Starlab®
LIVING SCIENCE

# Electrophysiology Report Brain Activity

NE® neuroelectrics

**Powered by**

Starlab®
STARLAB LIVING SCIENCE

## INTRODUCTION

Electroencephalography (EEG) is a non-invasive brain monitoring equipment that places the electrodes on the surface of the scalp to measure the underlying electrical brain activity. Neurons do not work in isolation but rather tend to work in synchrony. Coordinated assemblies of neurons that produce coherent activity generate currents that can be seen in the scalp. To reach the scalp these electrical signals go through layers of tissue, fluids, the skull and the skin, that can distort and attenuate the signals that reach the surface of the head. At each electrode EEG measures these voltage fluctuations generated by a broad population of neurons that are coordinated. We have measured your brain signals using Enobio, a last generation multichannel EEG sensor developed by our sister company Neuroelectrics.

## PARTICIPANT INFORMATION

PARTICIPANT CODE: Sub-01

SEX: Male

YEAR OF BIRTH: 1965

## RECORDING INFORMATION

EEG RECORD No.: 1

EEG DEVICE: ENOBIO 32

RECORDING DATE: 2021-11-12 20:27:32

START TIME: 20:27:32

END TIME: 20:42:39

## SIGNAL QUALITY

EEG is one of the biological potentials with lowest amplitude (typically a few microvolts). It is highly sensitive and is likely to be contaminated by undesired non cerebral potentials coming from the body itself or external sources. These unwanted signals dirtying your recording are called artifacts. Some of the most common biological artifacts that can pollute your EEG signal are due to eye blinking, heart activity or muscular contraction. Head and body movements during the recording produce irregular voltages that among other effects modify the drift and low frequencies of measured EEG. Finally, EEG is also affected by electromagnetic interferences coming from other electronic equipment close to the EEG sensor and power line noise.

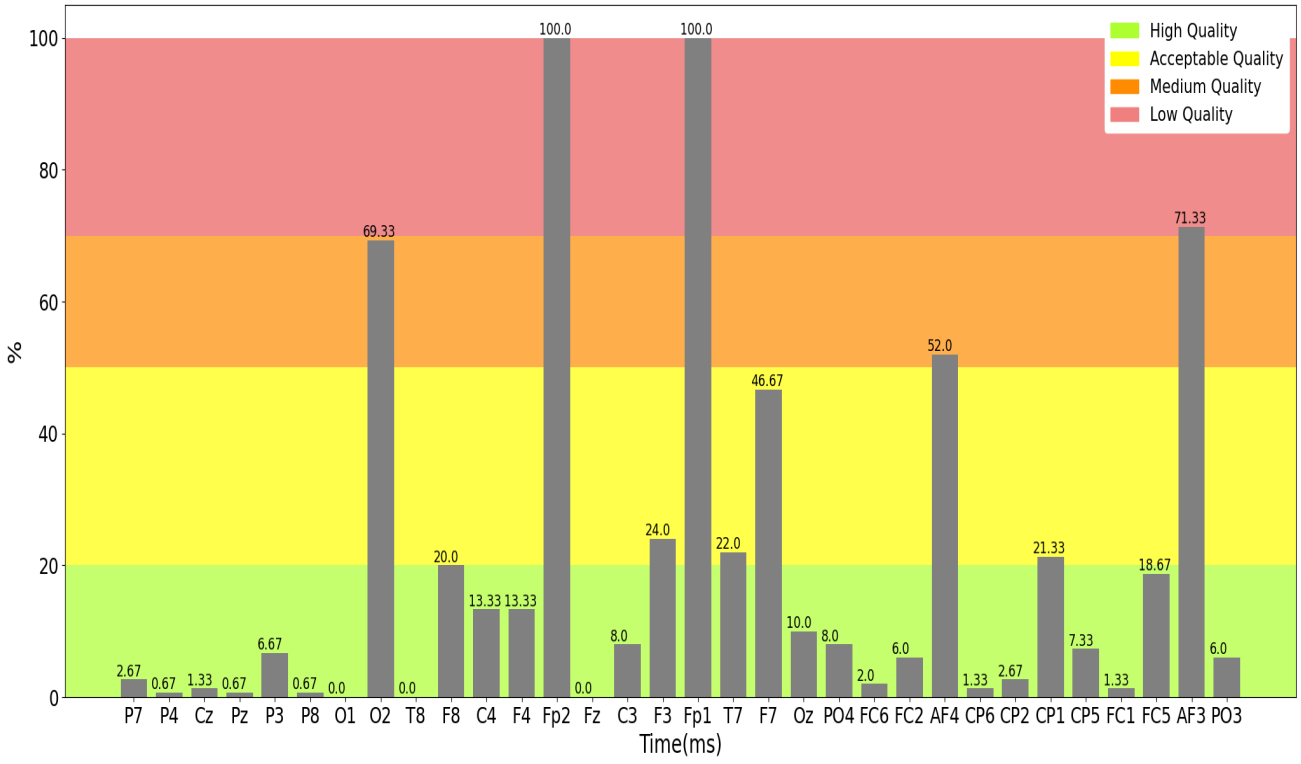


**Figure 2: Percentage of artifactual EEG per channel.**

## TEMPORAL BRAIN DYNAMICS

After cleaning and processing the temporal EEG series, the signal is ready to get information out of it. The following Figure displays the temporal evolution of brain dynamics during the inital resting EEG recording.

