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A reexamination of the Enright (1970) illusion: Distance from motion and stereo?

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Abstract

An observer looking out the side window of a rapidly moving automobile, with a neutral density filter over one eye, sees the world as dwarfed and moving by slowly (Enright, 1970). Enright argued that increased disparity from the Pulfrich effect causes near objects to appear nearer still, so that size constancy requires they be small, and speed constancy that they be moving slowly. However, it is possible the effect results from solving for absolute distance using mutual constraints provided by structure from motion and shape from relative binocular disparity (Richards, 1985; Kellman & Kaiser, 1995). In this case, the three-dimensional scene would retain its original apparent shape, and, critically, the entire scene (not just the near objects) would appear smaller and closer. Previous studies used small displays of isolated objects and failed to find such an effect (Brenner & Landy, 1999).

We reproduced the illusion under laboratory conditions. 180 digital images of a tabletop scene were taken at 0.35 cm intervals. Stereoscopic moving images were created by selecting pairs of images from this sequence; movies had varied camera speeds and interocular baselines. The resulting movies were displayed in a repeating 1-sec loop using a haploscope. Images subtended 30 x 20 deg. Vergence eye posture was held constant at approx. 0 or 6 deg by instructing observers to fixate a distant object in the scene.

As the baseline was increased from 7 mm to 12 cm, near objects in the scene appeared nearer and smaller, and apparent speed went down, as in the original illusion. Far objects decreased in apparent size, as predicted, but also increased in apparent distance. This violation of size-distance scaling suggests that separate computations exist for size and distance, with perceived distance and retinal image size not wholly determining perceived object size. Direct calculation of distance from motion and relative disparity does not account for Enright's illusion in any simple way.

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