



The Effects of Speed and Direction on Eye-hand Coordination for Moving Targets

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INTRODUCTION

We use vision to guide movements of our hands when performing various tasks (e.g., picking up a cup of coffee, catching a ball, etc.).

Previous research has demonstrated that during visually-guided grasping with stationary objects, participants look towards the eventual index finger contact point on the object, above its center of mass (COM)^{1,2}. However, whether or not this holds true for moving objects is unknown.

Grasping moving objects involves both spatial and temporal predictions. The hand is aimed at a location where it will meet the object, rather than the position at which the object is seen when the reach is initiated³.

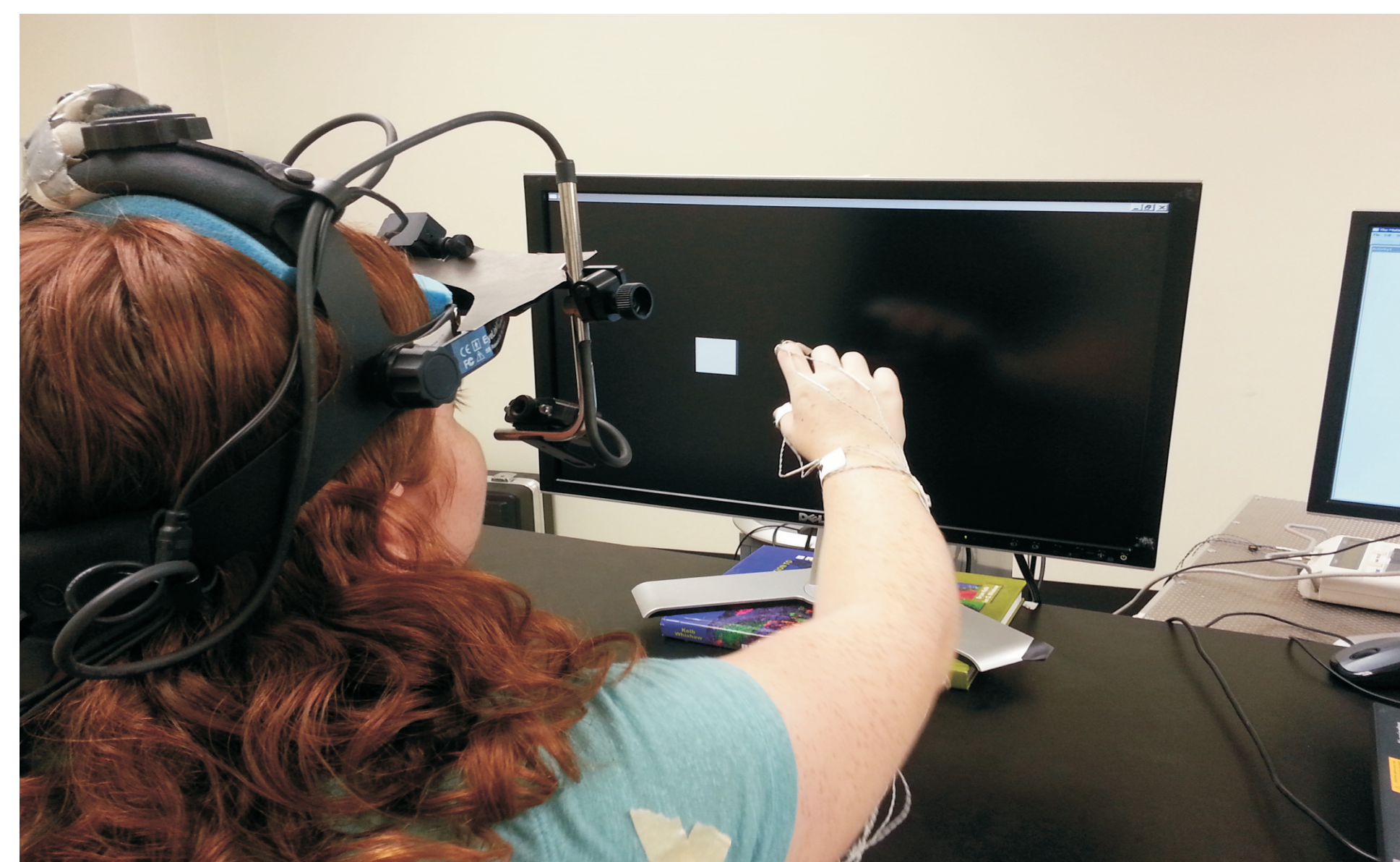
PURPOSE

To extend previous eye-hand coordination research involving stationary objects by exploring more complex scenarios, such as moving objects varying in speed and direction.

