Neural underpinning of monitoring in different domains: an EEG-fMRI investigation

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Keywords: monitoring, executive functions, EEG-fMRI co-registration, prefrontal cortex, fronto-parietal network.

The present study is focused on the ability to monitor the environment over time to detect the occurrence of targets. Previous literature points to the dorsolateral prefrontal cortex (DLPFC), and more generally to a fronto-parietal network, as crucial areas for its implementation. Our aim was to demonstrate that the neural activation related to this function is independent of the nature of the specific material being processed. To this end, a monitoring task was designed using stimuli belonging to two domains, known to activate different and lateralized brain areas. Specifically, face and object processing mainly rely on right temporal-occipital areas and on a left-lateralized fronto-parietal network, respectively.

Eighteen healthy participants completed our study. EEG and fMRI data were simultaneously recorded in a 3T-scanner. The fMRI and EEG data were separately analyzed to highlight the domain-independent brain activations attributable to tonic and phasic components of the monitoring process, respectively. Moreover, a parametric modulation of the BOLD signal, using ERPs as regressors, was performed to specify the neural substrate of the phasic component.

An fMRI conjunction analysis showed overlapping fronto-parietal activations for monitoring in the two domains. Consistently, ERPs showed a modulation of the potentials associated with monitoring over frontal and parietal electrodes already in the 370-470 ms time window. An EEG-fMRI integrative analysis revealed the involvement of specific clusters within the aforementioned fronto-parietal network, which likely reflect the phasic component of monitoring.

Therefore, monitoring the environment over time to detect target stimuli relies on a fronto-parietal network, independently of the specific task context.