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Accelerating self-motion displays produce the most compelling vection

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Abstract

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decision regarding the perceived coherence or transparency of the test plaid. Coherence reduction was hypothesised to demonstrate tuning around the spatial frequency (SF) of the plaid blobs. Movshon et al [1985, in *Pattern Recognition Mechanisms* Eds C Chagas, R Gatass, C G Gross (New York: Springer)] showed that adaptation to a moving grating reduces perceived coherence of a plaid and found a negative linear relationship between the SF of the test plaid and its post-adaptation coherence. However, the test plaids employed by Movshon et al, being asymmetric in contrast, would not ideally stimulate the proposed 'blob detecting' mechanism. Contrary to this earlier research, the preliminary results presented here show SF-tuning of post-adaptation plaid coherence.

◆ **A single population of velocity detectors can account for the adaptation differences to fast and slow motion**

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Motion aftereffects (MAEs) are illusory perceptions of motion after prolonged viewing of drifting patterns. MAEs are different for static and dynamic test stimuli. For example, static test stimuli cause MAEs for slow adaptation motion whereas dynamic test stimuli do so for fast adaptation motion (Verstraten et al 1999 *Vision Research* **39** 803 – 810; van der Smagt, 1999 *Nature Neuroscience* **2** 595 – 596). The authors interpreted these (and other) findings as supporting evidence for the idea that different populations of neurons process slow and fast motions. Verstraten et al used test stimuli that were either static or dynamic; no intermediate stimuli were used. Van der Smagt et al used two adaptation speeds. We investigated whether the use of two comparison points (static/dynamic or two velocities) may have caused the dichotomy in the data. We used the distribution-shift model (including velocity and direction adaptation, and explicit modeling of the test phase), and were able to reproduce the experimental data by assuming that there is just a single population of velocity-sensitive cells. An important assumption of the model was that the distribution of velocities in static test stimuli was narrower than in dynamic test stimuli.

◆ **Perceived velocity decreases with time: The case of interrupted motion**

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When a target is moving in the frontal plane with constant velocity, the perceived velocity decreases with time. This phenomenon could be explained with Bachmann et al's concept of perceptual acceleration (2003 *Consciousness and Cognition* **12** 279 – 297). Here, we examined how velocity perception is affected by a short interruption of motion. The target travelled across the computer screen and disappeared for a short time during motion. Velocities before and after motion interruption were varied and the point of subjective equality of velocities was measured. We found that perceived velocity after the interruption was lower than the one before the interruption. On the other hand, in the control condition, where after interruption the target reappeared at the initial onset position and thus travelled the same path twice, perceived velocity after motion interruption was similar to that before the interruption. The results indicate that, when a target travels behind an invisible occluder for a short time, it can preserve its identity owing to motion extrapolation and then its velocity can be effectively represented as soon as it reappears again. Perceptual acceleration is therefore most likely restricted to cases where representations of new objects are formed.

◆ **Accelerating self-motion displays produce the most compelling vection**

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We examined the vection induced when two very different types of simulated self-acceleration were added to displays simulating constant-velocity self-motion in depth. Contrary to the predictions of visual – vestibular conflict theory, coherent perspective jitter (random, high frequency) and coherent perspective oscillation (systematic, lower frequency) were both found to improve vection relative to non-accelerating controls. While only horizontal and vertical self-accelerations reduced vection onsets, self-accelerations along all three axes were found to increase the perceived speed of self-motion in depth and reduce motion aftereffects. These results are clearly incompatible with the notion that constant-velocity displays produce optimal vection. Rather, it appears that simulated self-acceleration not only facilitates the induction of vection, but it also produces a more compelling experience of self-motion in depth by reducing adaptation to the radial component of the optic flow.