

A pipeline for the modulation of smooth pursuit eye movement by personalized tDCS



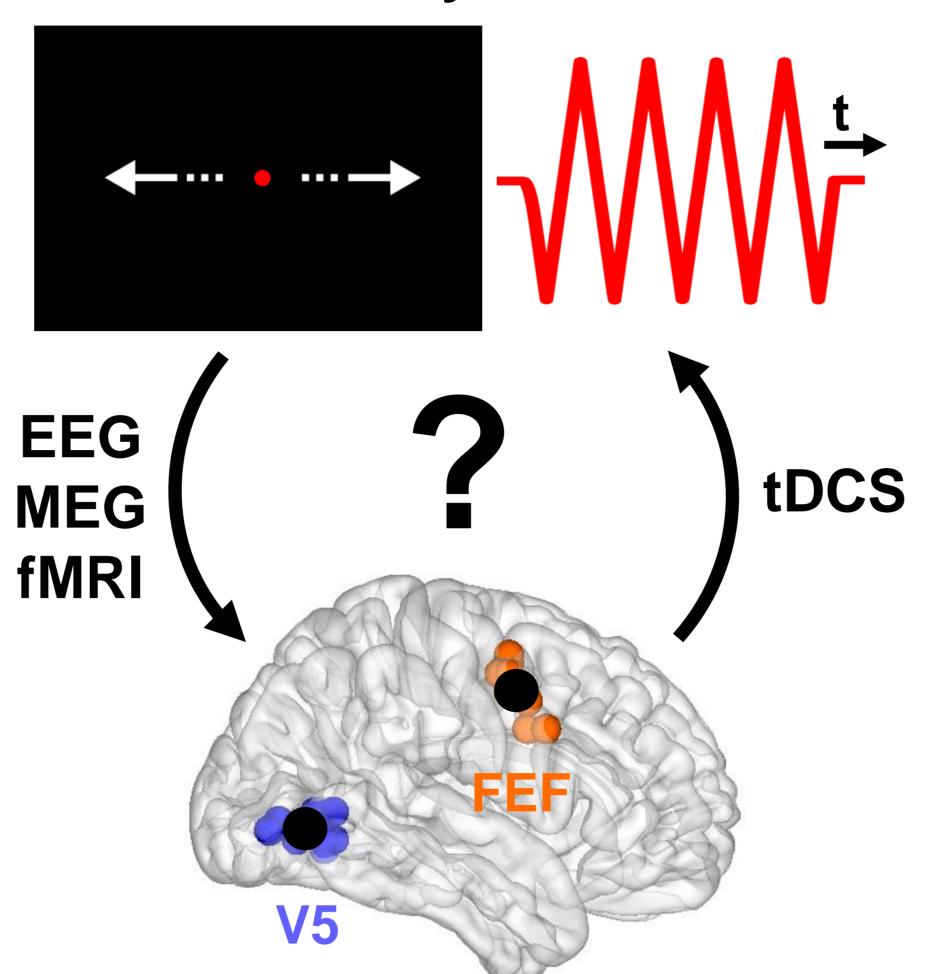
JO Radecke^{1,2}, A Sprenger^{2,3,4}, Y Buschermöhle^{5,6}, T Erdbrügger^{5,6}, A Kühn^{1,2}, S Rashidi^{1,2}, LS Thomann^{1,2}, L Espeter^{1,2}, H Stöckler^{1,2}, S Borgwardt^{1,2}, B Sack^{1,2}, TR Schneider⁷, J Groß^{5,6,8}, CH Wolters^{5,6} & R Lencer^{1,2,6,9}

¹Dept. of Psychiatry and Psychotherapy, ²CBBM, ³Dept. of Neurology, ⁴Institute of Psychology II, University of Lübeck, Germany; ⁵Institute of Biomagnetism and Biosignalanalysis, ⁶Otto Creutzfeldt Center for Cognitive and Behavioral Neuroscience, ⁹Institute for Translational Psychiatry, University of Münster, Germany; ⁷Dept. of Neurophysiology and Pathophysiology, University Medical Center Hamburg-Eppendorf, Germany; ⁸Institute of Neuroscience and Psychology, University of Glasgow, UK

