Left and right prefrontal routes to action comprehension

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Action comprehension exploits multiple cues available in the environment, from concrete motor features to contextual information. Together these cues allow individuals to successfully decode the intention guiding othersâ€™ behaviors and interact with them on a daily basis. Previous evidence suggests that motor features are dorsally processed via the fronto-parietal action observation network (AON); while semantic cues about objects in context are ventrally retrieved via temporal structures [1]. Importantly, these dorsal and ventral routes are known to be preferentially tuned to low (LSF) and high (HSF) spatial frequencies, respectively. Recently, we proposed a model of action comprehension where coarse LSF information about objects in context is rapidly projected to ventral and dorsal (AON) systems via the prefrontal cortex (PFC), providing a prediction signal of the most likely intention afforded by them [2]. Yet, the mechanisms supporting the integration between naturalistic action coding within ventral and dorsal systems and the prediction exploited by the PFC await for experimental testing. Furthermore, based on evidence [3] supporting the existence of left and right hemispheric preferences for processing HSF and LSF stimuli, respectively, we also tested for a potential difference in hemispheric contributions to processing context-embedded actions. To this end, we used a perturb-and-measure continuous theta burst stimulation (cTBS) approach, selectively disrupting neural activity in the left and right PFC (as well as vertex as active control region) and then evaluating the participantâ€™s ability to recognize filtered action stimuli containing only HSF or LSF. Overall, we found that stimulation over PFC triggered different spatial-frequency modulations depending on stimulation lateralization. Specifically, as compared to vertex, the stimulation over the left PFC led to a selective drop in performance for HSF, while stimulation over the right PFC selectively reduced performance for LSF action stimuli. These findings shed new light on the existence of different prefrontal routes for the estimation of othersâ€™ motor intentions, challenging current action models, which mainly focus on the ventral object recognition pathway. Our results suggest that these models should be updated to account for the contribution of an alternative route, namely, the magnocellular-dorsal pathway. Furthermore, they demonstrate that left and right PFC are differentially engaged depending on the spatial frequency of the stimuli, providing a broader account for how naturalistic complex actions are processed by the human brain.

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