Isolating the effect of one-dimensional motion signals on the perceived direction of moving two-dimensional objects

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Abstract:

A considerable body of evidence suggests the existence of a two-stage mechanism for the detection of global motion. In the first stage the motion of elongated contours is extracted and then at the second stage these one-dimensional (1D) motion signals are combined. What is the nature of the computation carried out in combining the 1D motion signals towards forming a global motion percept? We devised a set of stimuli that differentiate between different possible computations. In particular, they distinguish between a velocity-space construction (such as intersection of constraints) and a linear computation such as vector averaging. In addition, these stimuli do not contain two-dimensional (2D) motion signals such as line intersections, that allow unambiguous determination of global velocity. Stimuli were presented in uncrossed disparity relative to the aperture through which they were presented, to reduce the effect of line terminator motion. We found that subjects are unable to detect the veridical global direction of motion for these stimuli. Instead, they perceive the stimulus pattern to be moving in a direction which reflects the average of its 1D motion components. Our results suggest that the visual system is not equipped with a mechanism implementing a velocity-space computation of global motion.

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