Gamma-band activity reflects differential selection-for-action before single and double saccades

Daniel Baldauf [1]

[1] MIT, USA
[2] LMU, Munich, Germany

Synchronizations in the gamma range have been proposed to mediate top-down attention signals. Here we combined high-resolution eye tracking and EEG recording to study the neural mechanisms involved in the visual selection of upcoming movement goals.

Upon onset of an endogenous cue participants had to execute either single or double saccades to peripheral targets. We analyzed the EEG activity during the short reaction time interval between cue onset and start of the speeded saccadic response. Additionally, we tested the deployment of visual attention during movement preparation with a secondary letter discrimination task.

A frequency domain analysis of the EEG signals revealed an increase in occipital/parietal gamma band activity before saccade onset. This peak in gamma band activity temporally coincided with covert attention shifts to the saccade goal(s) as measured by the secondary letter discrimination task. The gamma response was even more pronounced before the initiation of double saccades, reflecting the visual selection of the additional saccade goals. The eye-tracking data suggest that the gamma response was not induced by microsaccades.

We therefore propose that neural synchronization in the gamma range co-occurs with the attentional selection of intended saccade goals and the

involved sensori-motor transformations. Moreover, these neural synchronizations are modulated by the amount of motor goals that need to be prepared.

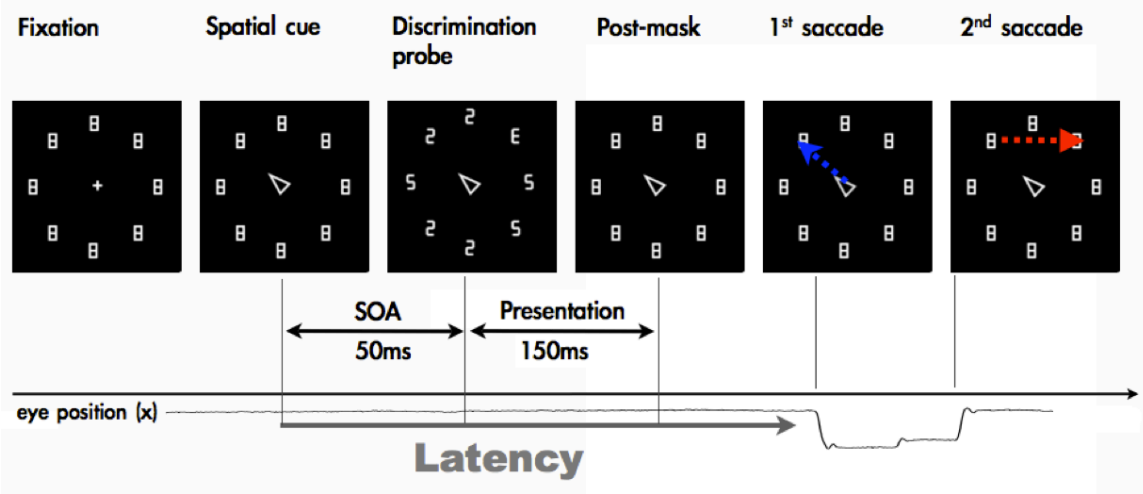

Fig.1 Experimental paradigm.

