Temporal dynamics of remapping captured by peri-saccadic motion trace

Introduction

Whenever an eye movement is made, several visual areas (e.g., LIP, FEF, CS) help maintain visual stability by shifting the activation for currently attended targets to the locations these targets will have after a saccade (Gottlieb et al., 1998; Kusunoki et al., 2000).

We show that the temporal dynamics of this anticipatory activation, known as remapping, can be directly visualized with a continuous motion stimulus that starts before and ends after the saccade.

Interestingly, even if the stimulus trajectory is perfectly straight and continuous, participants report seeing it broken into two pieces.

We explore this phenomenon to answer two main questions:

1. By how much does the trajectory appear shifted? (see Exp. 1)
2. When does this break happen relative to the saccade? (see Exp. 2)

Experiment 1:

- By how much does the trajectory appear shifted?

Experiment 2:

- Trajectory connected to appear aligned if correction occurs at the same time as remapping shift.
- Perceived break occurs at time “t” relative to saccade.
- We insert physical shift at time “t” to cancel perceived shift (3 possible times of path shift).
- Participants ran with their shifted measured in Experiment 1.

Method

Multiple staircase procedure

Results

- Participants report whether the bottom motion trace is to the left or to the right of the top motion trace.

- 5 participants (1 author, 4 naive). 15° saccade amplitude.
- 25° motion amplitude at 50°/sec.
- Online control of saccade execution (EyeLink 1000 at 2kHz).

Conclusion

- As previously observed with apparent motion (Cavanagh & Szinte, 2009), we observe here a large systematic misalignment of two motion paths seen peri-saccadically (about 16% of saccade amplitude) suggesting an overcorrection of the saccade vector.
- This perceived misalignment could be cancelled by presenting the opposite amount of bias about 30 msec after saccade onset.
- Our results show the pre-saccadic trace shifting in the direction opposite to the saccade and are therefore opposite to the results from peri-saccadic mislocalization (Matin & Pearce, 1966) and peri-saccadic compression (Ross et al., 1997) suggesting that the continued presence of the trace offers a different assay of the remapping process.
- Finally, the visibility of the pre-saccadic trace following the saccade is a novel demonstration of spatiotopic visual persistence.