

Testing an Object File Theory of Object Correspondence across Saccades

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E62

Introduction

How does the visual system establish correspondence between objects visible on separate fixations? Object file theory (Kahneman et al., 1992) proposes that objects are represented as a spatial index, with object property information bound to the index. In this view, object correspondence across saccades is established by position consistency (spatiotemporal continuity) without reference to an object's visual properties. However, Hollingworth et al. (submitted) recently found that object correspondence across saccades can be driven by memory for an object's shape or color. In the present study, we placed position and object property information at odds to investigate the primary determinant of object correspondence across saccades.

Method

Fixate center fixation cross

Looming cue: 30ms

Saccade executed toward target

Switch

Array shifts half position on 1/3 trials

No Switch

Eyes land midway between target and distractor and a corrective saccade executed to fixate target

Participants were instructed to either:

1. Correct gaze to the object in the appropriate position (top/bottom)
2. Correct gaze to the object with the appropriate color (red/blue)

When the objects switched, participants either had to correct gaze to the object defined by:

1. The target position with inconsistent color information
2. The target color with inconsistent position information

Dependent measures:

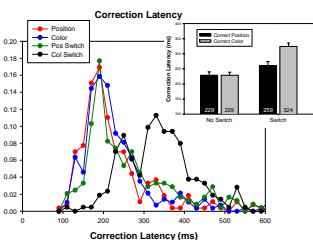
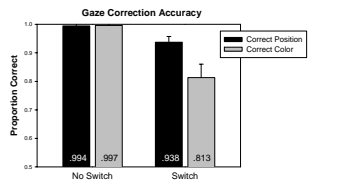
Gaze correction accuracy: proportion of trials the first object fixated was the appropriate target. This reflects the remembered features across saccades.

Correction latency: the duration of the fixation prior to the corrective saccade. This reflects the speed of target identification, saccade computation and initiation.

Experiment 1: Color Disks

E1 tested gaze correction to colored disks randomly drawn from two possible colors, blue and red. There were two possible values along the position dimension and two possible values along the surface feature dimension.

Experiment 1: Results

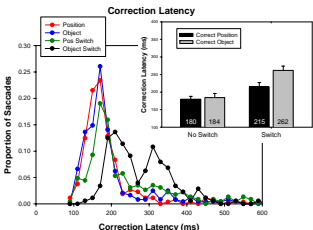
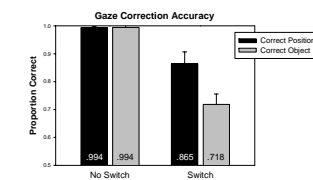


Position information was weighted more heavily than color in establishing object correspondence across saccades. However, inconsistent surface feature information impaired correction based on position.

Experiment 2: Real Objects

Replicated E1 with real objects allowing for rich surface feature representations.

Experiment 2: Results

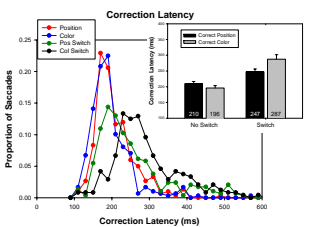
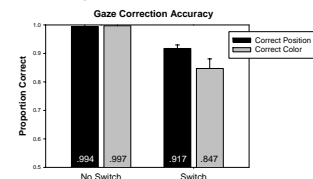


As in E1, position dominated object correspondence across saccades, and surface feature information impaired correction based on position.

Experiment 3: Position Control

In E1 and E2, the cued object in the position block indicated the direction of the possible shift. This may have allowed participants to preprogram a corrective saccade in that direction. This would have caused the faster and more accurate performance in the position block. In E3 the center object was always cued so the participant was unable to predict the possible direction of shift.

Experiment 3: Results



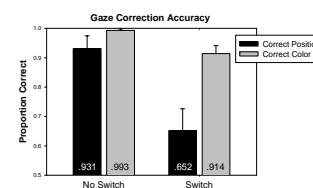
Position information continued to be weighted more heavily than surface feature information. However, surface feature information was involved in establishing object correspondence across saccades.

Reversing Correspondence Dominance from Position to Surface Feature Information

Experiment 4: Color Cue

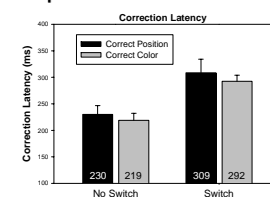
E1-E3 showed that using a looming, spatial cue (selecting the target via position) led to the dominance of position information in object correspondence. E4 & E5 tested whether selecting the target via surface feature information would lead to the dominance of surface feature information in establishing correspondence. The saccade target was cued by the appearance of the appropriate object at central fixation.

Experiment 4: Results



The effect was reversed. Surface feature information was weighted more heavily in establishing object correspondence, and position information played a smaller role.

Experiment 4: Results continued

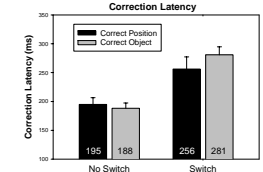
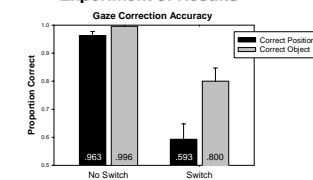


With extremely low accuracy, a small proportion of trials contributed to the latency analysis.

Experiment 5: Object Cue

Replicated E4 with real objects. This provided multiple available sources along the surface feature dimension to be encoded.

Experiment 5: Results



Repeating the findings of E4, surface feature information dominated object correspondence under conditions in which the target was selected via surface feature information. With low accuracy, a small proportion of trials contributed to the latency analysis.

Conclusions

- *Position dominated object correspondence when the target was selected by inherently spatial information (E1-E3).
- *Surface feature information dominated correspondence when the target was selected via surface feature information (E4-E5).
- *Mechanisms supporting object correspondence across saccades weight information differently dependent upon task demands.

References

- Hollingworth, A., Richard, A. M., & Luck, S. J. (submitted) Understanding the Function of Visual Short-Term Memory in Human Cognition: Transaccadic Memory, Object Correspondence, and Gaze Correction.
- Kahneman, D., Treisman, A., & Gibbs, B. (1992). The Reviewing of Object Files: Object-Specific Integration of Information. *Cognitive Psychology*, 24, 175-219.