Exploring the Onset Repulsion Effect

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Introduction

When observers are asked to indicate both the ONSET and OFFSET of a moving object, they systematically mislocalize the point of appearance back along the path of motion, that is, in a position that was never occupied

This "onset repulsion effect" (ORE) is larger and more consistent than offset localization errors (representational momentum) or errors parallel to the direction of motion

(Thornton, ARVO, 99;
See also Actis Grosso et. al, 1996)

Purpose

In four new experiments, the behavior of the Onset Repulsion Effect is explored in more detail and one potential explanation is discussed.

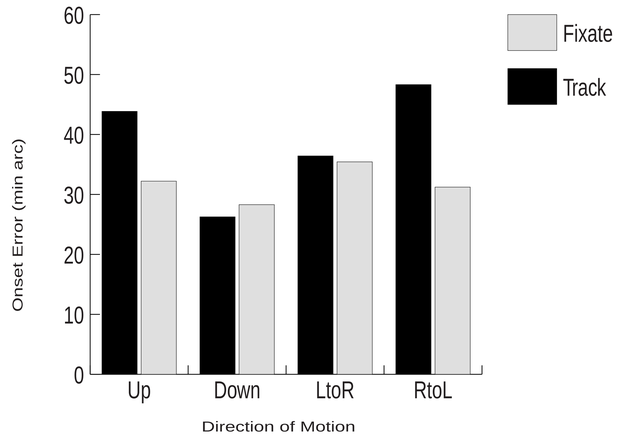
Method

On each trial a single black dot (20 min arc) appeared in a random location within 4° of the screen center.

The dot moved with a constant speed in one of 4 possible directions (Up, Down, LtoR, RtoL), randomly selected on a trial-by-trial basis. After traveling a short distance (between 3° and 6°), the dot disappeared.

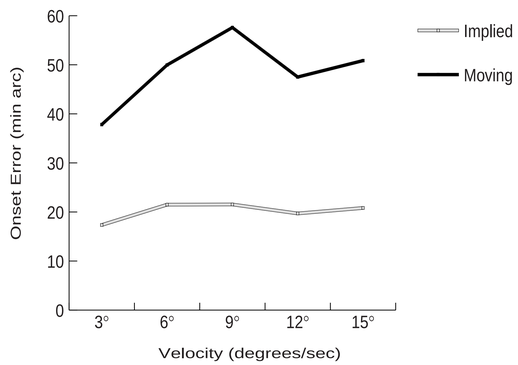
After a 1 second retention interval, observers (N=12 in all Exps.) were required to localize onset and offset points, clicking first on the perceived start and then on the perceived stop location using a standard mouse arrow cursor.

Eye Movements



The onset repulsion effect can be observed regardless of whether observers track the moving object or maintain central fixation.

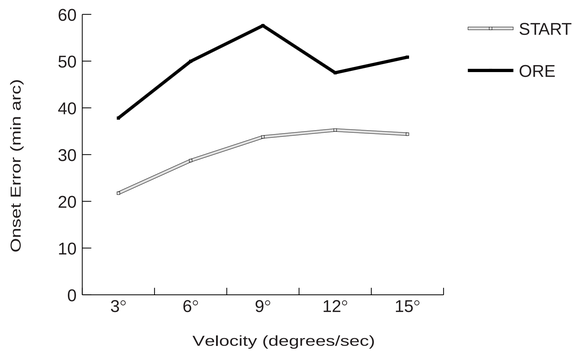
Velocity



The onset repulsion effect increases with velocity up to approx 10°/sec. As speed increases, observers shift the perceived onset point further away from the true origin.

We are currently exploring what happens with velocities in the range used to study the Fröhlich Effect (15°-50°/sec).

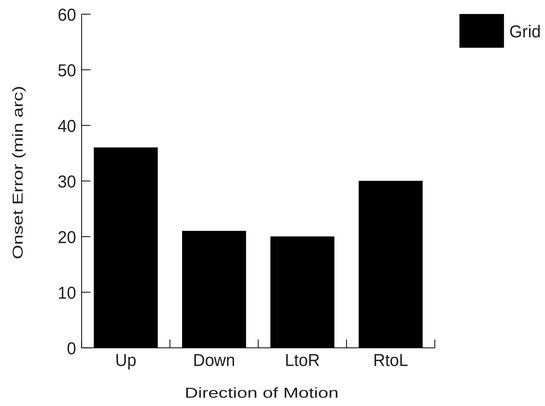
Attend Start



When observers are instructed to focus only on the start location, a small onset repulsion effect is still observed.

Thus, at least in this velocity range, the effect does not require attention to both the start and the stop locations.

Reference Grid



In this Experiment, a dense reference grid with 15 x 15 min arc cells covered the entire screen.

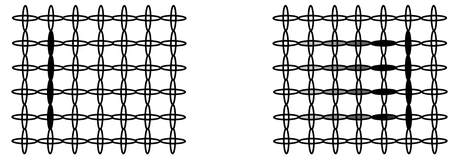
Even when the object moved within the grid, observers continued to mislocalize the start, placing it, on average, in the immediately preceding cell.

Mechanism?

Kim & Francis (1998) suggested that motion lines, such as those shown above, might have some physical reality in the form of "cortical afterimages".

Their analysis of the boundary-contour system, a neural-network model of visual perception (e.g., Grossberg, 1994), suggests that the inhibitory signals involved in the control of persistence could lead to the creation of "rebound trials", patterns of activation in channels orthogonally tuned to the orientation of the moving object.

Rebound trials, such as those shown below (redrawn from Francis & Kim, 1999) might provide useful information about motion, such as speed and direction.



If such reset mechanisms had an influence beyond strictly local pairs of detectors (i.e., back along the gradient of motion) then with the special case of motion onset, activation could conceivably "spread" beyond the physically stimulated path.

Related Work

Actis Grosso, R., Stucchi, N., & Vicario, G. B. (1996).
On the length of trajectories for moving objects. In S. C. Masin (Ed.) Proceedings of the Twelfth Annual Meeting of the International Society for Psychophysics, 185-190.

Francis, G. & Kim H. (1999).
Motion parallel to line orientation: Disambiguation of motion percepts. Perception, 28, 1243-1255

Freyd, J. J., & Finke, R. A. (1984).
Representational momentum. Journal of Experimental Psychology: Learning, Memory, and Cognition, 10, 126-132.

Grossberg, S. (1994).
3-D vision and figure-ground separation by visual cortex. Perception & Psychophysics, 55, 48–120.

Kim, H., & Francis, G. (1998).
A computational and perceptual account of motion lines. Perception, 27, 785-797

Müsseler, J. & Aschersleben, G. (1998).
Localizing the first position of a moving stimulus: The Fröhlich effect and an attention-shifting explanation. Perception & Psychophysics, 60, 683-695.