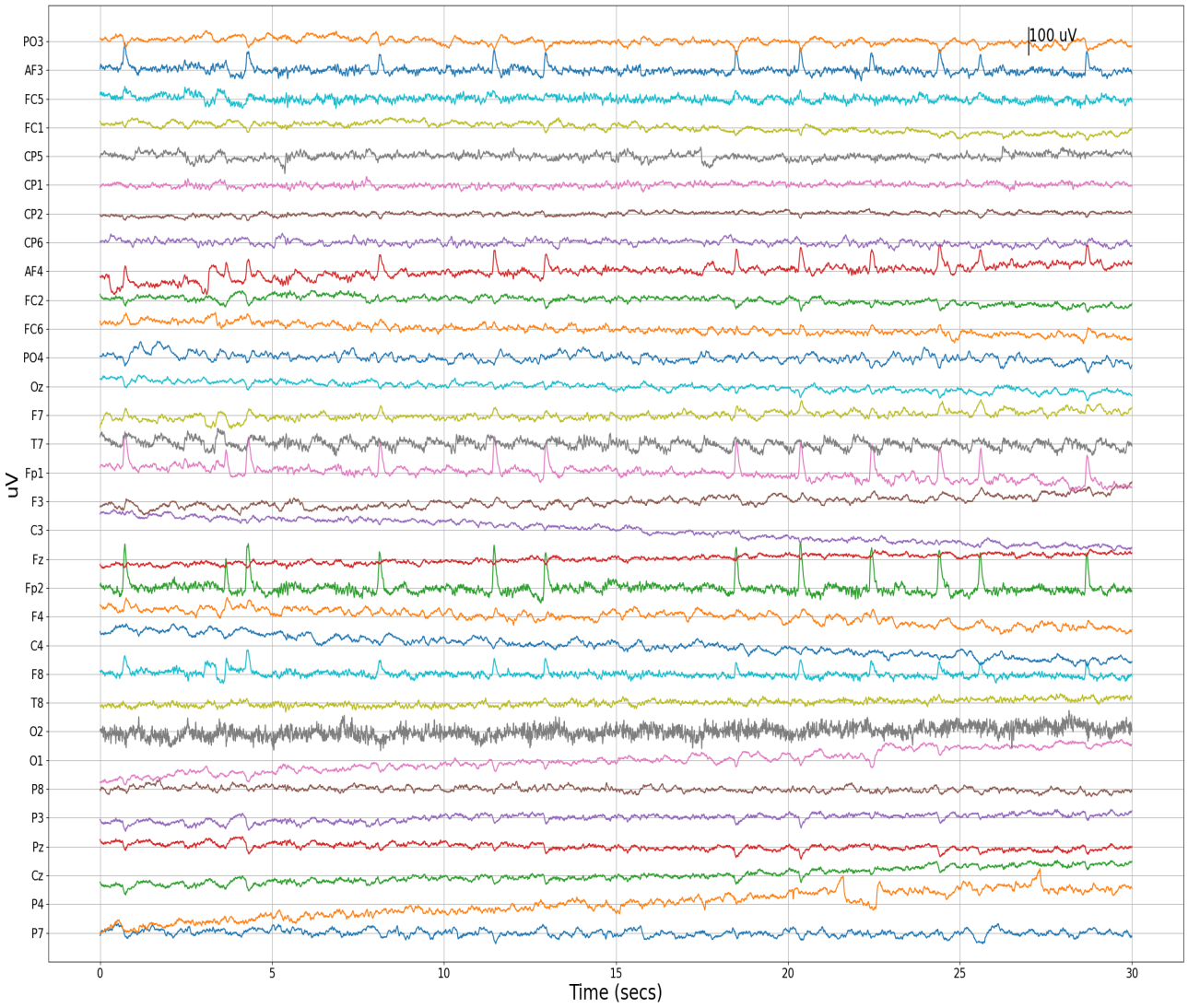


**Figure 3: Initial resting EEG recording (30 seconds).**

If we look more closely, we can observe the time evolution of the EEG rhythms in smaller time intervals. The figure below shows the EEG rates at a 2-second interval.

