

Development of a Combined TMS/Eye-Tracking Study for Executive Process

Assumption:

Executive control processes are independent functions distributed among prefrontal networks. Tested on two executive processes: task-switching and antisaccades.

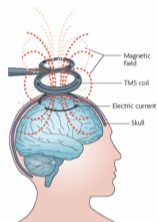
Hypothesis:

Suppression of frontal eye field (FEF) responsible for antisaccades (AS) should:

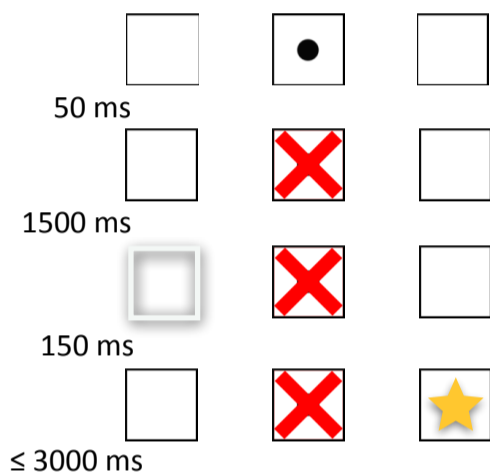
- ✓ increase reaction time for antisaccades
- ✓ not affect the execution of task switch between prosaccades and antisaccades

Design:

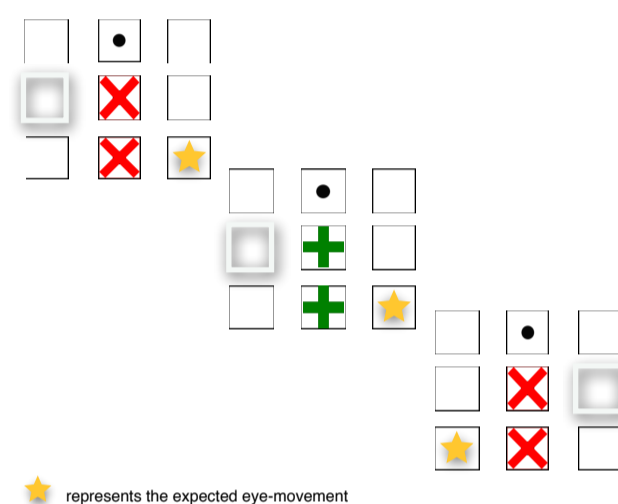
- Offline TMS protocol (continuous theta-burst), conditions: FEF, Vertex (control), No TMS
- Switching task (mixed), non-switching task (blocked)
- Linear Mixed Effects Regression
- 50 prosaccade + 50 antisaccade trials
- 100 mixed trials



Blocked condition: antisaccade

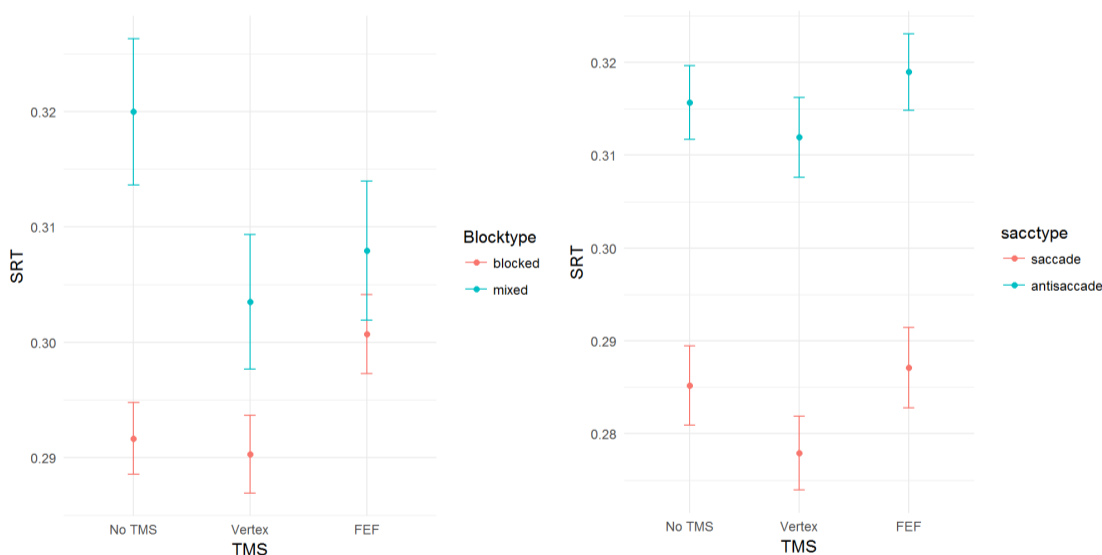


Mixed condition

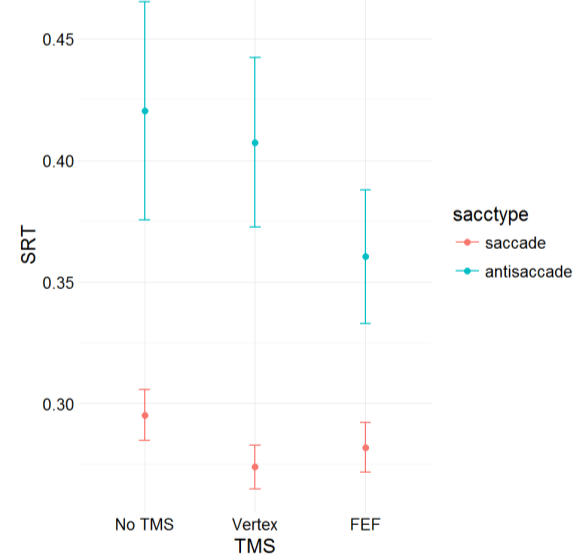


Results:

All trials with multiple eye-movements for correct target



Only mixed trials. Strict analyses.



3886 saccades (86% out of 4500 trials),
 3882 antisaccades (86% out of 4500 trials)

First saccade in the correct direction,
 saccades 2671 (68% of correct),
 antisaccades 377 (9% of correct).

Three-way interaction: Saccade type*Blocktype*TMS. Mixed task shows significant differences in AS latencies compared to blocked tasks.

No speed-accuracy trade-off.
 T-test FEF vs. No-TMS for AS = 0.017;
 T-test FEF vs. Vertex for AS = 0.016;
 T-test No-TMS vs. Vertex - not significant

Interpretation:

- Inhibition of FEF impact performance during high cognitive load (switching)
- Release of the inhibition speed up the programming of antisaccades
- Interaction of FEF and Superior Colliculus in programming task
- Offline TMS (theta-burst) may induce excitation for prefrontal processes

References: Barton, J. J. S., Cherkasova, M. V., Lindgren, K., Golf, D. C., Intriligator, J. M., & Manoach, D. S. (2002). Antisaccades and task switching: Studies of control processes in saccadic function in normal subjects and schizophrenic patients. *Neurobiology of Eye Movements: From Molecules to Behaviour*, 956, 250-263
 Jamadar, S. D., Fielding, J., & Egan, G. F. (2013). Quantitative meta-analysis of fMRI and PET studies reveals consistent activation in fronto-striatal-parietal regions and cerebellum during antisaccades and prosaccades. *Frontiers in Psychology*, 4(October), 1-15.
 Oik, B. (2005). Modulation of Antisaccades by Transcranial Magnetic Stimulation of the Human Frontal Eye Field. *Cerebral Cortex*, 16(1), 76-82.