Background

- Activity in area V5 and frontal eye fields (FEF) correlates with the processing of smooth pursuit eye movement [1,2]
- Transcranial direct current stimulation (tDCS) is able to causally modulate neural activity and behavior, but suffers from low reproducibility [3] due to individual variability
- Personalized tDCS can account for individual brain structure and function [4]
- → We present a pipeline for personalized tDCS targeting individual V5 and FEF for the modulation of smooth pursuit eye movement

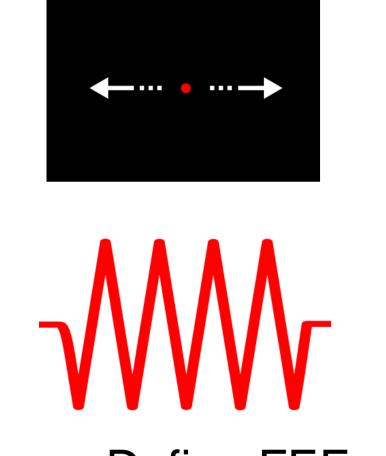
Horizontal eye movement

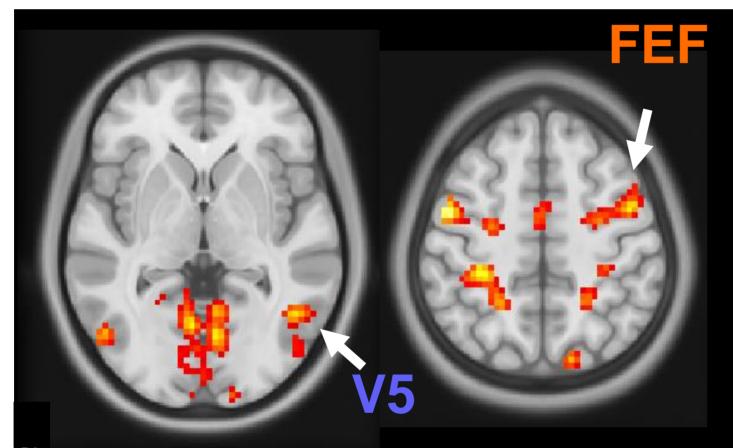


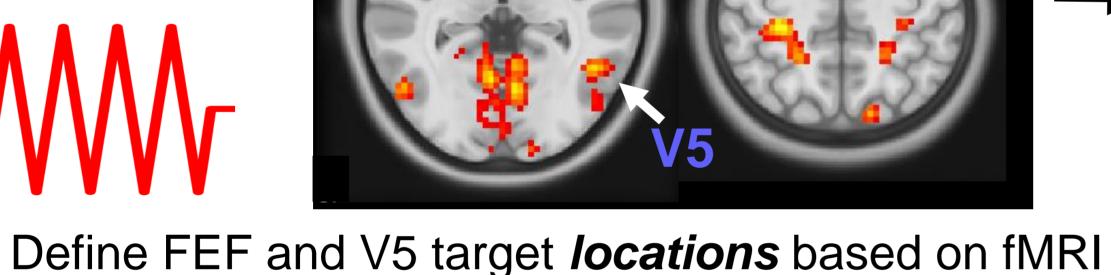
Methods

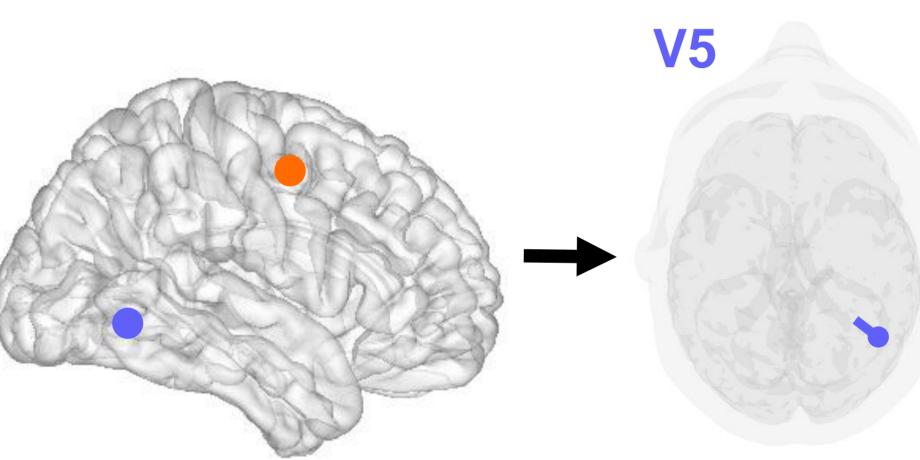
- V5/FEF stimulation targets are defined based on fMRI and combined EEG/MEG measurements
- Individual state-of-the-art headmodels are computed (T1, T2 and DTI)
- Skull conductivity is calibrated using somatosensory evoked activity from combined EEG/MEG recordings
- Personalized tDCS montages are optimized for the V5 and FEF stimulation targets using 74 potential sensor positions from a standard EEG layout

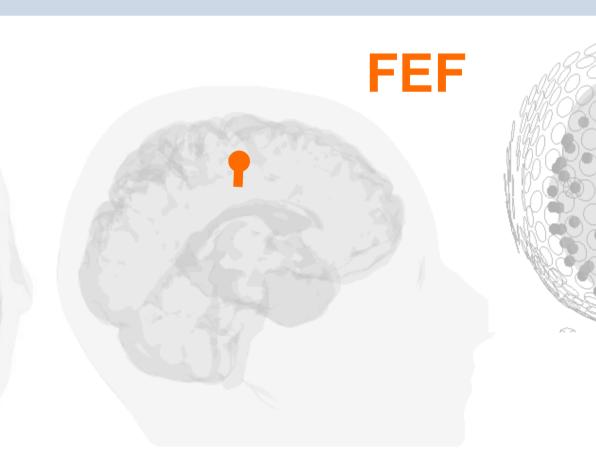
Functional MRI









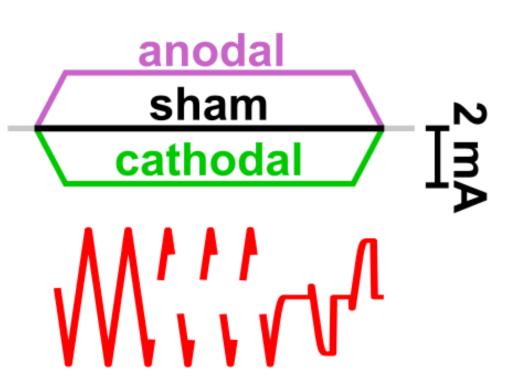


EEG/MEG

- Define target *orientations* based on EEG/MEG
