Notes and Comment

The vista paradox: Is the effect partly explained by induced movement?

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Walker, Rupich, and Powell (1989) describe a *vista paradox*. In their experiments, flagpoles at a great distance were viewed through a small window. The observer, starting at some distance from the window, walked towards it. The flagpoles were perceived as receding and contracting. This conflicts with their image expansion, which should have caused them to appear nearer and possibly larger, if size constancy was inadequate. Examples of the vista paradox are fairly diverse: In another case, perception of an island may be affected when an observer moves towards it through a tree-lined valley. The conditions for the paradox appear to be a relatively close and well-defined aperture (the window or the trees and valley sides) surrounding a distant stimulus (the flagpoles or the island). During observer movement, the aperture undergoes considerable visual expansion, while the distant stimulus undergoes much smaller visual expansion. Walker et al. assumed that the latter is negligible, a position that will be taken here.

Walker et al. plausibly point to *framing* effects as providing one line of explanation. The aperture, changing during observer movement from visually small to visually large, should lead to a diminution in perceived size of any stimulus it surrounds (see, e.g., Brigell, Uhlarik, & Goldhorn, 1977; Weintraub & Schneck, 1986). Other applicable effects are the *equidistance tendency* (Gogel, 1965a) and the *adjacency principle* (Gogel, 1965b). The former refers to the tendency for objects in the visual field to appear at the same distance. The latter modifies the equidistance tendency by supposing that it is stronger for objects closer in the visual field. In the vista paradox, aperture and distant stimulus would appear closest in depth when the aperture is smallest, at the beginning of observer motion. As the observer moves, adjacency is reduced, so the equidistance tendency is reduced. However, Walker et al. note that these lines of explanation are incomplete. The perceived contraction of the distant stimulus in the vista paradox should, they suggest, be counteracted by its perceived *decreased* distance to preserve size-distance invariance (Emmert's law). Furthermore, there must be a dynamic component to the vista

paradox, since a succession of static views gives an attenuated effect.

One phenomenon consistent with the above, and ignored by Walker et al., is *induced movement*. Naturalistically, this is familiar in the perceived movement of the moon on a cloudy and windy night. The moon, otherwise phenomenally stationary, is seen to move in the opposite direction to the clouds. The classic laboratory demonstration of induced movement consists of a luminous rectangular frame surrounding a luminous stationary spot viewed in the dark: Movement of the frame may not be perceived, but opposite movement of the spot will be perceived (Duncker, 1929/1938). Subsequently, a wide variety of displays has been devised. The inducer may move with or without overall displacement. Induced movement may be linear, rotary, expansional/contractional, or in-depth (reviewed by Reinhardt-Rutland, 1988).

Appropriate to the vista paradox are studies of induced expansion/contraction and movement-in-depth. Inducers have included real movement-in-depth (Farne, 1970, 1972) and illusory movement-in-depth exploiting binocular differences (Gogel & Griffin, 1982) and brightness (Farne, 1977). One of Farne's (1972) inducers was a circle that stroboscopically expanded. A static circle concentric with and surrounded by the inducing circle was seen to recede. The display has obvious similarities with static framing-effect displays, from which a contraction of the enclosed circle would be predicted. In other displays, static framing effects could not contribute: Reinhardt-Rutland (1983b, 1984) exploited the perceived expansion/contraction and movement-in-depth of a rotating spiral to induce expansion/contraction and movement-in-depth of a circle concentric with the spiral. Induced recession was consistently linked with induced contraction; conversely, induced approach was consistently linked with induced expansion, thus defying size-distance invariance. Where two- and three-dimensional effects are simultaneously reported, this is a general finding (see also Farne, 1970, 1972, 1977). Reinhardt-Rutland (1983b, 1984) also showed that, as with other forms of induced movement (e.g., Reinhardt-Rutland, 1981), induction is most effective if the induced stimulus is central to the inducer. This is consistent with the conditions for the vista paradox. Induced movement-in-depth can be a substantial effect: Indirect measurements suggest that it can be up to 50% of inducing movement in perceived magnitude (Gogel & Griffin, 1982).

Four additional points can be added, although they have not been investigated under conditions closely comparable to the vista paradox. First, induced movement is not dependent on near-threshold inducing speeds, as sometimes has been supposed (see, e.g., Becklen & Wallach,

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1985; Gogel, 1979), so the great visual speed of an aperture, as an observer gets closer, would remain a plausible inducer. Second, induced movement can add to image movement: For example, Day (1981) measured induced movement by nulling it with image movement. Thus, induced movement could have combined with image expansion of the distant stimuli in Walker et al.'s experiments. Since image expansion was small, induced movement could have swamped its effects. Third, induction is not dependent on close proximity of induced and inducing stimuli in the visual field (Reinhardt-Rutland, 1983a); therefore, induced movement may still occur when the aperture is in the far periphery of the observer's visual field. Fourth, although most studies investigate induced movement under conditions of fixation, several studies, including that of Gogel and Griffin (1982), have involved observer movement (e.g., Becklen & Wallach, 1985; Gogel, 1979). Observer movements have been small: Results reveal that induced movement may be enhanced during them (see Reinhardt-Rutland, 1988). This indicates that kinesthetic information, as is inherent in Walker et al.'s procedure, need not impede the observation of induced movement.

One must conclude that the vista paradox probably exploits effects found in previous laboratory studies. Walker et al. rightly point to stationary effects, particularly framing effects. In addition, induced expansion/contraction and movement-in-depth must be regarded as plausible candidates.

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(Manuscript received June 19, 1989;
accepted for publication August 3, 1989.)