DATA COLLECTION

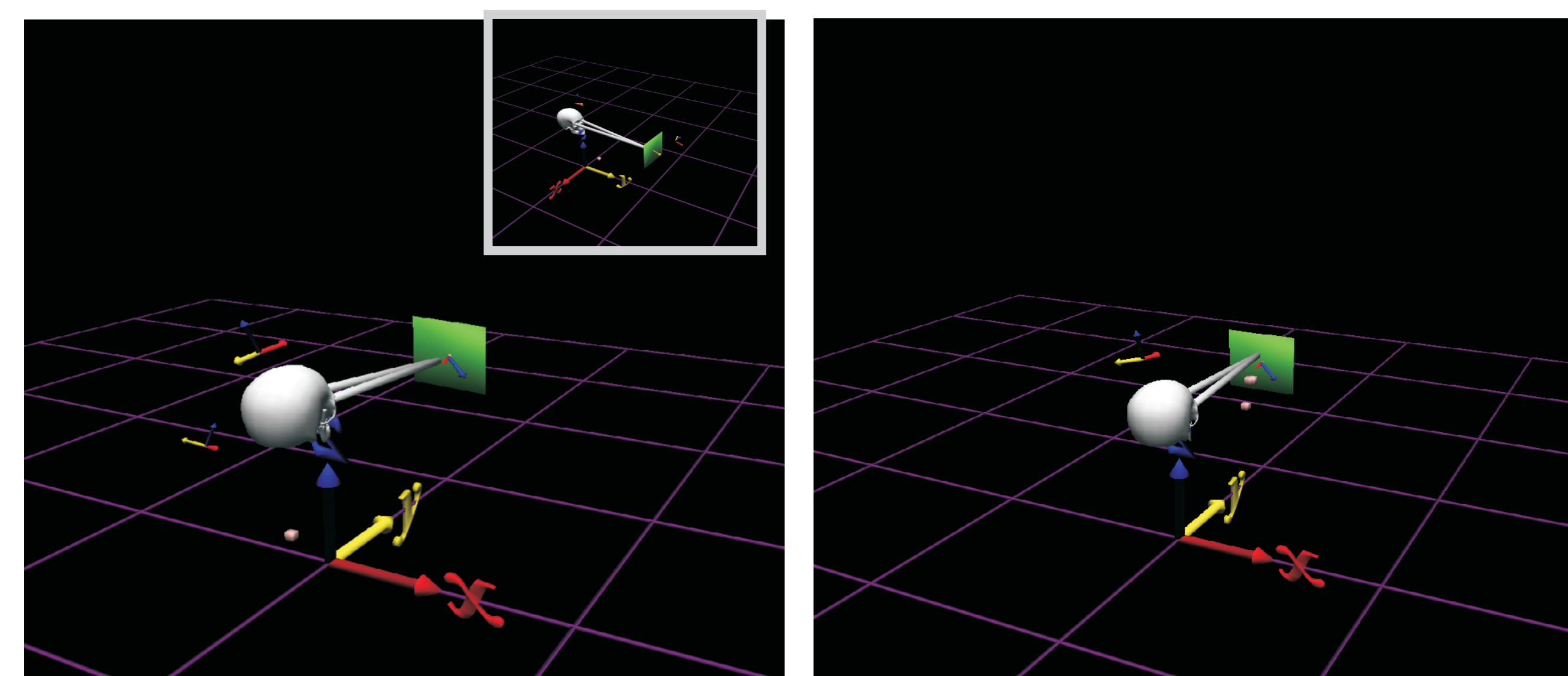
Participants: Twelve (7 female) right-handed undergraduate psychology students with normal or corrected-to-normal vision between the ages of 19 and 27 years ($M = 23$).

Integrated eye-hand motion tracking system



Eye position was recorded using an EyeLink II eye tracker and grasp movements were recorded using an Optotrak Certus motion tracker.

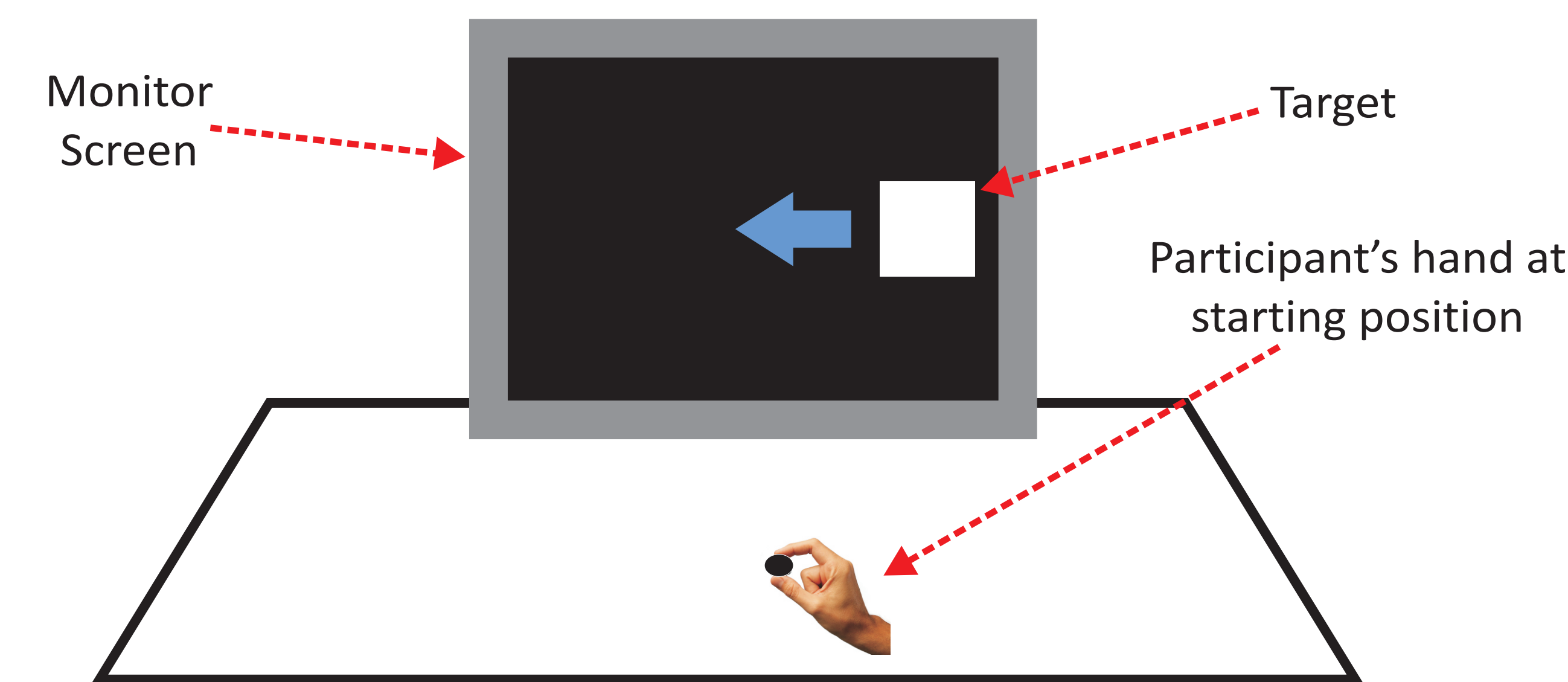
Screenshots of the MotionMonitor software



