

# *The Coordinate System Used in Visual Tracking*

*Piers Howe, Yair Pinto, and Todd Horowitz*

## Abstract

Tracking moving objects is a fundamental attentional operation. Without tracking, attention cannot be maintained on objects translating through space. Here we ask which coordinate system is used to track objects, retinal (retinotopic), scene-centered (allocentric), or both. While maintaining gaze on a fixation cross, observers tracked three of six disks, which were confined to move within an imaginary square. Relative to the imaginary square, the disks all moved at the same speed. By moving either the imaginary square (and thus the disks contained within), the fixation cross (and thus the eyes), or both, we could increase disk speeds in one coordinate system while leaving them unchanged in the other. Increasing disk speeds in either coordinate system reduced tracking ability by an equal amount. These data support the hypothesis that humans track objects *simultaneously* in both retinotopic and allocentric coordinates. This finding imposes a strong constraint on models of multiple object tracking.