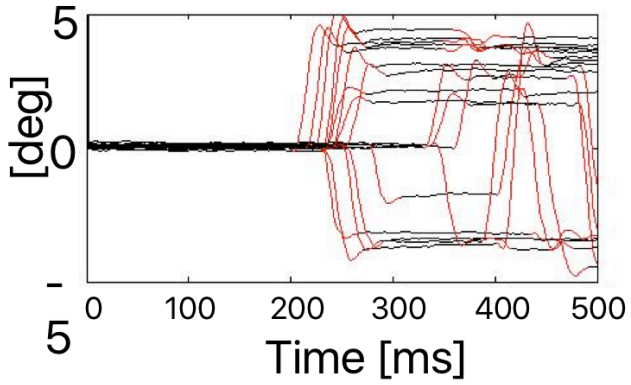

Fig. 2 Behavioral results: Eye-movement traces over time

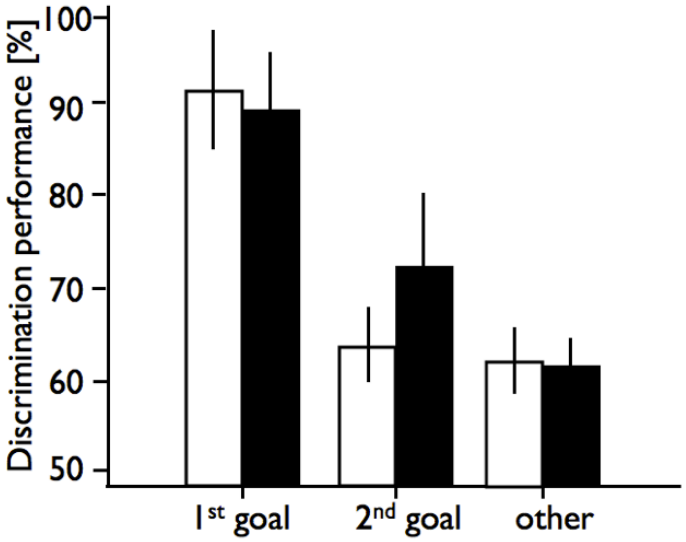

Fig.3: Behavioral results: discrimination performances in the secondary letter discrimination task.

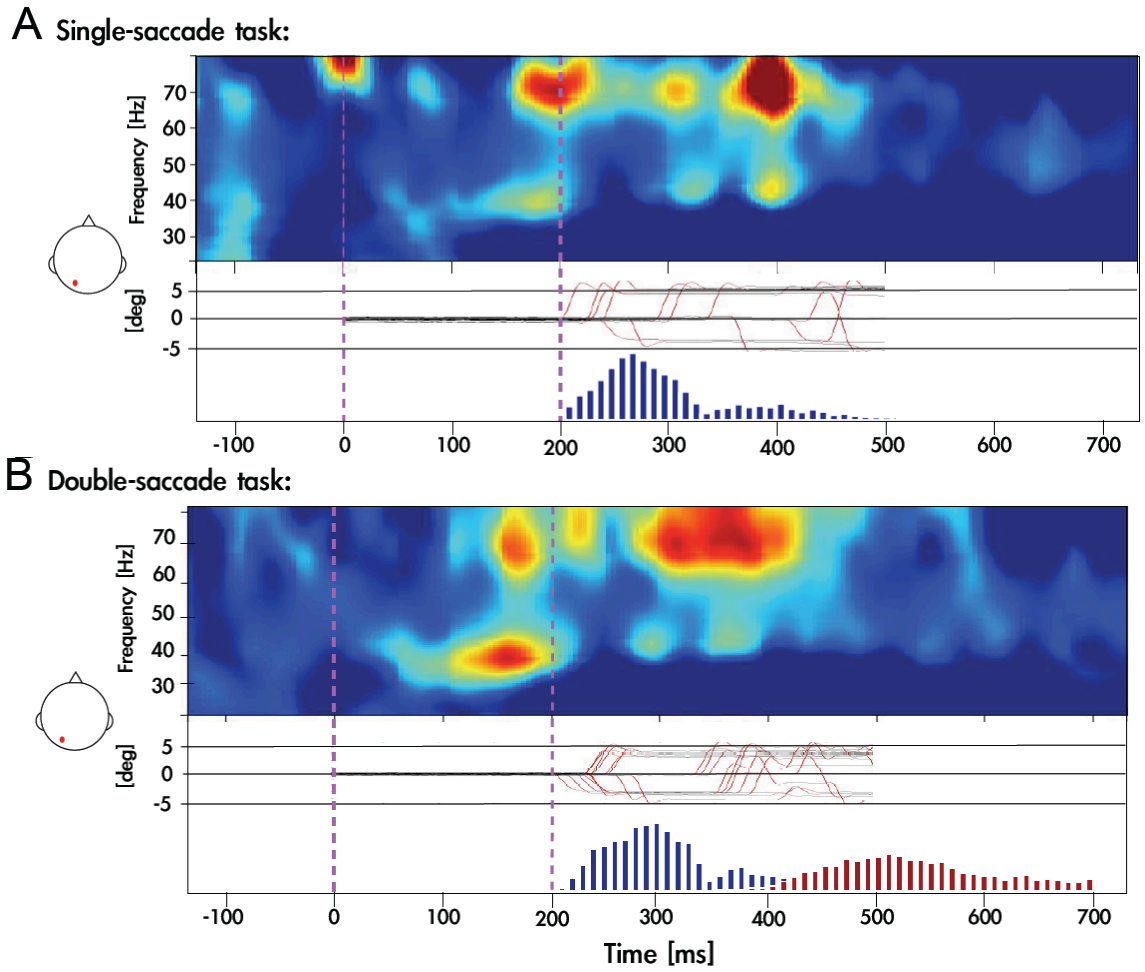

Fig.4: Electrophysiological results: Increased gamma already before onset of the planned movement(s). **(A)**Single-saccade trials, **(B)** Double-saccade trials

