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Treating attention deficits in chronic stroke patients using Slow Cortical Potential (SCP) Neurofeedback

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Introduction: Slow cortical potentials (SCPs) are slow polarization shifts measurable with electroencephalography (EEG) and lasting from 300 ms to several seconds. Negative polarization shifts represent cortical activation or excitability while positive shifts express cortical inhibition. SCPs can be brought under voluntary control by neurofeedback training and were successfully used for attention enhancement in children with attention deficit disorder [1]. As in chronic stroke patients attention deficits often remain after cognitive rehabilitation treatment is completed, we investigated the potential of SCP neurofeedback training for attention enhancement in this target population. We hypothesized people with chronic attention deficits after stroke to learn willful SCP control via neurofeedback training (H1) and willful shifts toward cortical negativity leading to attention and concentration increase being measureable on the behavioral level (H2).

Methods: Twenty-five chronic stroke patients with subjectively reported attention deficits, were included in this study. Ten dropped out and the remaining sample (N=15) was on average 62 years old (M=62.40, SD=8.73) and included four females. Participants' attention was tested using the Test battery of Attentional Performance (TAP), more specifically the subtests 'divided attention' and 'alertness'. Participants were trained to control their SCPs for 8 sessions over a time period of two to three weeks using Biotrace Software (MindMedia, the Netherlands). A circle presented in the middle of the screen had to be either increased (negativity) or decreased (positivity) in size. If accurate, the circle color changed from light grey to green. In case the participant willfully produced the requested SCP polarity for 80% of the time during the last 4 seconds of each 6 second trial, a smiley face was presented as a reward. Each session consisted of 10 training blocks including 50 trials. After the last training session, post training attention assessment was performed.

Results: Concerning H1, we found stroke patients to learn willful control over their SCPs via neurofeedback training. ANOVA suggested a main effect of block, (F=6.18, p=.01) qualified by a triple interaction of block, session, and condition (F=5.27, p=.02). Follow-up analysis indicated that, across all sessions, no difference between conditions could be found in the first block of each session, but that, beginning in the fifth session, stable differences between conditions emerged in the last block number. H1 was confirmed (see figure 1). We also found that patients could significantly increase their T-scores in TAP DA Omissions (t(14)=-3,461,p=.004). Therefore, our second main hypothesis was partially confirmed.

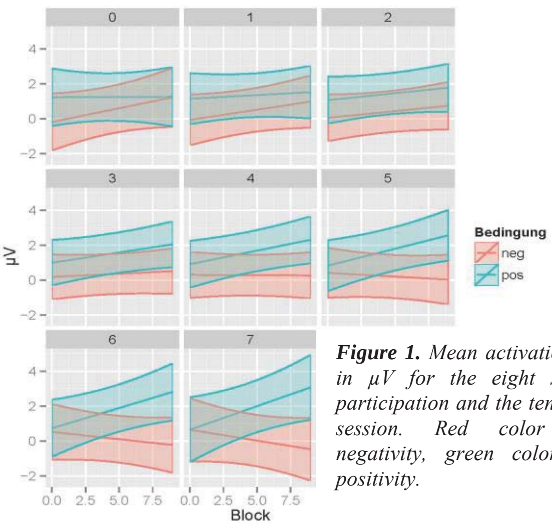

***Figure 1.** Mean activation depicted in µV for the eight sessions of participation and the ten blocks per session. Red color indicates negativity, green color indicates positivity.*

Discussion: Ten participants of our original sample dropped out either because they were too exhausted, not compliant or had difficulties in understanding the instructions. Therefore, in the future, training sessions need to be adjusted to be shorter, using a more intuitive and possibly also entertaining feedback and the thresholds for reinforcement should be decreased to reduce frustration and strengthen learning.

Significance: Although the sample size needs to be increased, we cautiously conclude that SCP neurofeedback training is a promising new treatment possibility for chronic stroke patients with attention deficits.

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References

[1] Arns, M., Heinrich, H., Strehl, U. (2014). Evaluation of Neurofeedback in ADHD: The long and winding road. *Biological Psychology*, 95:108-15.