

Tracking Objects and Tracking Our Eyes during Disrupted Viewing

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Research questions.

How & when do we track objects?

Background

(Keane & Pylyshyn, 2006; Aks et al,..)

1. *When tracking objects, does the visual system encode the location and trajectory of tracked objects?*
2. *Is encoding only triggered from abrupt changes that occur in the real world such as when objects disappear behind other objects?*

Current questions

1. What is the role of eye-movements *and attention* in tracking objects?
2. What are the dynamics?
 - a. *Centroid vs. Switching strategy*
 - b. *Switching & Crowding: Do fixations oscillate between targets when positioned at the center of target clusters, and move when targets disperse?*

How and when the visual system samples information when tracking objects is an important focus for the present project, This work is part of our attempt to better understand the mechanisms and dynamics of “disrupted” object-tracking. One important approach entails studying the time course and pattern of eye-movements used in object

tracking. <Omar's work>

Centroid vs. Switching

Fehd & Seiffert (2008) found that people use a “center-looking strategy” where people tend to fixate in the center of a group of targets when tracking 3 or 8 items. Only when tracking a single target do the eyes tend to fixate on the items themselves; in these cases, eyes tended to fixate on the center of the single target item. Fehd & Seiffert argue that rather than centroid strategy serving to minimize target eccentricities, visual system may be tracking a global object formed by grouping together items (as argued by Yantis & colleagues). There are various reasons why their results may be better fit to alternative account(s) that attention tracks individuated objects (Pylyshyn et al.).

Methodological note:

We will use a “**fixation-to-item**” analysis which weights the relative distance between eye-position and each of the 8 item positions (4 of which are the tracked targets and 4 are distracters). This analysis will be used to answer a variety of questions about the process and dynamics of tracking.

Do fixations oscillate between targets when concentrated in the center of target clusters, and move when targets disperse?

In their analysis, Fehd & Seiffert averaged responses across each trial. In our pilot work, where we are examining the relation between eye-position and item-position over the course of each trial, we have found a substantial amount of switching of fixation positions. This suggests that by focusing only on aggregated positions we may be masking important dynamics that make up these averages. If there are frequent switches between eye-positions during the course of a trial, averaging may be an oversimplification, and may mislead us to actual underlying mechanism: e.g., centroid account gives false impression that eye-movements are far smoother than they actually are.

*Problems with ‘center looking strategy’
‘free fixation’ vs. ‘central fixation during object tracking.’*

Is tracking better when subjects fixate at the center of the screen than when they are free to fixate where they chose?

We have found tracking accuracy is significantly better when subjects do not receive instructions as to where to fixate during MOT. When instructed to fixate the center of the display, performance is worse. This raises question whether tracking during free-fixation trials—is it better when individuals opt to view the center?¹

Attention & Eye-movements: Division of labor?

While Fehd & Seiffort (2008) do provide compelling evidence that where eyes fixate is different from where attention is focused theoretical interpretation of their centroid results may be lacking. We explore this possibility further that eye-movements and attention may engage in a ‘division of labor’ enabling people to effectively track multiple objects.

Disrupted viewing & Division of labor

We use disrupted viewing to learn about following aspects of MOT:

1. Tease apart the division of labor across attention and eye-movements
2. To learn when the visual system extrapolates motion?
 - a. When interrupted (either by eye-blink or occluding event), ...
 - Do eye-movements extrapolate motion paths? Or do the eyes lag behind at point of fixation just prior to the interruption (similar to the halt advantage found in MOT accuracy?)
 - Does motion-extrpolation only occur when tracking a single item or when attention is focused on 1 or 2 items?
 - What is the effect of motion path?

¹ *Individual Differences & Tracking experience*

Do some strategies correlate with better tracking performance, and is this reflected in individual differences (such as long-term video game players displaying superior tracking).

3. How long can position information persist over time?
 - a. Testing different duration of interrupt.

When does the visual system sample information during object tracking?

Methodological note: Here we will explore the dynamics of tracking during two types of sampling procedures: 1) Fixed sampling where eye positions will be sampled at regular intervals (e.g., every 100ms during tracking). 2) Variable rate sampling determined by fixations: eye-positions will be recorded when the eyes pause momentarily, or fixate, on particular region of the display.