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Title: Errare humanum est…avoiding the error even more: fMRI evidence of brain networks involved in response suppression.

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Avoiding wrong responses to the environment is what usually makes our daily activities smooth and effective. Cognitive functions such as conflict detection and response suppression allow us to achieve that aim. Previous studies have identified single brain areas involved in these high-level functions. However, our brain works more as a set of dynamic and interactive networks than as a group of independent regions. Nevertheless, the neural networks supporting response suppression are not yet well-characterized. This issue was addressed in the present study.

FMRI images where obtained from 14 young healthy participants performing a go/nogo task. In that task, nogo visual stimuli (i.e., coloured letters and numbers) elicit high vs. low conflict with go stimuli. Specifically, high-conflict nogo stimuli share features with the go stimulus, thus requiring the suppression of a prepotent response. Two versions of the same task were administered. In a first version, only 2 stimuli per condition were presented (e.g., target stimuli: “blue O” and “red X”). However, in order to control for possible effects of visual memory strategies and physical characteristics of the stimuli, a more complex version of the same task was also used, with stimuli defined by broader categories (e.g., coloured consonants and vowels) rather than single items.

We used a multivariate Partial Least Squares (PLS)[1] analysis approach in order to identify brain networks that co-varied with task conditions. Contrasts between conditions were not specified a priori but determined by PLS in a data-driven fashion.

Results show that few areas were uniquely involved in selecting not to respond when low-conflict nogo stimuli were shown. On the other hand, a broader network activated in the presence of high-conflict nogo stimuli was found, including ventrolateral and dorsolateral prefrontal gyri, premotor regions, and anterior cingulate gyrus. This pattern was found in both the simple and the complex version of the go/nogo task.

However, what makes a network a network is functional connectivity between its areas. The latter was assessed by selecting a seed peak voxel in a ventrolateral prefrontal area identified in the previous analysis, and running a subsequent Multiblock PLS analysis. This analysis identifies how distributed patterns of brain activity covary together with the seed voxel and in relation to the task conditions. Results of this analysis confirmed that many of the areas identified in the previous analysis were indeed functionally connected with each other especially when response suppression was required.

Extending previous neuropsychological work, these findings show that this high-level cognitive function involves a set of brain areas functionally organized in a distinctive network.

1. McIntosh, Bookstein, Haxby, & Grady (1996). Spatial pattern analysis of functional brain images using partial least squares. Neuroimage, 3: 143-157.