NEURAL SENSITIVITY TO TRANSLATIONAL SELF- AND OBJECT- MOTION VELOCITIES

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Background: The ability to detect and assess world-relative object motion is a critical computation performed by the visual system. This computation, however, is greatly complicated by observer motion, which generates a global pattern of motion on the observer's retina. How the visual system implements this computation is poorly understood.

Aims: This study aimed to unveil the potential neural signature of object-motion detection by manipulating relative motion velocity between the observer and the object as a strategy to test how the brain accomplishes this computation.

Method: We used a combined approach of surface-based brain mapping, task-evoked activity by fMRI, and advanced data analysis procedures. In 26 healthy volunteers we first identified a set of egomotion-related visual areas (CSv, pCi, PIC, V6, V3A, VIP and MT+) by using the flow field stimulus. We then examined their response to the main fMRI experiment consisting of observation of movies reproducing different velocities of visually induced translational self- and object-motion within a realistic virtual environment. Repeated-measures ANOVAs were used to test the brain sensitivity to different combinations of self- and object-motion. Parametric and representational similarity (RSA) analyses were used to test whether the activity of these regions was modulated by self- and object-motion velocity.

Results: We found that, among all the egomotion areas, CSv and V6 showed a remarkable preference for pure self-motion with respect to pure object-motion and to any combination of self- and object-motion. Results from parametric and RSA analyses revealed that areas MT+, V6+, and V3A also showed a response profile reflecting different object-motion velocities.

Conclusions: A differentiated profile emerged among the egomotion regions during a visual motion stimulation including self- and object-displacements and a combination of them. Areas MT+, V6, and V3A showed a response profile reflecting different self- and object-motion velocities. Notably, "real motion" detection has been ascribed to the monkey areas MT+, V6, and V3A, since they host a good percentage of "real-motion" cells, i.e., neurons responding to the actual movement of an object in the visual field, but not to the movement of its retinal image self-induced by self-motion. We suggest that these regions may be involved in the critical computational process needed to detect scene-relative object motion during visually induced self-motion.

Keywords: Optic flow, Object-motion, Self-motion, Functional magnetic resonance, Egomotion, Neural similarity

Publications:

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