Double dissociation between the extrastriate body area and the posterior superior temporal sulcus during biological motion perception: converging evidence from TMS and fMRI

Joris Vangeneugden[12], Marius Peelen[2], Duje Tadin[3] & Lorella Battelli[14]
[1]Center for Neuroscience and Cognitive Systems, Italian Institute of Technology, Rovereto, Italy
[2]Center for Mind/Brain Sciences, University of Trento, Rovereto, Italy
[3]Center for Visual Science, Department of Brain and Cognitive Sciences, and Department of Ophthalmology, University of Rochester, Rochester, New York, USA
[4]Berenson-Allen Center for Noninvasive Brain Stimulation, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts, USA

Our brains engage numerous regions when exposed to biological motion, with the posterior superior temporal sulcus (pSTS) being the primary locus. The exact roles of hMT+ and the extrastriate body area (EBA) remain unclear. Here, we set out to determine the specific roles of pSTS and EBA during biological motion perception, focusing on walker orientation and walking direction. To obtain converging evidence, we conducted separate TMS and fMRI experiments within the same subjects (N=12). Two separate tasks were used in the TMS study: walker orientation probing form processing and walking direction probing motion/sequence processing. Task performance was compared before and after applying repetitive offline TMS (1Hz) over EBA and pSTS (based on fMRI-guided stereotaxy). In the fMRI study, EBA and pSTS were mapped in separate scans using standard localizers. Subsequently, runs with point-light walkers were subjected to MVPA, determining the amount of static (orientation) and dynamic (direction) information present within EBA and pSTS. Both TMS and MVPA revealed a strong double dissociation between inferred functions of EBA and pSTS. Disrupting EBA impaired performance on the walker orientation task, while leaving walking direction performance intact. In contrast, disruption of pSTS processing resulted in the opposite effect ($p<.001$). Similarly, EBA BOLD response revealed significant walker orientation information and no walking direction information, while (again) pSTS BOLD response displayed the opposite pattern ($p<.005$). We provide converging and causative evidence that dissociates EBA (static body processing) from pSTS (dynamic body sequence processing) during action perception.