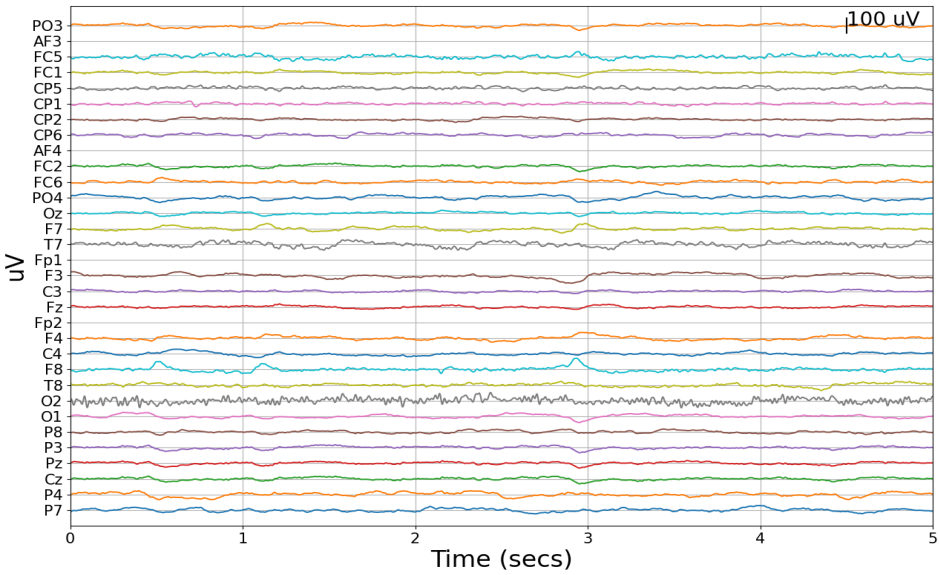


**Figure 4: Initial resting EEG recording (5 seconds).**

The following figure shows the EEG in less channels, in an interval of 2 seconds.

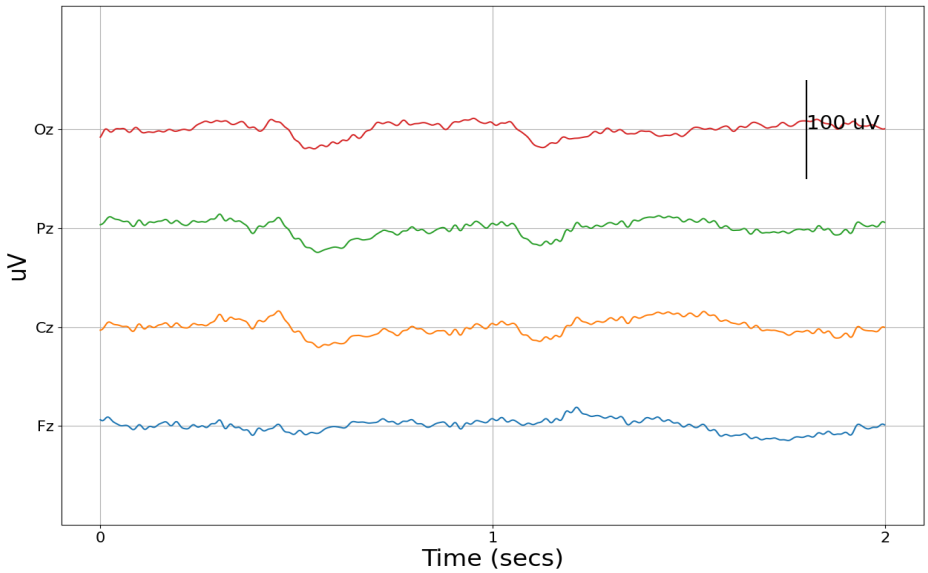


**Figure 5: Initial resting EEG recording (2 seconds).**

## SPECTRAL RESPONSE

Traditional EEG analysis focuses on measurement of frequency and amplitude of EEG signals. Time dependent signals, such as the EEG, can be decomposed into a sum of pure frequency components, using for example the well known Fourier transformation, which is grouped in bands. These bands are labeled with Greek letters, a classi cation used commonly can be the following; Delta: 0-4 Hz, Theta: 4-8 Hz, Alpha: 8-12 Hz, Beta: 12-30 Hz, and Gamma: above 30 Hz. It has been acknowledged that the frequency spectrum in EEG shows a decrease in power with increasing frequency. Rhythmic activity within a certain band has been seen to have a characteristic power distribution and to correlate with di erent physiological or cognitive functions. Low frequencies are related with low arousal and high frequencies are related with high arousal. For example Delta power is dominant during sleep, whereas Theta power is prominent in early sleep states as well as in states of decreased vigilance. In the case of Alpha power, it is an indicator of relaxed wakefulness and as vigilance decreases, it shifts from posterior regions to anterior areas. It is the validated general biomarker for ageing. Beta power is dominant during wakefulness.

## SPECTRAL RESPONSE - POWER SPECTRAL DENSITY

The following Figure shows the Spectral Density per electrode in the frequency range from 0.5 to 45 Hz and the Power Scalp Maps.