- See poster by Buschermöhle et al. for details

Exemplary stimulation targets and tDCS montages

To be continued: Experimental tDCS design



- Personalized tDCS will be applied in N = 20 participants (20 min., 2 mA)
- Pursuit eye movements will be recorded at t0, during tDCS and for two post-tDCS timepoints
- tDCS is expected to specifically modulate eye velocity, acceleration and pursuit latencies
- → Analyze eye movement data together with electric field simulations and fMRI and EEG/MEG data

References

[1] Lencer R, Nagel M, Sprenger A, Zapf S, Erdmann C, Heide W, et al. Cortical mechanisms of smooth pursuit eye movements with target blanking. An fMRI study. European of Neuroscience 2004;19:1430–6. Journal https://doi.org/10.1111/j.1460-9568.2004.03229.x. [2] Ohlendorf S, Sprenger A, Speck O, Glauche V, Haller S, Kimmig H. Visual motion, eye motion, and relative motion: A parametric fMRI study of functional specializations of smooth pursuit eye movement network areas. J Vis 2010;10:21-21. https://doi.org/10.1167/10.14.21. [3] Wiethoff S, Hamada M, Rothwell JC. Variability in response to transcranial direct current stimulation of the motor cortex. Brain Stimul 2014;7:468-75. https://doi.org/10.1016/j.brs.2014.02.003. [4] 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.



