Influence of Slow Oscillating Transcranial Direct Current Stimulation (so-tDCS) on Electroencephalogram (EEG) and Cognitive Performance

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Introduction

Recent research [Kirov et al., 2009] has shown that transcranial slow oscillating stimulation increases EEG power in slow oscillations at frontal EEG positions as well as power in the theta and beta frequency band equally distributed across electrode sites. While applying stimulation during learning an improvement of memory performance can be observed. Enhancing the excitability of the prefrontal cortex (PFC) by means of anodal tDCS will presumably result in improved working memory function [Levy & Goldman-Rakic, 2000]. Primary endpoint of the study is an increase in slow oscillation (0.4-1.2Hz) power, at F7, F8 and Fz, as well as on theta (4-8Hz) and beta (15-25Hz) power across electrode sites. Secondary it is hypothesized that stimulation enhances cortical excitability in PFC, resulting in increased cognitive performance (indicated in improved Digit Span, DSST and PVT test results).

Material and Methods

Study design: Randomized, sham controlled, double-blind cross-over trial

Subjects: 30 healthy individuals divided in three groups at 10 subjects each

Procedure: See Figure 1 and 2

Stimulation: Anodal sinusoidal tDCS of 0.75Hz and 250µA; anodes F3 and F4, cathodes mastoid; stimulation duration 30minutes (5 blocks at 5minutes, one minute break in between). See also Figure 3 and 4

Tests: PSQI, HADS, ESS, AAT, KSS, PVT, Digit Span, DSST

EEG: Fz, Cz, Pz, C3, C4, P3, P4, F7, F8, T3, T4, EMG, EOG, ECG

Statistics: Program PASW ® Statistics 18, dependent t-tests for paired samples

Results

Performance test results reveal that it is possible to elevate cognitive alertness of healthy subjects through anodal so-tDCS. Moreover, a power increase in theta at frontal as well as at central electrode sites was found, indicating that theta oscillations might mediate short term memory improvement. This is in line with previous results identifying theta as promoter for hippocampal encoding processes [Kirov et al., 2009]. Of specific interest is the fact that a slow oscillation power increase in central sites was observed but no effect in frontal sites. This is contradictory to the results from Kirov et al. (2009) and should therefore be further elaborated.

For definite conclusions final data collection and analysis need to be completed, including evaluation of more EEG electrode sites and artifact removal procedures.

References: