Tracking objects with moving textures

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Introduction

When people keep track of multiple moving objects, do they use the motion of the objects to help them track?

Previous research has suggested that motion information is not used well, but instead location information is primary (Keane & Pylyshyn, 2006; Fencsik et al., 2007).

However, this research used the target recovery task, in which tracked targets disappear momentarily.

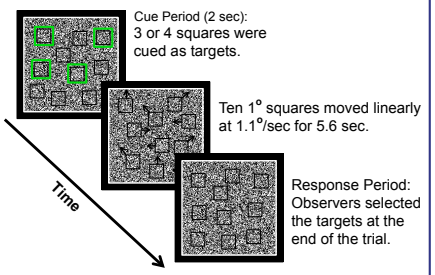
Here, we investigated whether motion information would influence tracking ability when target recovery was not required.

Purpose

We examined whether observers use motion for multiple object tracking by manipulating the motion of the texture on top of the objects.

General Methods

Multiple Object Tracking Task



Tracking accuracy was measured as the mean proportion of targets correctly selected.

Motion Defined Objects: All squares had the same texture as the background, making them only visible by their motion during the tracking interval.
Black borders appeared around all squares during the cue and response periods.

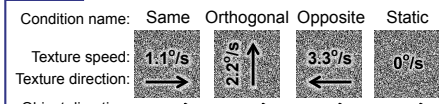
Using motion defined objects made motion information salient and increased the likelihood that we would find effects of motion during tracking.

Experiment 1

Does texture motion influence target tracking?

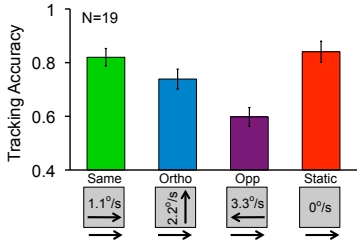
If motion is used to track targets, tracking accuracy should be influenced by the direction of the texture motion.

Method



Object speed was always 1.1 °/sec. Texture speed was always 2.2 °/sec relative to the background.

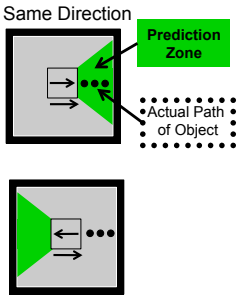
Tracking accuracy was influenced by texture motion



There was a main effect of texture motion $F(1, 54) = 93.1$, $p < .05$.

Motion information influences tracking.

Motion Prediction Hypothesis



If observers use motion to predict the future target locations during multiple object tracking, they will be more accurate when the texture moves in the Same direction than in the Opposite direction of the object.

Tracking accuracy should decrease as texture motion deviates further from the object's motion.

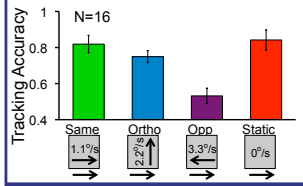
Experiment 2

Is motion used to predict target locations?

In Exp. 2, we retested the conditions in Exp. 1 and added new comparison conditions to test several hypotheses.

Method

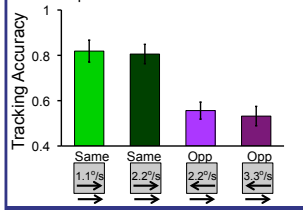
A new set of participants tracked textured objects moving on a textured background as in Exp. 1.



Results replicated Exp 1. Texture motion influenced tracking accuracy $F(3, 45) = 36.7$, $p < .05$.

Are faster textures harder to track?

Texture speed was varied for the Same and Opposite conditions.

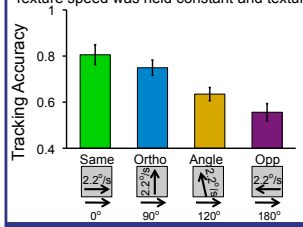


No, faster textures were not harder to track. Texture speed had no effect ($t(15) = 1.1$, $p > .05$).

Tracking was better for Same than Opposite conditions regardless of speed ($t(15) = 9.0$, $p < .05$).

Does texture direction affect tracking accuracy?

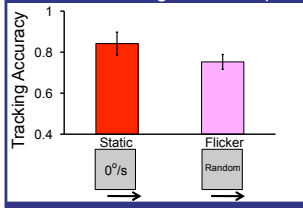
Texture speed was held constant and texture direction varied.



Tracking accuracy decreased as the texture direction deviated further from the object direction $F(3, 45) = 33.5$, $p < .05$).

This result supports the motion prediction hypothesis.

Does flickering texture impair performance?



No, objects with flickering textures were tracked as well as objects with static textures ($t(15) = 2.5$, $p > .05$).

A changing texture with no coherent motion did not affect tracking.

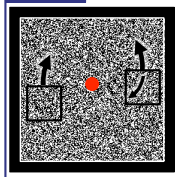
Motion may be used to predict target locations.

Experiment 3

Does mislocalization explain our results?

Motion-defined objects can be mislocalized in the direction of motion (Ramachandran & Anstis, 1990).

Method

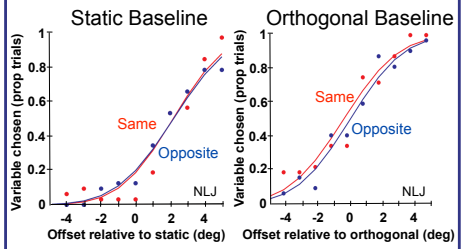


Variable square: Same or Opposite
Baseline square: Static or Orthogonal

The variable square could be aligned, ahead or behind the baseline square.

Task: The observer indicated which square was ahead

We measured the proportion of trials observers selected the variable square for each offset value.



No misalignment effect was found.

Observers did not report Same textured squares as further ahead than Opposite textured squares.

Mislocalization cannot account for the effect of texture motion on multiple object tracking.

Conclusions

Tracking accuracy decreased as the motion of the texture deviated further from the target's direction.

Our results suggest that people do use motion information in multiple object tracking.

Tracking may depend on a mental representation that uses motion to predict future locations of targets.

References

Fencsik, D., Klieger, S., & Horowitz, T. (2007). *Perception & Psychophysics*, 69(4), 567-577.
Keane, B., & Pylyshyn, Z. (2006). *Cognitive Psychology*, 52, 346-368.
Ramachandran, V., & Anstis, S. (1990). *Perception*, 19(5), 611-616.

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