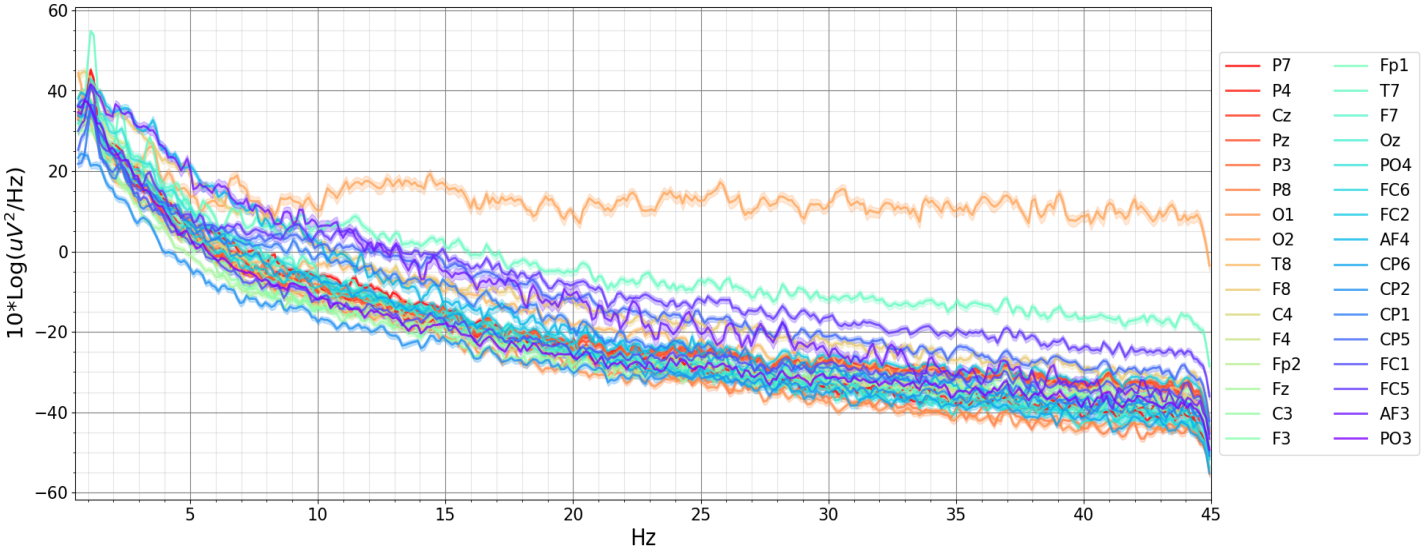


**Figure 6: Spectral response in the 0.5-45Hz range.**

## SPECTRAL RESPONSE - Separated

The following Figure shows the Spectral Density per electrode in the frequency range from 0.5 to 45 Hz, separated by electrode.