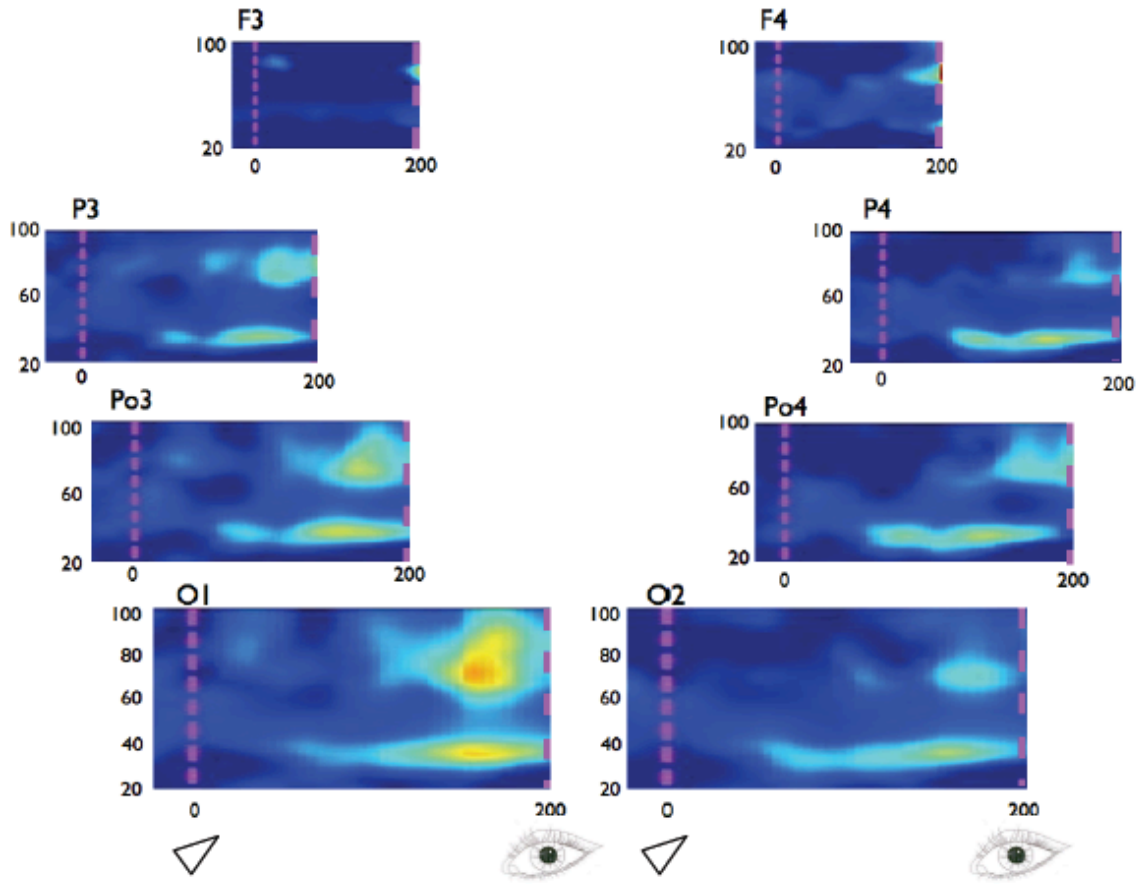

Fig.5: Electrophysiological results: topography

REFERENCES:

[1.] Baldauf, D. & Desimone, R. (2014). Neural mechanisms of object-based attention. Science, 344, 424-427.

[2.] Baldauf, D. (2011). Chunking movements into sequence: The visual pre-selection of subsequent goals. Neuropsychologia, 49(5), 1383-1387.

[3.] Baldauf, D., & Deubel. H. (2010). Attentional landscapes in reaching and grasping. Vision Research, 50, 999-1013.

[4.] Baldauf, D., & Deubel, H. (2009). Attentional selection of multiple movement goal positions before rapid hand movement sequences: an ERP study. Journal of Cognitive Neuroscience, 21(1), 18-29.

[5.] Baldauf, D., Cui, H., & Andersen, R.A. (2008). The posterior parietal cortex encodes in parallel both goals for double-reach sequences. Journal of Neuroscience, 28(40):10081-10089.

[6.] Baldauf, D., & Deubel, H. (2008). Visual attention during the preparation of bimanual movements. Vision Research, 48, 549-563.

[7.] Baldauf, D., & Deubel, H. (2008). Properties of attentional selection during the preparation of sequential saccades. Experimental Brain Research, 184, 411-425.

[8.] Baldauf, D., Wolf, M., & Deubel, H. (2006). Deployment of visual attention before sequences of goal-directed hand movements. Vision Research, 46, 4355-4374.