Notes and Comment

Velocity or spatial and temporal separation: A comment on Farrell

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In a study of visible persistence, Farrell (1984) used a temporally sampled rotating radial line to examine the effects of angular separation (10° , 20° , 30° , and 40°) and temporal sampling rate (11, 14, 18, and 25 Hz) on the number of lines visible simultaneously. The results showed linear increases in the number of lines reported as the temporal sampling rate was increased, with the slopes of the increasing functions related directly to the radial separation of the lines.

Farrell acknowledged some discrepancies between her results and those of her predecessors (Allport, 1970; Efron & Lee, 1971), which we have discussed elsewhere (Stelmach & Hearty, 1987). She also noted a spatial effect consistent with what is known of suppressive phenomena (Di Lollo & Hogben, 1987), but noted the absence of a non-linearity in the temporal function, which such phenomena would appear to require (Kahneman, 1968; Weisstein, 1972).

In discussing her results, Farrell understandably elected to characterize her displays in terms of the factors that she directly manipulated: the angular separation between successive presentations of the lines and the temporal sampling rate. We note, however, that the displays were multidimensional and can be characterized not only in terms of separation and display rate, but also in terms of their principal conjugate—the angular velocity of the rotating line (note that the total duration and the total number of samples also varied). Compared with the original characterization, Farrell's data are represented more simply using angular velocity.

Figure 1 replots Farrell's original data in terms of the principal conjugate—angular velocity. As the figure shows, Farrell's data fall along a single curvilinear function of angular velocity, whereas four separate functions were needed in the original characterization. The recharacterization is possible because angular and temporal separation interact and because the precise form of the interaction is as would be expected if radial velocity (or its correlate) were the determining factor.

Given the simplicity and parsimony of this representation of the data, it might be more profitable to question why the number of lines reported increased with velocity rather than why one part of a putative suppressive mechanism appeared and the other did not. This shift in emphasis would agree with the current trend toward the use of motion and velocity tuning as the basis for mechanisms in psychophysical, computational, and neurophysiological modeling (Burr, Ross, & Morrone, 1986; Fleet & Jepson, 1985; Kelly, 1985; McKee, Silverman, & Nakayama, 1986; Watson & Ahumada, 1985).

One problem with the current conceptualization is that, for a given rotational velocity, the actual linear velocity of the line increases as one moves out along the radius. In Farrell's case, the outer tip of the line was moving 2.25 times faster than the inner tip. It remains to be seen whether the visual system responds to rotational velocity separately from linear velocity. However, observations in our laboratory suggest that the effects observed by Farrell occur in displays containing either rotatory or translatory movement.

Figure 1. Farrell's (1984) data replotted as a function of angular velocity at four levels of angular separation between lines.

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(Manuscript received June 9, 1987;
revision accepted for publication July 17, 1987.)