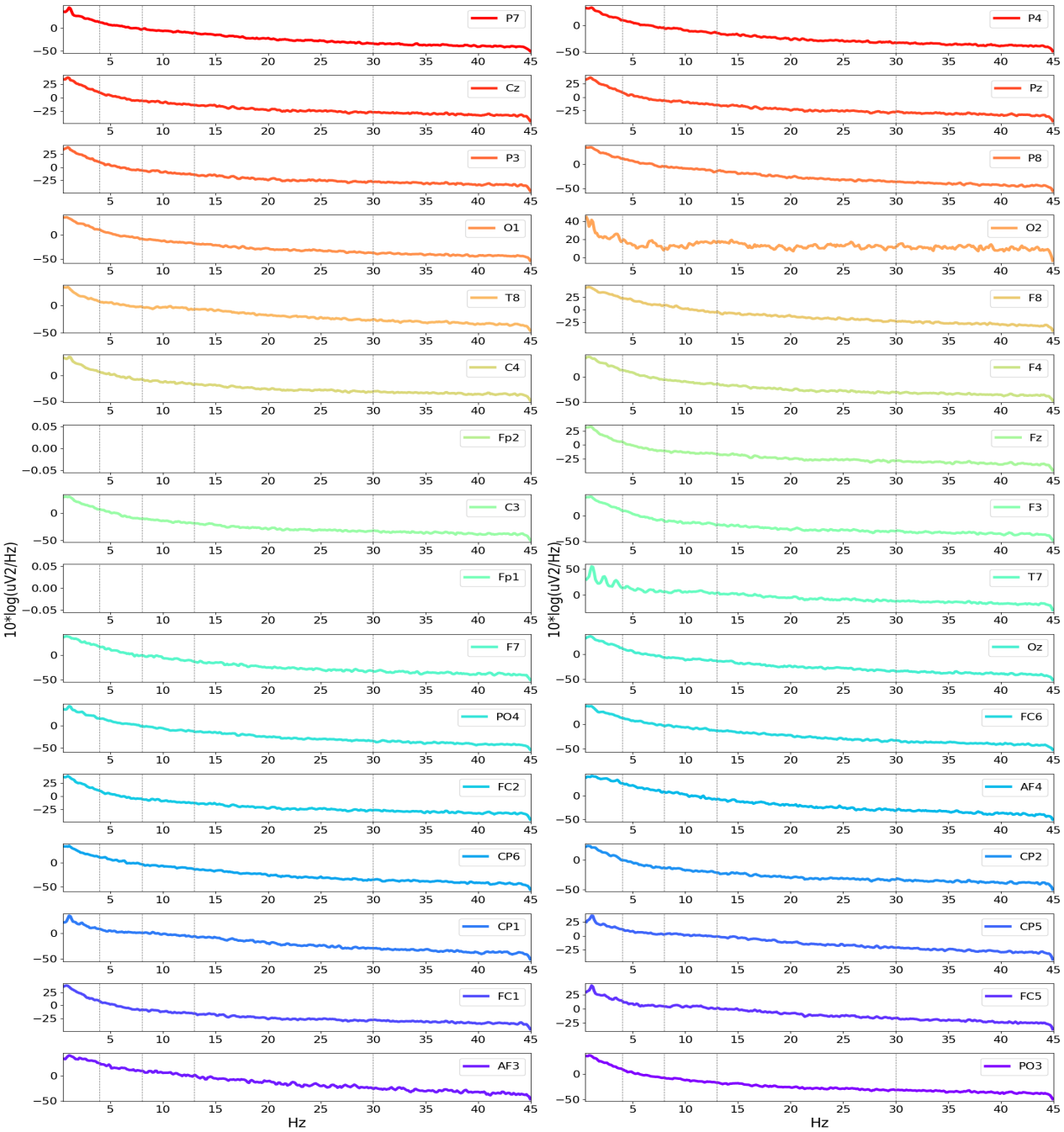


Figure 7: Spectral response in the 0.5-45Hz range.

## SPECTRAL RESPONSE - TOPOGRAPHY

The following Figure shows the Power Scalp Maps for each of the frequency bands

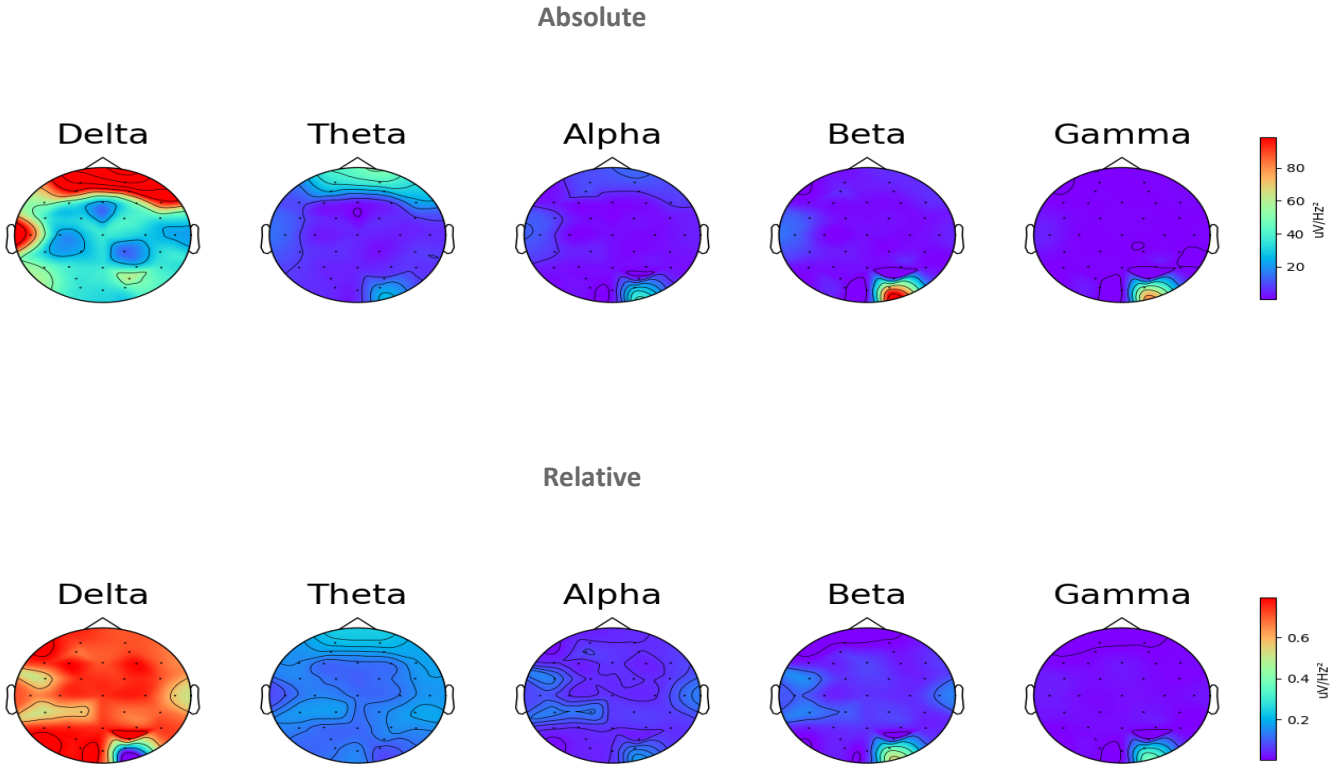


**Figure 8: Power Scalp Map.**

## SPECTRAL RESPONSE - BANDS

The following graphs show the Absolute and Relative Band Power over all of the electrode for each frequency band.

