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Three Mechanisms of Human Visual Motion Detection
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New psychophysical methods enable the isolation and measurement of three mechanisms of human motion perception. The first two are primarily monocular, bottom-up, sensitive, and fast. A third-order mechanism computes motion from a "feature salience map." It is inherently binocular, insensitive, slow, but highly versatile--it computes motion from luminance, contrast, depth, motion-defined-motion, flicker and other types of stimuli, and it is influenced by attention. This article describes how these mechanisms were isolated and how the relations between them were defined. For over 100 years visual motion perception has been a central problem in perceptual theory. On the one hand, motion appears to involve an early set of pattern recognition (the "same" pattern must be located first here and then there); on the other hand, motion appears to invoke a unique perceptual experience quite different from pattern or shape perception. Almost from the beginning of the experimental study of motion perception, it has been evident that more than one kind of computation is involved, and there has been a plethora of dual-process motion theories. While there clearly is a kernel of truth underlying most of these dichotomies and theories, there have been two pervasive problems: No one has been able to obtain a demonstrably pure measure of any proposed mechanism. Nor has there been a clear distinction between the algorithm by which motion is computed and the preprocessing of the visual image prior to the point of motion computation. Here, we describe the combination of a new paradigm (pedestal displays) in conjunction with several critical subsidiary paradigms (interocular displays, stimulus superpositions with varying phases and directions, stimulus mixtures, and attentional manipulations) that enable us to clarify some of these issues.