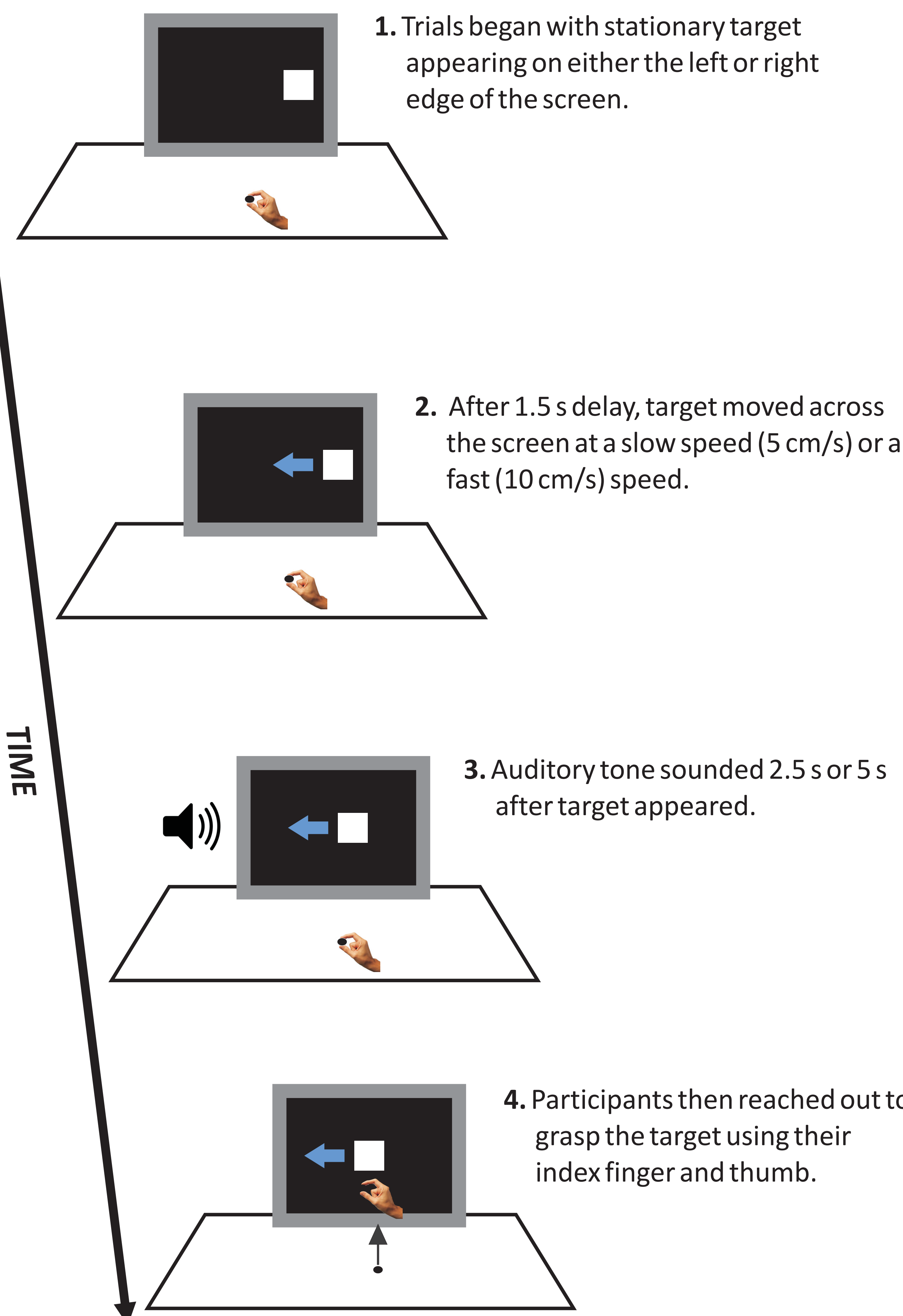
Recorded eye and hand data were integrated into a common reference frame via MotionMonitor software (Innovative Sports Training, Inc.).

