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Exploring the electrophysiological basis of a novel mechanism for the social perception of attention - the “mind beam” hypothesis

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Abstract

An important task in social cognition is understanding what another person is paying attention to. Accurately perceiving the attention, intention, and beliefs of another person, so-called “theory of mind,” underpins fluent social functioning and high social-emotional intelligence. The “mind beam” hypothesis of social attention, which has been supported by non-invasive functional magnetic resonance imaging (fMRI) experiments, posits that the brain models the attention of others as an implied motion, or “mind beam,” connecting agents to attended objects. To identify the electrophysiological correlates of this hypothesized implied motion, human neurosurgical patients with implanted cortical stereoelectroencephalography (sEEG) and subdural grid electrodes performed a visual motion task to determine whether they could discriminate activity patterns associated with the direction of low-level visual motion and significantly decode the gaze direction in images depicting a sighted face, but not a blindfolded face. A classifier trained on grid-wide high-gamma power associated with low-level visual motion streaming left versus right was able to significantly decode gaze direction in static images depicting a sighted face (56.7-66.7%, p-value 0.00-0.04), but not in images with a blindfolded face (40.0%-50.0%, p-value 0.44-0.99) in four subjects. The decoding was specific to electrodes in mesial temporal structures (amygdala, hippocampus and entorhinal cortex) contralateral to the subjects’ dominant hand and electrodes at the temporoparietal junction; cortical regions with known roles in spatial reasoning and social cognition. Together, these results suggest that even though we are unaware of it, our brains encode others’ attention as an implied motion streaming from social agents to attended objects. These results offer a first step in understanding the cortical circuits responsible for social attentional modeling.