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Top-down biasing signals of non-spatial, object-based attention

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Abstract

In order to understand the neural mechanisms that control non-spatial attention, such as feature-based, object-based, or modality-based attention we use signal processing tools in temporally high-resolving MEG signals to identify the inter-areal communication, through which large-scale attentional networks orchestrate the enhanced neural processing of attended non-spatial properties. In particular, we investigate interactions by means of synchronous, coherent oscillations of neuronal activity. Applying those methods allowed us identifying a fronto-temporal network that biases neural processing on a high, object-class level of neuronal representation. In particular, an area in the inferior part of frontal cortex, the inferior-frontal junction (IFJ), seems to be a key source of non-spatial attention signals. For example, when attending to one of two spatially overlapping objects that can not be separated in space, IFJ engages in coherent, high-frequent oscillations with the respective neuronal ensembles in IT cortex that represent the respectively attended object-class. A detailed analysis of the phase relationships in these coupled oscillations reveals a predominant top-down directionality, as IFJ seems to be the driver of those coherent interactions. We propose that the selective synchronization with different object representations in IT cortex allows IFJ to route top-down information about the attended object-class and to flexibly set up perceptual biases. Our results also suggest that attention networks in frontal cortex may be subdivided in dorsal and ventral subnets providing spatial and non-spatial attention biases, respectively.