EXPERIMENTAL TASK

Experimental Set-up:

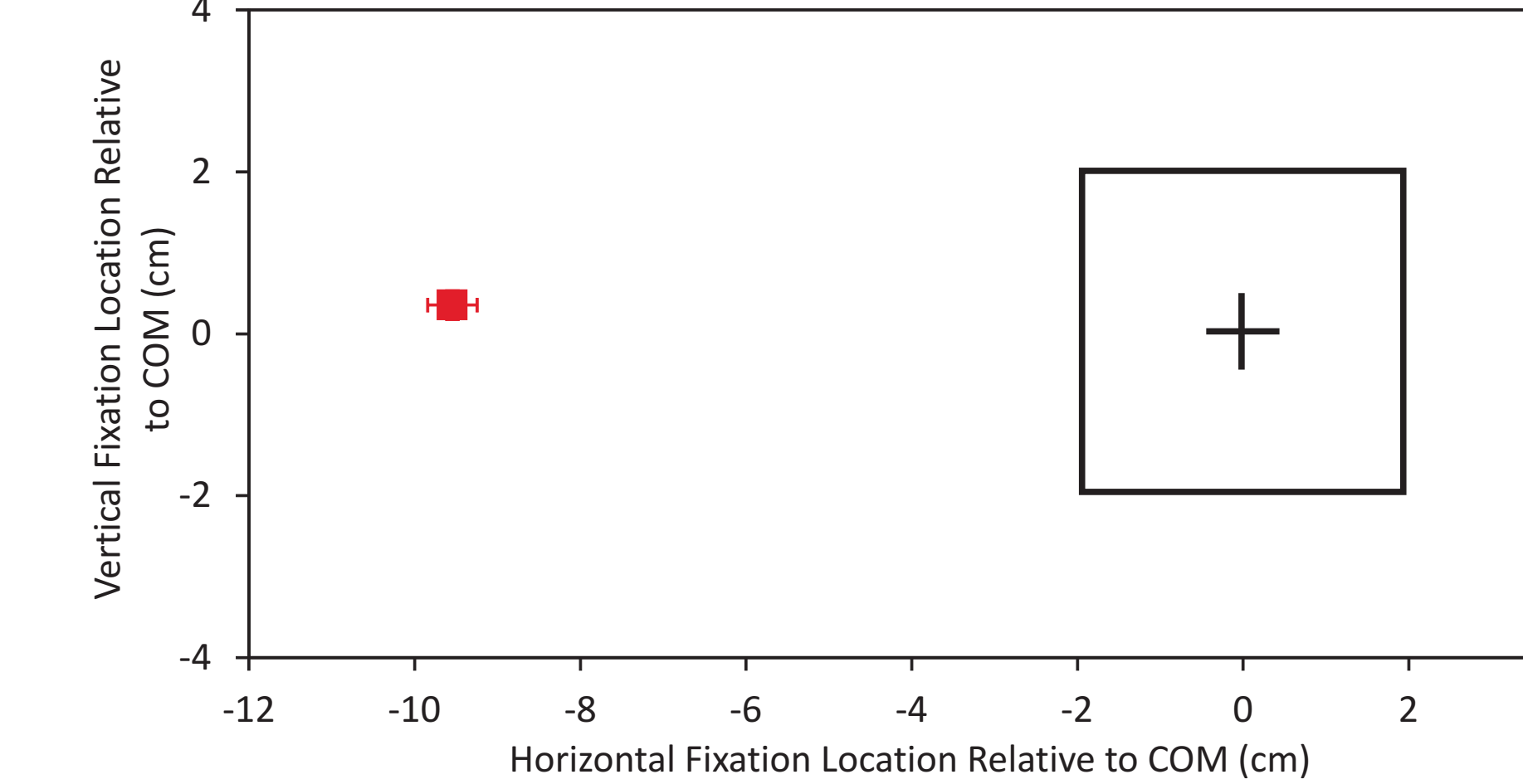


Procedure:

