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A Theory of Isoluminant Chromatic Motion Perception

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An isoluminant chromatic display contains different colors but all of the colors are precisely equal in brightness. Therefore, the motion in such displays is perceived neither by color-sensitive mechanisms of the brain, which are thought to be insensitive to motion, nor by motion-detection mechanisms, which have been shown to be insensitive to color. Four experiments are reported to demonstrate that isoluminant chromatic motion is perceived exclusively via the so-called third-order motion-detection system. [Note: The first-order motion system computes motion from the luminance $l(x, y, t)$ in a display. The second-order systems computes motion from the quantity of texture $q(x, y, t)$ at each point of a display. The third-order system computes motion from the salience $s(x, y, t)$ of each point in a display. Salience is 1 for points that are segmented as figure, 0 for points segmented as ground, and salience takes intermediate values for ambiguous points.] The experimental results show that isoluminant chromatic motion has the following properties, all indicative of third-order motion: It fails the pedestal test, (2) has a temporal corner ("cutoff") frequency of 3–6 Hz, (3) is indifferent to whether successive frames are delivered to the same or to different eyes, and (4) the illusion of "motion standstill" can be produced with highly visible chromatic gratings that satisfy an equal-salience condition. These findings indicate that movement of pure-color displays is not detected by some subsystem of the brain's color-sensitive perceptual mechanism, but by the third-order motion system at a higher level of the brain where cues about form, texture, depth and color are simultaneously available and where selective attention can influence the process.

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