

Personalized tACS targeting the dorsal attention network specifically modulates visuo-spatial attention

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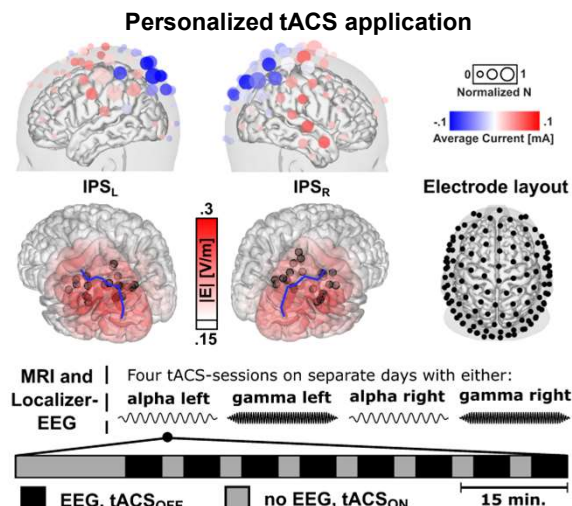
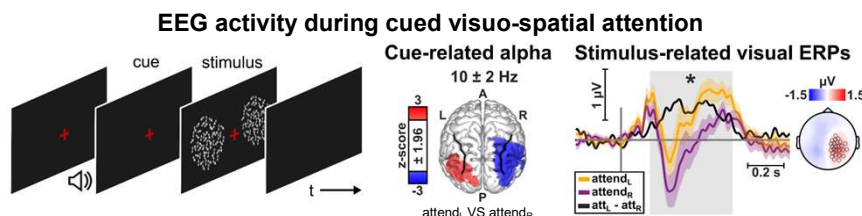
Background

Covert visuo-spatial attention is marked by lateralized neural alpha power along the dorsal attention network [1]. However, results from applications of normative alpha-tACS remain inconclusive about the contribution of neural alpha oscillations [2]. At the same time, electric field simulations showed high inter-individual variability that might account for the limits of normative tACS [3]. Here, we applied personalized alpha-tACS in a cued visuo-spatial attention paradigm, and recorded EEG after-effects in an intermittent stimulation protocol.

→ We hypothesized that alpha-tACS targeting the left or right parietal cortex shifts attention to the ipsilateral hemifield and modulates lateralized EEG brain activity, respectively.

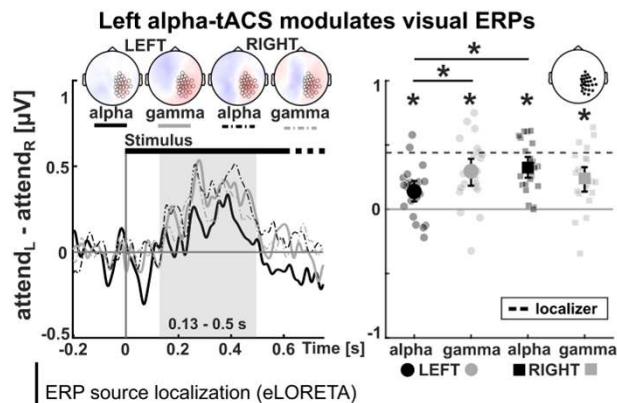
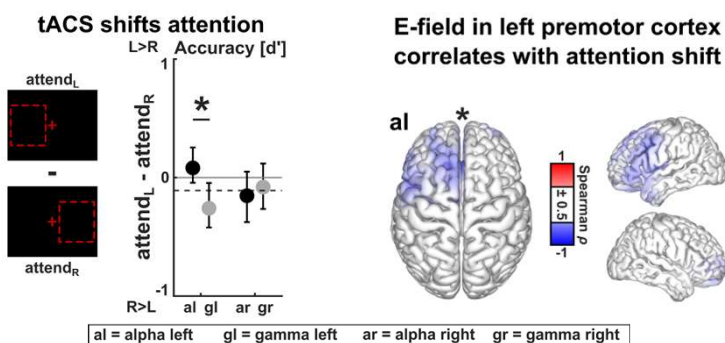
Methods

- N = 20 healthy human participants
- Personalized stimulation montages were defined based on individual alpha lateralization during visuo-spatial attention and six compartment finite-element headmodels
- Personalized tACS was applied in four pseudo-randomized sessions (10 Hz or 47.1 Hz targeting the left or right parietal cortex, within-subject design, 1.5–2 mA baseline-to-peak)
- High-resolution EEG was recorded during tACS-free intervals (126 channels)
- Behavior, EEG and electric field simulations were analyzed



Results

- Left, but not right, alpha vs. gamma-tACS shifted attention to the left hemifield and modulated visual ERPs in left premotor cortex.
- Simulated electric field intensities in left premotor cortex correlated with attention shift of behavior.
- Left alpha-tACS modulated stimulus-related visual ERPs in right posterior EEG sensors. Neural sources of ERPs were located in left premotor cortex.



Conclusion

Alpha-tACS targeting the left parietal cortex...
...modulates visuo-spatial attention and evoked EEG activity in the left dorsal attention network
... affects the left premotor cortex in terms of network modulation and/or co-stimulation

→ Left dorsal attention network, including the left premotor cortex, might be more susceptible to subtle tACS-neuromodulation than the right hemisphere

References [1] Siegel, M., Donner, T. H., Oostenveld, R., Fries, P., & Engel, A. K. (2008). Neuronal Synchronization along the Dorsal Visual Pathway Reflects the Focus of Spatial Attention. *Neuron*, 60(4), 709–719. <https://doi.org/10.1016/j.neuron.2008.09.010>. [2] Coldea, A., Morand, S., Veniero, D., Harvey, M., & Thut, G. (2021). Parietal alpha tACS shows inconsistent effects on visuospatial attention. *PLOS ONE*, 16(8), e0255424. <https://doi.org/10.1371/journal.pone.0255424>. [3] Radecke J-O, Khan A, Engel AK, Wolters CH, Schneider TR. Individual Targeting Increases Control Over Inter-Individual Variability in Simulated Transcranial Electric Fields. *IEEE Access* 2020;8:182610–24. <https://doi.org/10.1109/ACCESS.2020.3028618>.