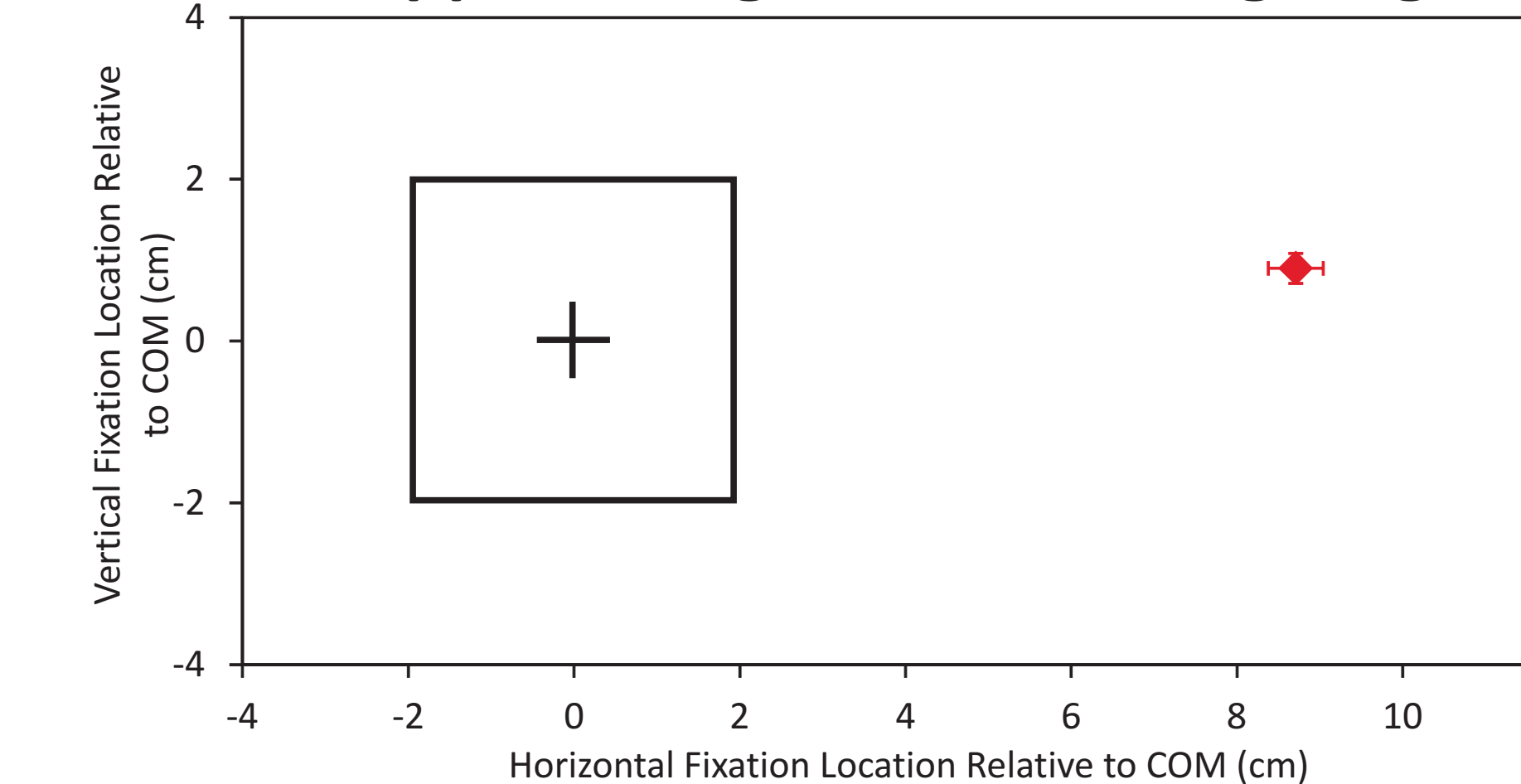


EYE FIXATIONS

Appears: Leftward Moving Target

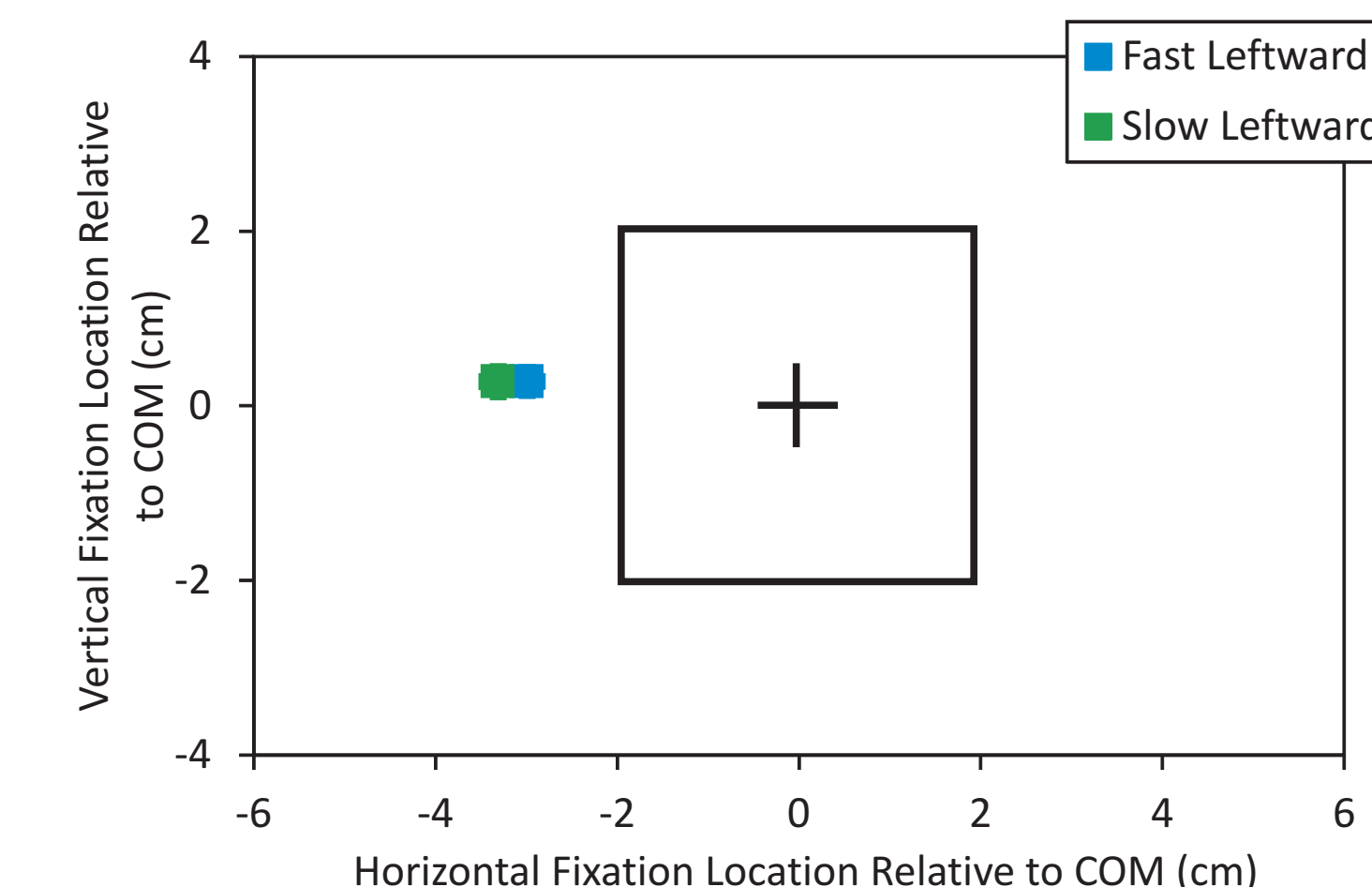


Appears: Rightward Moving Target

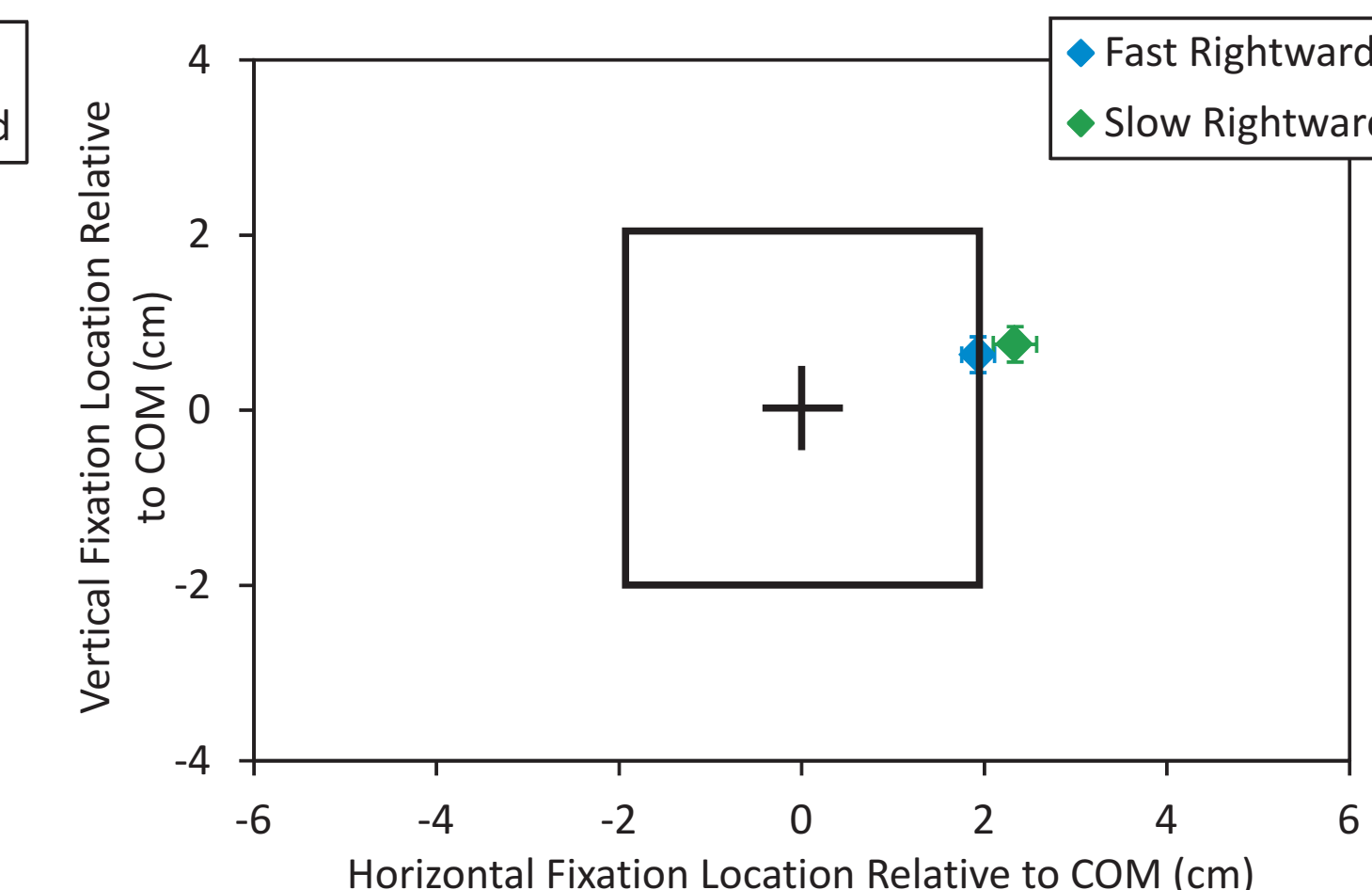


- Participants anticipated the target's movement by fixating significantly ahead of the leading edge.
Main effect of direction in the horizontal (p < .001) and vertical (p < .01) dimensions.