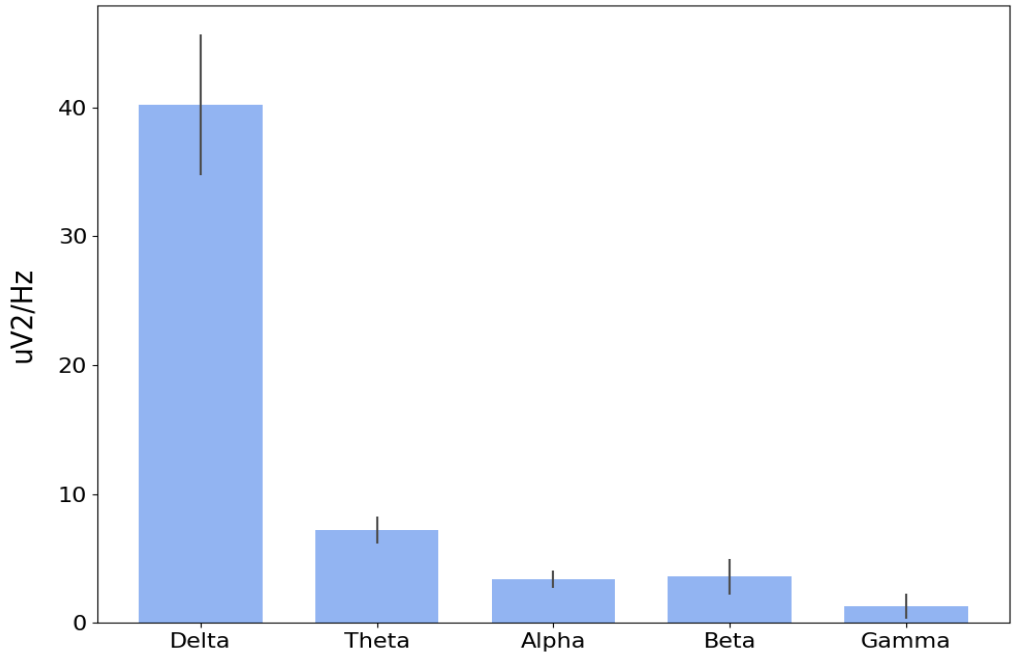


Figure 9: Absolute Band Power over all electrodes.

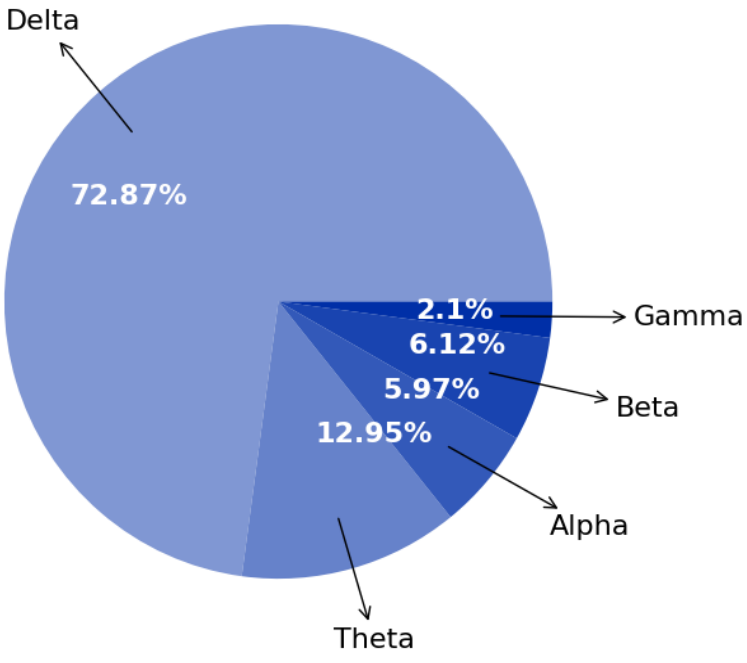


Figure 10: Relative Band Power over all electrodes.

## SLOW TO FAST RATIO

During the maturation of a person there are changes in the relationship between slow waves (Theta, Delta) and fast waves (Alpha, Beta). From later ages, an increase in the ratio (Delta + Theta)/(Alpha+Beta) is expected.

