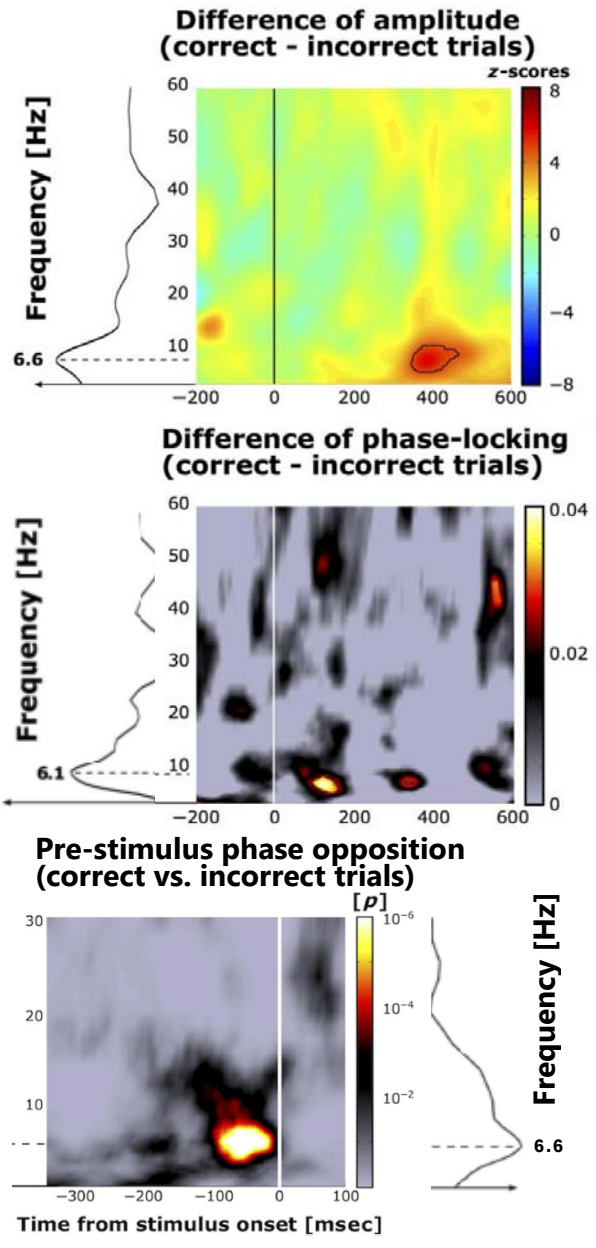
This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no. 600785

Theta oscillations modulate attentional search performance periodically

Dugué L, Marque P & VanRullen R. (2015) Theta oscillations modulate attentional search performance periodically. *J Cogn Neurosci.,* in press, *doi:10.1162/jocn_a_00755*.

Visual search—finding a target element among similar-looking distractors—is one of the prevailing experimental methods to study attention. Current theories of visual search postulate an early stage of feature extraction interacting with an attentional process that selects candidate targets for further analysis; in difficult search situations, this selection is iterated until the target is found. Although such theories predict an intrinsic periodicity in the neuronal substrates of attentional search, this prediction has not been directly tested in human electrophysiology. As the mechanisms of spatial updating critically depend on attention, such a test is particularly relevant to the SPACECOG endeavor: the dynamics of attention must impose constraints on the implementation of spatial updating mechanisms.



In this paper we used a combination of EEG and TMS to study attentional periodicities in visual search. EEG measurements indicated that successful and unsuccessful search trials were associated with different amounts of poststimulus oscillatory amplitude (top panel) and phase-locking (middle panel) at ~6 Hz and opposite prestimulus oscillatory phase at ~6 Hz (bottom panel). A trial-by-trial comparison of pre- and poststimulus ~6 Hz EEG phases revealed that the functional interplay between prestimulus brain states, poststimulus oscillations, and successful search performance was mediated by a partial phase reset of ongoing oscillations. Independently, TMS applied over occipital cortex at various intervals after search onset demonstrated a periodic pattern of interference at ~6 Hz (not shown here). The converging evidence from independent TMS and EEG measurements demonstrates that attentional search is modulated periodically by brain oscillations. This periodicity is naturally compatible with a sequential exploration of multiple attentional targets, each represented in turn on a different cycle. Therefore, a spatial updating mechanism simultaneously keeping track of several attention pointers (e.g. across saccadic eye movements) needs to coordinate its own dynamics with those of the attention cycle.