Moves: Leftward Moving Target

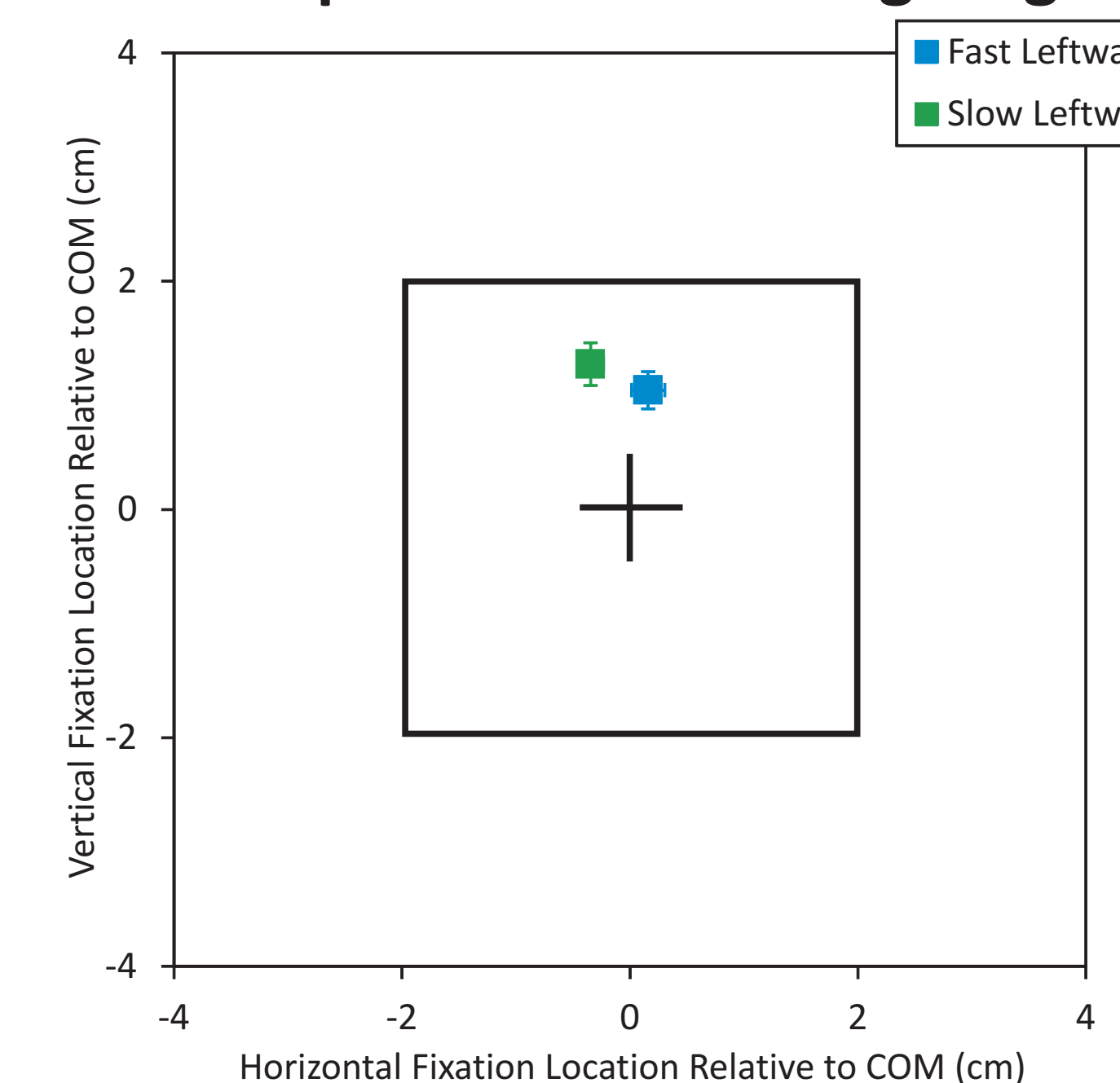


Moves: Rightward Moving Target

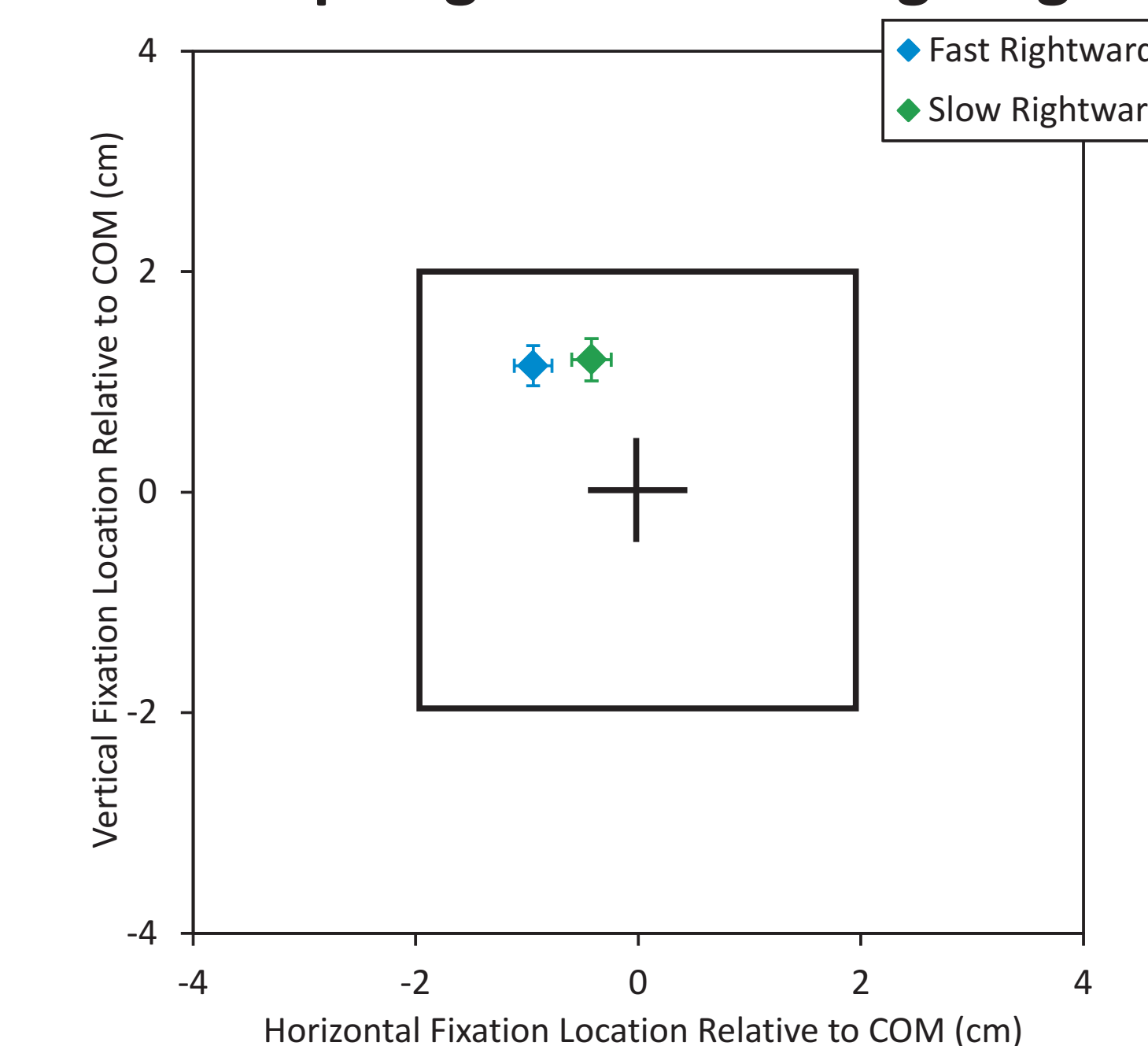


- Once the target began to move, participants shifted their fixations much closer to the target's leading edge.
Main effect of direction in the horizontal (p < .001) and vertical (p < .05) dimensions.
Interaction between speed and direction (p < .01) in the horizontal dimension.

