EPICHAD

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Introduction

EPICHAD is an acronym for “Epilepsy in Children and Adults“. This project is conducted within the course Methological working in the neurosciences 2021 of the master study “cognitive and integrative systemneuroscience” at the university in Marburg. In this study we want to look at the differences in EEG data between children and adults, that are living with epilepsy. We hypothesize, that children have higher frequency oscillation than adults. In this study we used an opensource dataset from openneuro.org.[2]

Subjects

This study consists of 30 human subjects that underwent whole-night video-EEG recorgings. 14 subjects were classified as children, with an age-range from 0.7 - 6.6 years. The other 16 subjects were classified as adults with the age between 7.1 - 17.4 years. All subjects suffered from focal or generalized epilepsy.

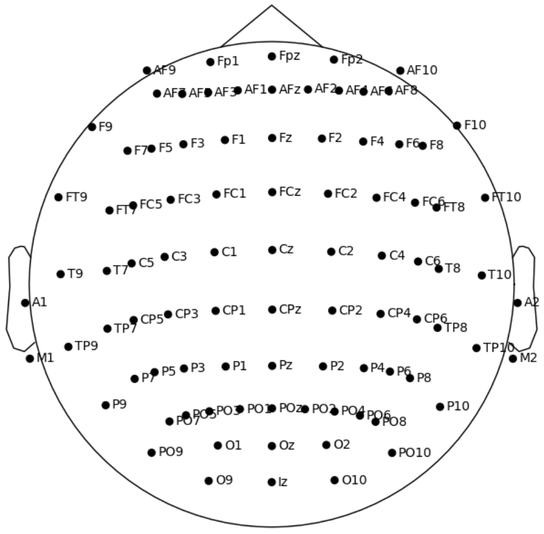

Figure 1: ***International 10-20 system for EEG.*** Each electrode has a letter to identify the lobe: pre-frontal (Fp), frontal (F), temporal (T), parietal (P), occipital (O) and central (C)."Z" refers to electrodes placed on midline sagital plane of scull (FpZ, Fz, Cz, Oz). Even-numbered electrodes (2, 4, 6, 8) refer to electrodes on right side of the head, whereas uneven-numbered electrodes (1, 3, 5, 7) refer to the left side. Cz & Fz are ground reference points for all electrodes, A1 & A2 are used for colateral referencing of all EEG electrodes.

Methods

The original study is a sleep experiment, where the EEG data was recorded with 21 electrodes based on the 10-20 system (Fig. 1). The analysis of the data was done with MNE-Python, where the first step was the preprocessing. Therefore, the data was first of all filtered with a notch filter at 60 Hz and afterwards with a most specific raw filter with fixed frequency limits (low frequency = 0.1 Hz and high frequency = 40.0 Hz). Furthermore, the hamming-window design was used in order to plot the data. For artifact reduction and to visualize 8 components, an Independent Component Analysis (ICA) was conducted, with an added low frequency filter of 1.0 Hz (Fig.2). After the preprocessing, fixed epochs of 2 seconds were applied, in order to reduce the data points. Topopmaps were generated to picture the epochs (Fig. 3, 4).

