Multimodal assessment of TMS acute and long-term changes

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Background: Here we explain acute effects of TMS over left DLPFC using a new online TMS/fMRI setup in combination with advanced imaging and neuronavigation methods. Resting State functional connectivity and DTI Tractography further explain resulting activation patterns at a network level.

Methods: The study was performed on a 3T Tim Trio scanner (Siemens, Erlangen). The TMS system used included a MagProX100 stimulator and MRi-B91 MR-compatible TMS coil (Magventure, Farum, Denmark). Five right-handed female subjects (age: 28.6 ± 4.3 years) were examined. During stimulation (80%, 90%, 100% and 110% of individual's motor threshold), functional images were acquired using EPI (echo-planar imaging) sequence with TR/TE=1000/33ms, 28 slices, 1.5x1.5x3mm³. FMRI data analyses were performed using SPM12. The design matrix comprised four regressors representing different stimulation amplitudes. DTI tractography was performed using DSI Studio.

Results: TMS led to intensity-dependent activation increase in the left DLPFC and the contralateral DLPFC (Fig. 1): Higher stimulation intensities evoked higher bilateral activation. ACC showed a more complex response pattern. Resting-state functional connectivity maps using the stimulation target as seed-voxel showed a network very similar to the TMS-derived activation pattern (Fig. 2).

Conclusions: This is the first study to assess the acute influence of TMS over DLPFC at an individual level, made possible by a dedicated concurrent TMS/fMRI coil array. Here we show a dose-dependent increase in activity not only underneath the stimulation site but also on the contralateral homologous area and apparent mediating responses in the ACC. This network is confirmed by additional resting-state and tractography data.