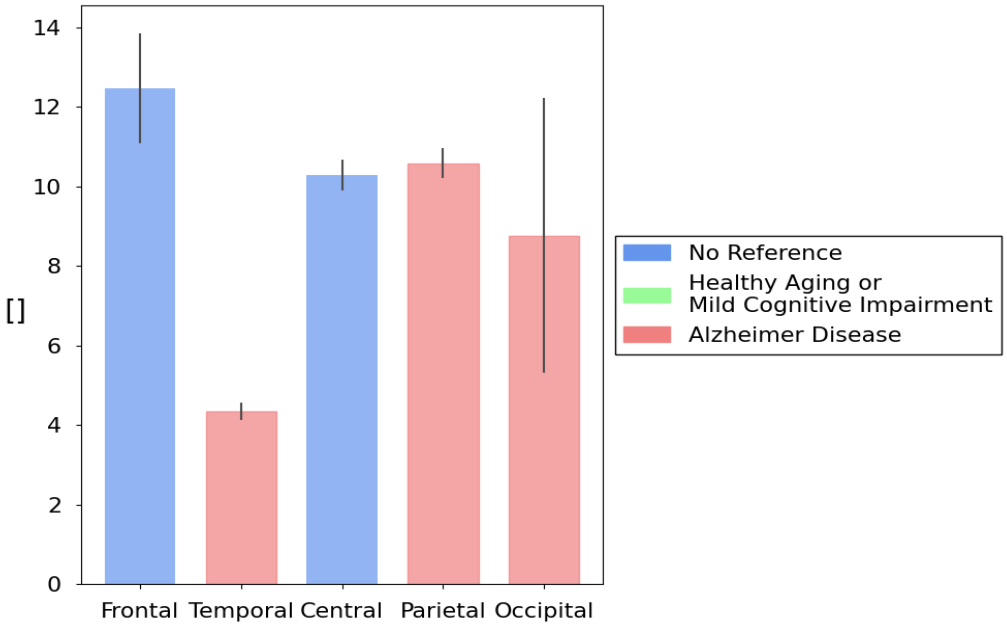


Figure 11: Slow to Fast Ratio.

## THETA/ALPHA RATIO

Another marker is the Theta/Alpha ratio, shown in the graph below.

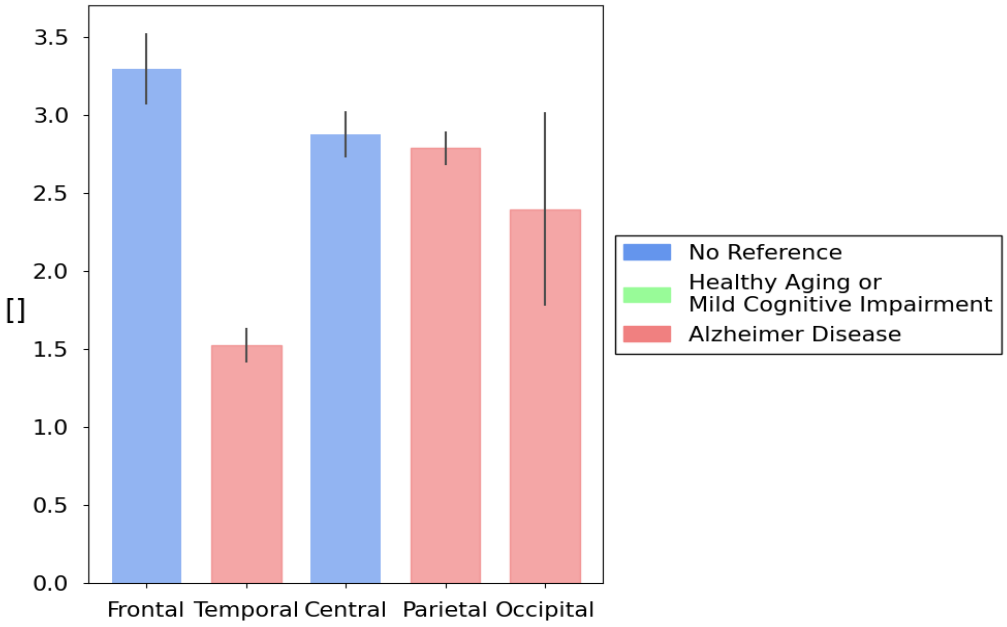


Figure 12: Theta/Alpha Ratio.

## INTERHEMISPHERIC ALPHA ASSYMETRY

The graph below shows the interhemispheric alpha asymmetry in the frontal and posterior regions.

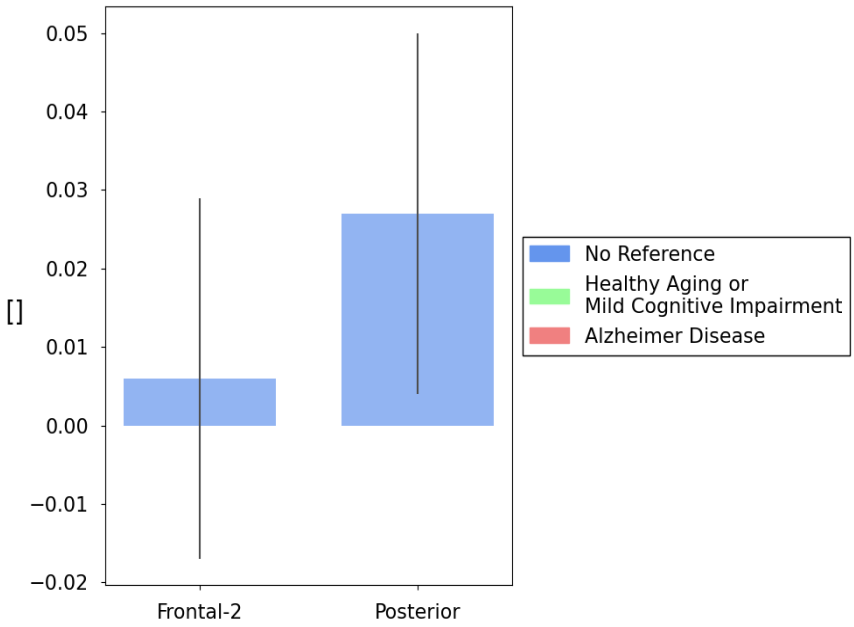


**Figure 13: Interhemispheric Alpha Asymmetry.**

## PEAK ALPHA FREQUENCY

The following graphs describe the analysis performed in the Alpha frequency range. The distribution of the maximum power of Alpha along the surface of the head is illustrated in the models, and the frequency in which this maximum power is found for each electrode is specified in the table.

