

Analyzing the Effects of Music Therapy on Prefrontal Alpha Band Power: A Comparative Study of Pre- and Post-Task EEG Activity

introduction:

In recent years music therapy has gained a lot of attention, in both medical and psychological fields. Music has been considered a tool that changes the mood, people tend to choose certain music genres in different situations. Our study aims to examine how music affects relaxation depending on brain activity recordings. Relaxation is perceptible in EEG as increased alpha frequency (8-13 Hz), in the prefrontal regions which are associated with calm and focused states. We hypothesize that engaging in a music listening task would increase relaxation. To meet this goal we will harvest the data using two channels (Fp1, Fp2), both detect signals from the mentioned region.

With the aim of studying the subject, we utilized data from a study on burn patients that included 9 subjects, each subject's data was collected during three phases (pre, during and post listening to music task).

methods:

Data Collection and Preprocessing

To obtain the data, we organized a folder for each participant, which contained data from two sessions and three phases. Initially, we planned to merge the pre- and post-phases for all participants to work with just two folders. However, while working on the code, we found out that working with the raw files was not difficult, as they were already structured in a way that made merging unnecessary. Therefore, we decided to maintain individual folders for each participant. The original dataset included 9 participants, but we excluded the 9th participant's data due to similar numbers across phases, which made it unsuitable for our analysis.

In order to analyze the data we used a python code that included the following libraries: mne for EEG analyzes, Pandas for data manipulation, Matplotlib and Seaborn for data visualization, and SciPy for statistical analysis.

Data Preprocessing

The EEG data were initially examined for any missing values or inconsistencies. Afterward, the data were filtered to focus on the alpha frequency range (8–13 Hz) to assess relaxation levels. We also normalized the data to ensure consistency across participants.

Analysis Procedure

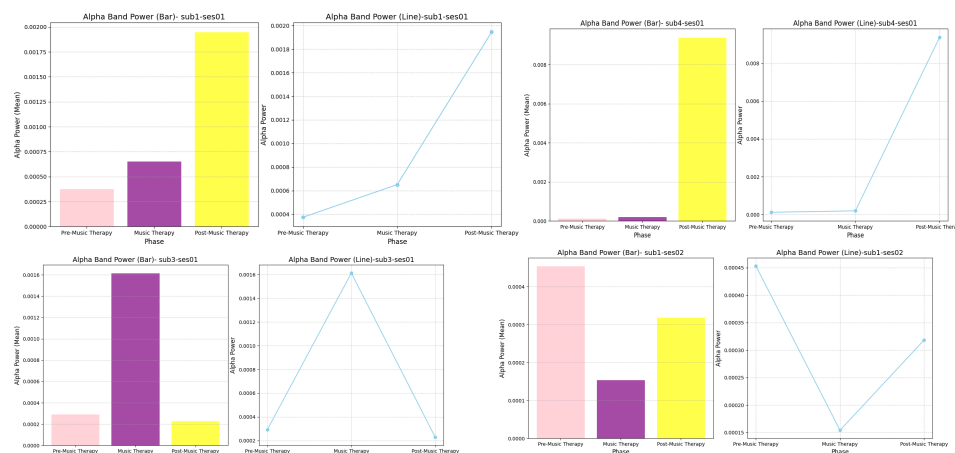
To analyze the EEG data, we used the MNE library to process and analyze the signals. We performed statistical comparisons between the pre-music therapy, and post-therapy phases using SciPy, employing paired t-tests to evaluate differences in alpha power between phases.

Data Visualization

Data visualization was performed using Matplotlib and Seaborn. We generated line plots to show the changes in alpha power across phases and boxplots to compare the distributions of alpha power between participants. These visualizations allowed us to identify overall trends and individual variations in the data.

results and conclusion:

For each participant we generated four plots, two for each session. One is a line plot that shows the changes in alpha power mean and a boxplots to compare the distributions of alpha power between the sessions (look at figures for instance)



The analysis exposed a significant change in alpha power between pre and post-music therapy phases. The T-statistic was -2.38, and the P-value was 0.031 (Figure 2), which indicates that the difference in alpha power between the phases is statistically significant at the 0.05 level.

Looking at the data, most participants showed a trend toward increased alpha power during the music therapy phase (Figure 1), with some variability. For instance, sub1 demonstrated a noticeable increase in alpha power from Pre-Music Therapy (0.000374) to Post-Music Therapy (0.001946), while sub5 showed a particularly large increase during the Music Therapy phase (0.029341), although this dropped somewhat post-therapy (0.003195). In contrast, other participants, like sub7, showed minimal changes across the phases.

These results suggest that listening to music might increase relaxation, as reflected in the changes in alpha power, although individual variations were present, we can see these variations (we can refer to them as MSW - the variations that are unexplained by the independent variable).

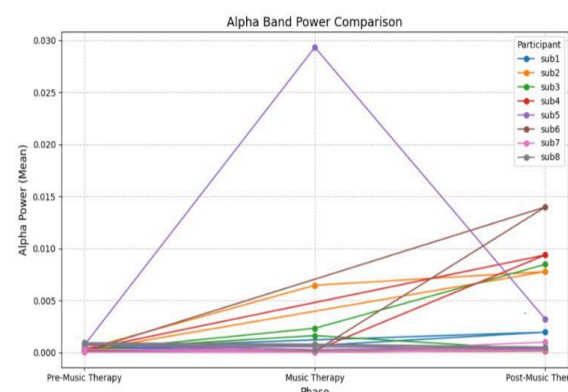
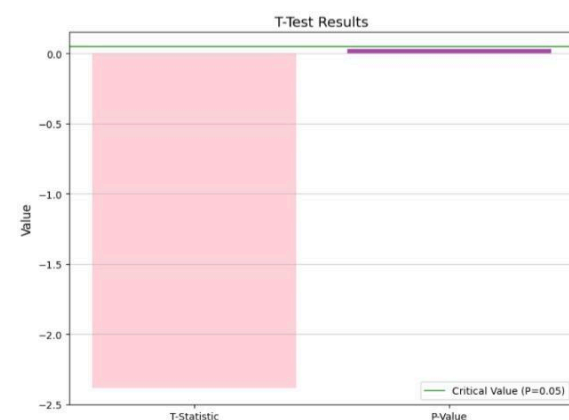


Figure 1

The heatmap plot visualizes the mean alpha power for each participant across different phases, (participants as rows, mean alpha as columns), the Color intensity represents the magnitude of the mean alpha power (red shows higher values, blue shows lower values - higher values represent more differences).

