53-407

A Measure of Localization of Brain Activity for the Motion Aperture Problem using Electroencephalograms

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Problem. Through a limited-sized aperture bars appear to move in a direction normal to their orientation. The motion aperture problem is an important rubric for analyzing early stages of visual processing, particularly with respect to the perceptual completion of motion sampled across two or more apertures (M.Okada, S.Nishina and M.Kawato, Neuro Report, 14, 14, 1767-1771, 2003).
Experiment. A circular aperture is displayed in the center of the visual field, and, in a baseline condition, a bar initially appears to move from the lower-left to the top-right (its normal motion direction). While the baseline bar is moving, two additional circular apertures appear, and within each aperture a "flanker bar" appears to move in an up or down (control) direction. For these flanker bars the line ends are visible in the two apertures and thus can disambiguate the motion of the base bar. For an upwards movement of the flanker line the subjects perceive the flanker bar connected with the base bar and all three parts move upward. We investigate the motion perception of the moving bars by changing line speed, radii of the apertures, and line length while recording and then analyzing spatio-temporal brain activities by electroencephalograms (EEGs). Latencies in the brain are estimated using equivalent current dipole source (ECD) localization for two subjects.
Result. Soon after the flankers appear, ECDs are localized along the ventral pathway, which are assumed to be generated by the recognition of the aperture's form. After the bars move, ECDs are localized along the dorsal pathway, presumably generated by the motion of the bars. In addition, for the perception of veridical (grouped) motion and not normal motion, ECDs were localized to the middle frontal gyrus and the inferior frontal gyrus.

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