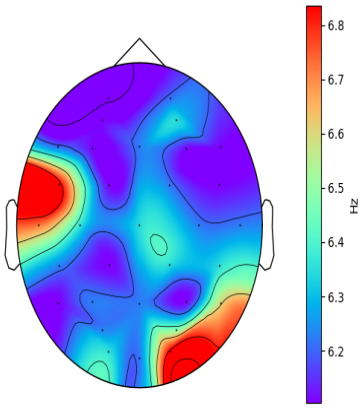


**Figure 14: Maximum frequency distribution.**

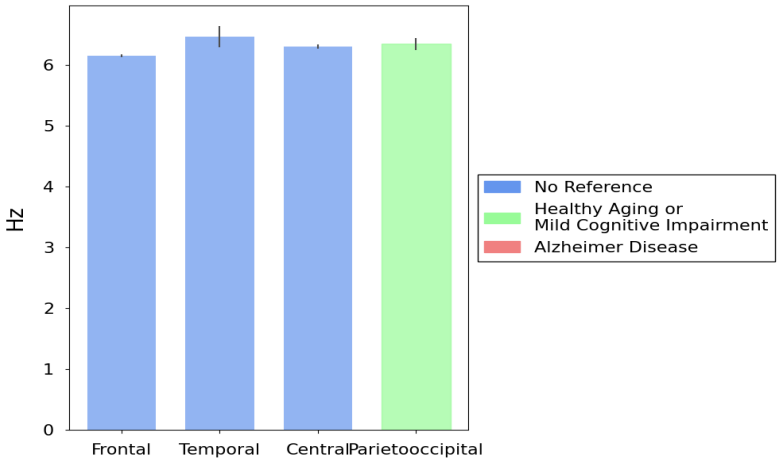


**Figure 15: Frequency of maximum power**

| Electrode | PAF (Hz) |
|---|---|
| P7 | 6.104 |
| P4 | 6.104 |
| Cz | 6.348 |
| Pz | 6.226 |
| P3 | 6.226 |
| P8 | 6.592 |
| O1 | 6.348 |
| O2 | 6.836 |
| T8 | 6.226 |
| F8 | 6.104 |
| C4 | 6.226 |
| F4 | 6.104 |
| Fp2 | 6.225 |
| Fz | 6.226 |
| C3 | 6.348 |
| F3 | 6.104 |
| Fp1 | 5.977 |
| T7 | 6.714 |
| F7 | 6.226 |
| Oz | 6.226 |
| PO4 | 6.47 |
| FC6 | 6.104 |
| FC2 | 6.226 |
| AF4 | 6.348 |
| CP6 | 6.348 |
| CP2 | 6.348 |
| CP1 | 6.104 |
| CP5 | 6.226 |
| FC1 | 6.104 |
| FC5 | 6.836 |
| AF3 | 6.104 |
| PO3 | 6.226 |

**Table 1: Peak Alpha power values per channel.**

## DECISION MATRIX

The following table shows a summary of all the results obtained for each of the different features. The last row contains a the probability of belonging to each cogntive category. Please note that this results should only be used as an indicative measure and not as a final diagnosis tool.

| Feature | Healthy Aging | Mild Cognitive Impairment | Alzeihmer Disease | Screening type |
|---|---|---|---|---|
| Slow To Fast Ratio - Temporal | 0 | 0 | 1 | HA/MCI vs AD |
| Slow To Fast Ratio - Parietal | 0 | 0 | 1 | HA/MCI vs AD |
| Slow To Fast Ratio - Occipital | 0 | 0 | 1 | HA/MCI vs AD |
| Theta to Alpha Ratio - Temporal | 0 | 0 | 1 | HA/MCI vs AD |
| Theta to Alpha Ratio - Parietal | 0 | 0 | 1 | HA/MCI vs AD |
| Theta to Alpha Ratio - Occipital | 0 | 0 | 1 | HA/MCI vs AD |
| Peak Alpha Frequency - Parietooccipital | 1 | 0 | 0 | HA vs MCI/AD |
| Final Outcome | 0.14 | 0.0 | 0.86 | |

**Table 2: Decision Matrix Table**

## EEG BRAIN PROFILE

This report shows the EEG recorded during wakefulness, in a resting state with eyes closed. The quality of the signal is within the expected values, which allows an adequate analysis.

*This report describes EEG activity in terms of quantitative EEG (qEEG) measures. There are no known serious risks associated with EEG. During the recording, there may be instances where your data might produce findings of clinical significance for you and your relatives, whose responsibility to communicate is the Clinic. The data contained in this report needs to be assessed and interpreted by a physician with electrophysiology expertise. Explicit content of this Report does not prescribe the application of any kind of treatment, does not give medical recommendations about the interpretation of the EEG, nor provides clinical interpretation of the visualized results.*