Evidence for trans-saccadic fusion

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Introduction

In 1983, several studies reported the failure of trans-saccadic fusion – the integration of pre- and post-saccadic percepts across saccades. We re-investigated this issue and addressed two potentially problematic aspects of the stimuli used in these previous studies:

- We used simpler objects where spatial alignment was not critical
- We reduced the contrast of the post-saccadic stimulus to minimize the possibility that it might mask the pre-saccadic percept.

In addition, we compared trans-saccadic perceptual integration with within-fixation integration (i.e. the two successive stimuli were presented across a saccade or within a single fixation).

Methods

- Pre-test: Determination, via an adaptive staircase procedure, of best individual post-saccadic stimulus contrasts for reporting a perceptual integration in a subsequent test (N=17).
- Main experiment: One third of the participants (N=6) performed two experimental conditions: saccade & fixation. The actual position of the first stimulus (a vertical line) varied between the left and right extremities of the second one (3 horizontal lines).

Critically, participants had 4 answer options:
- A vertical line on the left side of the horizontal ones
- A vertical line on the right side of the horizontal ones
- Horizontal lines only, that succeeded the vertical one
- No horizontal lines

Question: What did you see at the end of your eye movement?

Results

Three embedded, independent staircases were used to converge on the contrast that maximized the frequency of reporting integration. The resulting threshold contrasts were generally very low.

Main Exp.: Integration response analysis

Response distributions in the saccade and fixation conditions were not statistically different (Ch(2)=5.454, p=0.065).

Response biases (∫ vs =) as a function of the saccade direction (or side of stimuli presentation in the fixation condition [Ch(1)=9.613, p=0.001]) but not in the fixation condition [Ch(1)=0.021, p=0.885].

Conclusion

Irrespectively of whether a saccade occurred between the successive presentation of two simple stimuli, participants most often integrated the two stimuli into a new, composite percept, provided that the second stimulus did not mask the first. This can explain why previous studies failed to find trans-saccadic fusion.

In the saccade condition, because participants often reported seeing integration rather than a succession of percepts, we believe that this integration was a perceptual phenomenon.

In addition, the systematic directional biases are compatible with remapping. Presumably, remapping could provide a prediction of the vertical line that could be integrated with the horizontal lines to give rise to the fused percept. An effect comparable to the gain less than 1 predicts a directional bias.

This short-lived fusion occurs in spatiotopic coordinates, suggesting that the prediction provided by remapping might help the visual system cope with the shifts in retinal coordinates produced by each saccade and contribute to our experience of visual stability.

References


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