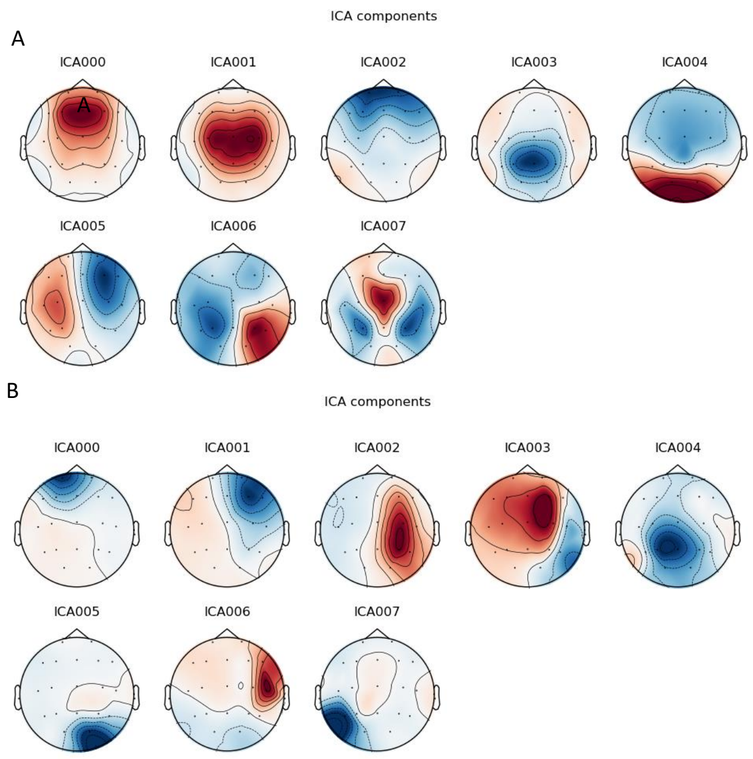

Figure 2: ***Outcomes of ICA.*** (A) shows outcome of ICA in adult subject (subject 22). (B) shows ICA outcomes in children (subject 24). In both groups the 21 channels & 8 components were used for ICA fitting.

Results

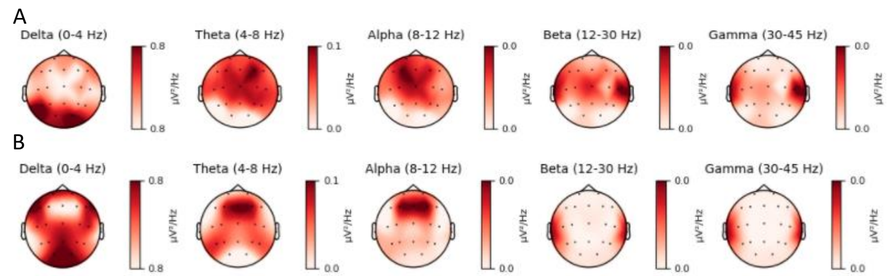

Figure 3: ***Topomap outcome without vmax and vmin.*** (A) shows topomap outcome in aduld subject (subject 22), while (B) shows topomap outcome of children (subject 24) without averaged scaling for both groups with vmax & vmax.

Delta shows strong activation in temporal and occipital lobe in adults (Fig. 3 (A)), while in children the activation is mostly focused on the occipital lobe (Fig. 3(B)). In adults, Theta and Alpha indicate a stronger activation in the frontal lobe than children. Beta and Gamma show mostly activity at the temporal lobes in both subject groups.

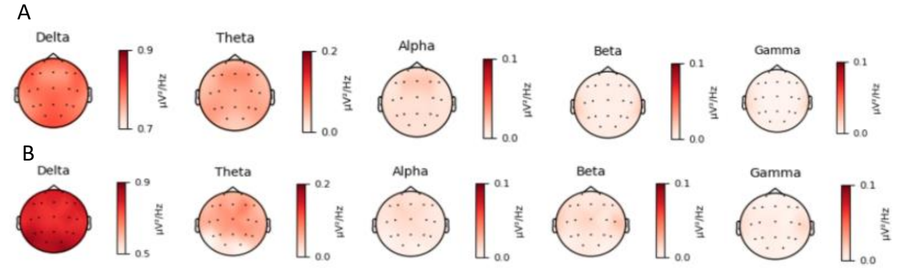

Figure 4: ***Topomap outcome with vmax and vmin.*** (A) shows activity division in aduld subject (subject 22; Delta 0.7-0.9; Theta 0.0-0.2; Alpha/Beta/Gamma 0.0-0.1), while (B) shows topomap outcome of children (subject 24; Delta 0.5-0.9; Theta 0.0-0.2; Alpha/Beta/Gamma 0.0-0.1) with averaged scaling for both groups with vmax & vmax.

Delta shows overall an higher activity in both subject groups in comparison to the other frequency bands Theta, Allpha, Beta and Gamma (Fig. 4 (A)). Interstingly, in children it's obervable, that Delta has stronger activity in the whole brain (Fig. 4 (B)). In contrast to that, there are similar patterns indicated for Theta, Alpha, Beta and Gamma in both groups.

Conclusion

This study proves the hypothises of different oscilation pattern between children and adults, in paricuilar an higher activation in the brain. It's indicated in an higher frequency oscillation in children.

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Poster Metadata:
OSF Project: https://osf.io/xbqwg/
GitHub Project: https://github.com/Michaela000/EPICHAD

Datatset:
(2): https://openneuro.org/datasets/ds003555/versions/1.0.1

References:
[1] https://doi.org/10.1093/braincomms/fcab052
[3] doi: 10.1109/EMBC.2015.7319296. PMID: 26737196.