: Emotional states associated to brain activity registered in the EEG (obtained from 1 subject)



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Analyzing the results obtained in the EEG measurements made in 5 participants, it is important to highlight that the measurements were made in approximately 10 minutes because it was considered a relevant time in which the person could concentrate on the sound of the bowls. Now, observing the graphs obtained in figure 4 there are five parameters, AF3, T7, Pz, T8 and AF4, which refer to the EEG connection points on the person's scalp, providing information on brain activity found in each case. From this, the amplitude of each graph can be analyzed, which indicates the intensity of brain activity and the significant changes in it. From this, it can be observed that in the five cases there is no great amplitude in brain activity and the response is highly similar over time, which indicates that when people are exposed to Tibetan sound stimuli without any other, a decrease in brain activity can be achieved, so it can be understood that the person is in a state of constant relaxation without interruptions. Returning to the graphs in figure 5, they describe the different frequencies of the brain waves present in the recorded EEG. In the case of the FFT graph, it seeks to analyze the spectral distribution of brain waves and provides information about the amplitude of different frequencies in the EEG spectrum, while Band Power refers to the power of brain waves within different bands of specific frequency, where these bands are divided by:

- Theta (4-8 Hz): Related to states of deep relaxation, meditation, and light sleep.
- Alpha (8-12 Hz): Characteristic of a state of active relaxation, rest and eye closure.
- Beta (12-30 Hz): Associated with states of alertness, mental activity and cognitive processes.
- Gamma (30-100 Hz): Related to processes of attention, perception and complex neuronal activity.

From which it is observed in the graphs that the greatest brain response in the five cases is found in Theta and Alpha, with the greatest in all cases being Alpha, which indicates that the people managed to enter a state of active relaxation and rest when exposed to the sound of Tibetan bowls.

Finally, in figure 7, the graphs seek to show the emotional states associated with the recorded brain activity, these being: En (Anger), Ex (Excitation), Fo (Frustration), In (Interest), Re (Relaxation) and St (Stress). In the case of Anger, fluctuating responses were found, since in two of the cases it started at a high level and then decreased over time, but in the other three cases the response remained high or very changing over time. In the case of Arousal, this was constant in all cases, remaining low. Frustration is another interesting response to analyze since even though it was not very high in all cases, over time it presented high variations, where it constantly increased and decreased. In the case of interest there was a constantly flat response, while in relaxation a response was obtained without many fluctuations but that oscillated between a neutral and high response. Finally, in the case of stress, the response remained constant between medium and low.

Figure 6 summarizes these results, showing the relative power of EEG Band Power Across participants with respect to each of the evaluated subjects.

Figure 6: EEG Band Power Across participants

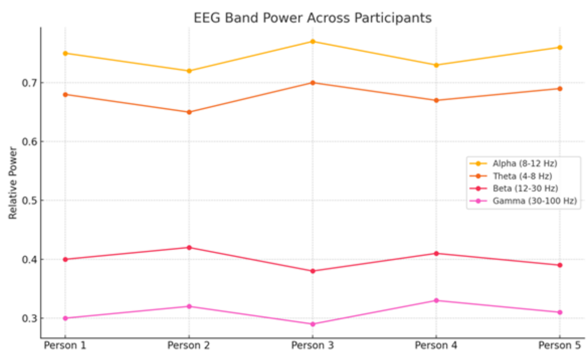

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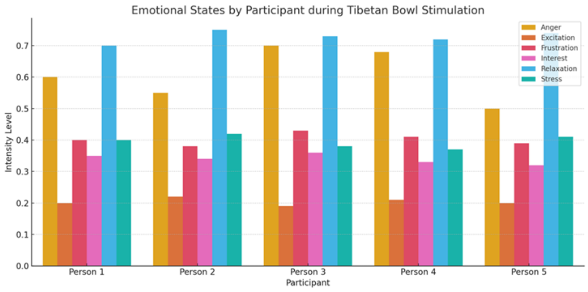
Figure 7 shows the Intensity Level of Emotional States by Participant during Tibetan Bowl Stimulation with respect to the participants.

Figure 7: EEG Band Power Across participants



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5. Conclusions

For the brain response during stimulation with bowls, analysis of brain activity using EEG while people were constantly stimulated with the bowls showed a low response amplitude at each point on the scalp. Furthermore, brain activity showed few significant fluctuations. These findings indicate that the bowl stimuli generated a generally stable, low-intensity brain response. Regarding brain activity in the frequency bands, it was found that the predominant brain activity during stimulation with the bowls was in the Theta frequency bands and, mainly, in the Alpha band. These bands are associated with states of relaxation and rest. This suggests that the Tibetan stimuli generated a relaxation effect in the people involved in the study. In the emotional responses measured, an expected response in relaxation was obtained, since it remains constant and even increases at certain moments of time. However, in many cases high responses and several fluctuations were observed in the emotions of Anger and Frustration, so it would be important in the future to conduct studies related to these emotions to understand these changes.

In conclusion, overall, of the project, the results suggest that stimulation with Tibetan bowls mainly induced states of relaxation and rest in the people evaluated. Furthermore, emotional responses showed different patterns, indicating that the influence of Tibetan stimuli may vary depending on the emotion evaluated. These findings support the idea that Tibetan stimuli can have positive effects on relaxation and emotional well-being.

Future work and Recommendations

Future research aims to expand the sample size to enhance the statistical significance and generalizability of the results, including diverse demographic profiles such as different age groups and clinical populations (e.g., individuals with anxiety or insomnia) would provide insights into the broader applicability of Tibetan stimuli. Additionally, comparative studies involving other relaxation modalities—such as binaural beats, nature soundscapes, or guided meditation—would help position Tibetan bowl stimulation within the wider spectrum of auditory therapies.

It is also recommended to implement more advanced EEG analysis techniques, such as source localization and connectivity mapping, to uncover deeper neurophysiological mechanisms involved in the relaxation process. Integration of multimodal data, including Heart Rate Variability (HRV) or Galvanic Skin Response (GSR), may further validate EEG findings and enrich emotional profiling. Longitudinal studies could also explore the cumulative effects of repeated Tibetan bowl sessions on neural plasticity and emotional regulation.

Finally, the development of real-time neurofeedback systems using Tibetan stimuli may open new avenues for personalized meditation and therapeutic interventions, especially for mental health support and stress management.

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