

EEG initial analyses of attention neurofeedback training in healthy subjects reveal virtually no alterations in their resting state frequency bands' power

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Introduction: Neurofeedback training (NFBT) has been used as an alternative or supplementary technique to treatments involving disorders such as attention deficit, hyperactivity, anxiety, amongst others [1,2]. However, it has been subject of great debate in the literature, encompassing controversial findings and non-rigorous and non-standardized studies. Our aim was to conduct a controlled NFBT study for attention training in healthy subjects using their electroencephalography (EEG) signals.

Materials and Methods: Data from four volunteers (3 men) were acquired with the g.USBamp (g.tec®) amplifier, at a 256 Hz sampling frequency, with 16 dry electrodes. Subjects were placed sitting comfortably in a chair facing a computer screen. They were instructed to modulate a combination of their C3 beta (13 – 18 Hz) and C2 sensory-motor rhythms (12 – 15 Hz), aiming to maintain it above a threshold that was calculated at the beginning of each session, at rest, prior to the NFBT. We used the difference (D) between the power of their EEG signal in these frequencies and this threshold to assess the success or failure of the subject's performance. Three NFBT interfaces were used: (I1) a vertical red bar that would go up and down according to the subject's signal, which they were instructed to attempt to maintain above the threshold; (I2) an interface with two competing cars, one representing the subject's signal and the other, the threshold; (I3) the subject's signal would control the screen brightness, while they were reading a text. In each session, all three interfaces were applied, in random order, for 5 minutes each. Moreover, 2 minutes resting-state (RS) recordings were performed prior and immediately after the NFBT.

Results and discussion: Fig. 1 displays color matrix graphics of the alpha band's power difference between pre and post-training conditions for each subject. Results for the theta and beta bands were very similar, and are not displayed here. A Wilcoxon rank test revealed that only electrode 'Cz', in the alpha band, for Subject 1, showed a significant variation ($p < 0.05$) between pre and post RS conditions after all the NFBT sessions.

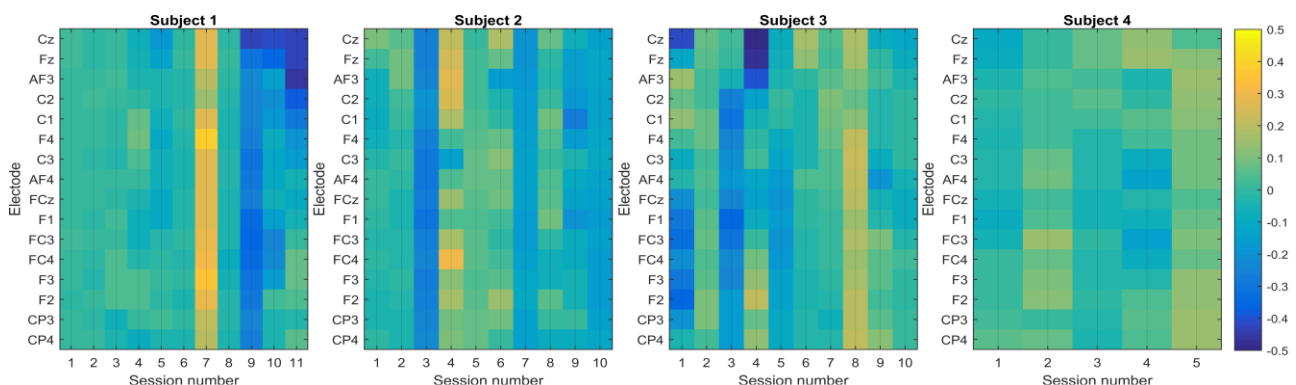


Figure 1. Difference between post and pre NFBT alpha band's power for each subject. Color scale is shown in arbitrary units.

Conclusion: We could not identify any significant pattern that might be related to our NFBT protocol, either indicating that our protocol may have not been effective for the desired effects, or that NFBT, indeed, could not produce changes in the studied features. Had we found any definitive pattern, the inclusion of sham and control groups would be necessary to assess how much of the change is due to the NFBT itself.

References: [1] Fuchs T et al., Applied Psychophysiol. Biofeedback 8(1) : 1-12, 2003; [2] Uhlmann C et al., Seizure 10: 34-38, 2001.