Supporting Information

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SI Text

Additional Flash-Lag Phenomenology. In addition to the perceptual phenomenology that we describe, the literature on the flash-lag effect reports some further effects. Thus, if the moving object reverses direction at the time of the flash, the magnitude of perceived lag remains largely unchanged, but the direction of lag reverses (1–3); moreover, if the moving object stops abruptly when aligned with the flash, the perception of lag is effectively eliminated (3). The implication of these observations as drawn by the authors is that object motion after the flash determines much of the effect.

Although our results do not speak directly to these issues (we could not test them with the apparatus shown in Fig. 3), these phenomena may also have an explanation within the framework we have used. For instance, because the stimulus in each of these conditions provides different empirical information (e.g., the trajectory change encountered when an object bounces back off a surface, and the disappearance behind an occluder, respectively), the empirical significance of the stimulus is also different, and therefore would be expected to elicit a percept that accords with the frequency of occurrence of such stimuli in relation to the behaviors that would have dealt with them successfully. In both cases, the effects observed would be those expected on empirical grounds.

The Basis for the Shape of the Psychophysical Function. When the speed of a moving object increases, the amount of perceived lag increases in a nonlinear manner (Fig. 4). Although this shape fits very closely the curve predicted empirically, the psychophysical function also could be conceived in terms of a saturating neural mechanism (see *Discussion*), or as an instance of Weber's law. We note in the text, however, that positing saturation would be arbitrary; in addition, Weber's law is embedded in an empirical explanation (i.e., optimizing successful behavior empirically depends on adjusting just-noticeable differences to the processing ability of sensory systems that can only generate a limited number of action potentials per unit time).

The main reason that most other studies have reported a linear rather than a nonlinear function is simply because a much smaller range of speeds was tested (see *Results* and *Discussion*). One study we are aware of that used Gabor patches presented at very low speeds ($\leq 8°/s$) (4) actually reported a nonlinear *decrease* in perceived lag with increasing speed. Given the difference in stimuli, however, it is not possible to compare these results to the results extracted from the simulated environment we used. As noted, a definitive explanation of the flash-lag effect and other more complex motion percepts in empirical terms will depend on motion data from natural environments, as in the case of brightness, color, and form (5–7).

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