Grasp: Leftward Moving Target



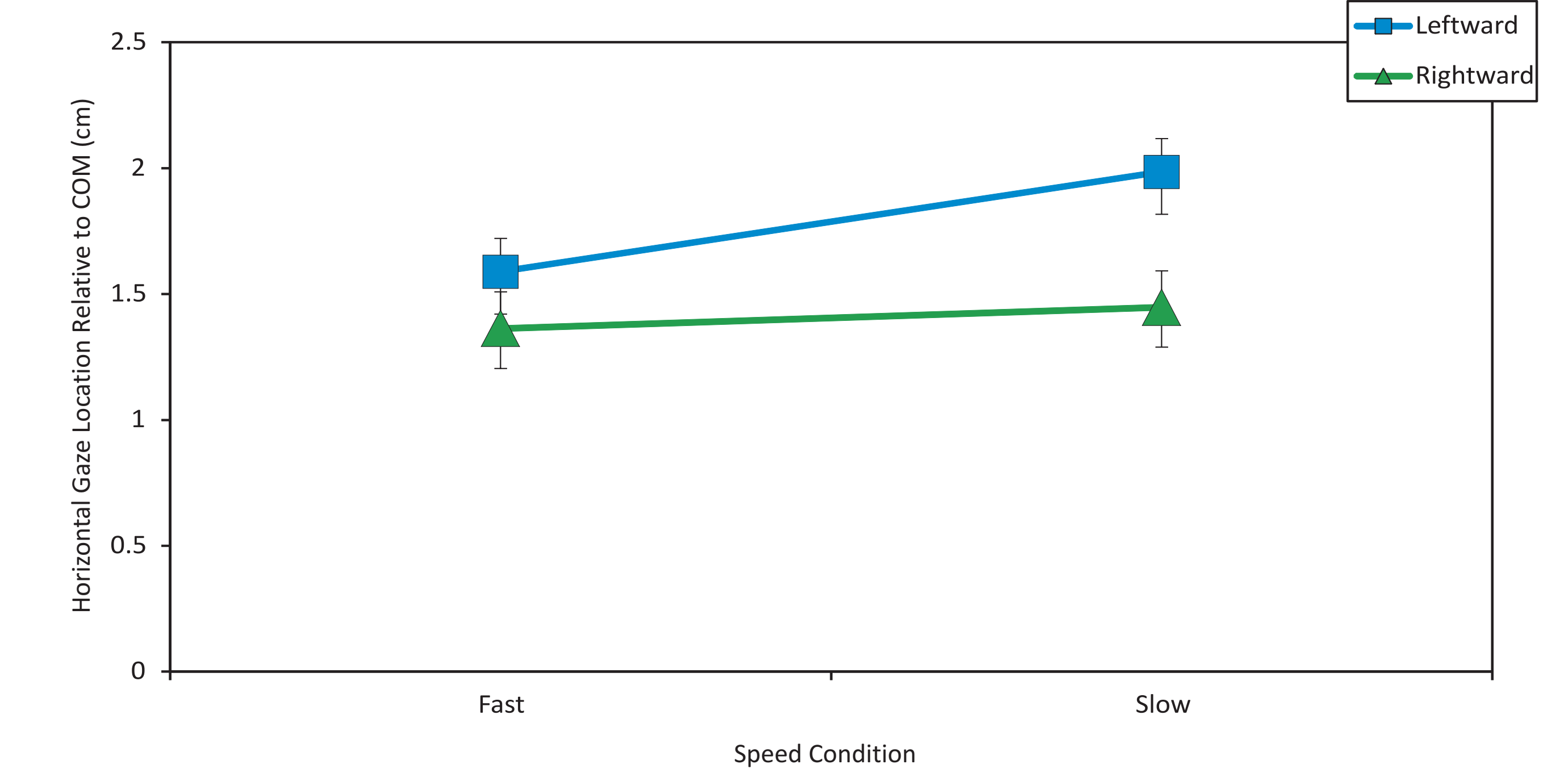
Grasp: Rightward Moving Target



- Final fixations when participants grasped the target were generally above the target's COM, towards the index finger contact point.
Main effect of direction in the horizontal dimension (p < .05).
Interaction between speed and direction in the horizontal (p < .001) and vertical (p < .05) dimensions.

TRACKING ERROR

Root Mean Square Error for Horizontal Gaze Locations



- Participants fixated further ahead of the target's COM when direction of motion was leftward, particularly at the slower speed.
Main effects of speed (p < .001) and direction (p < .05).
Interaction between speed and direction (p < .05).

CONCLUSIONS

- Participants anticipated movement of the target by looking far ahead of the target's leading edge (7.1 cm on average).
Participants consistently fixated towards the leading edge of the target, regardless of speed.
Upon initiating their reach, participants fixated towards the top edge of the target.
Final fixations when the target was grasped were biased towards the index finger contact point.

REFERENCES

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