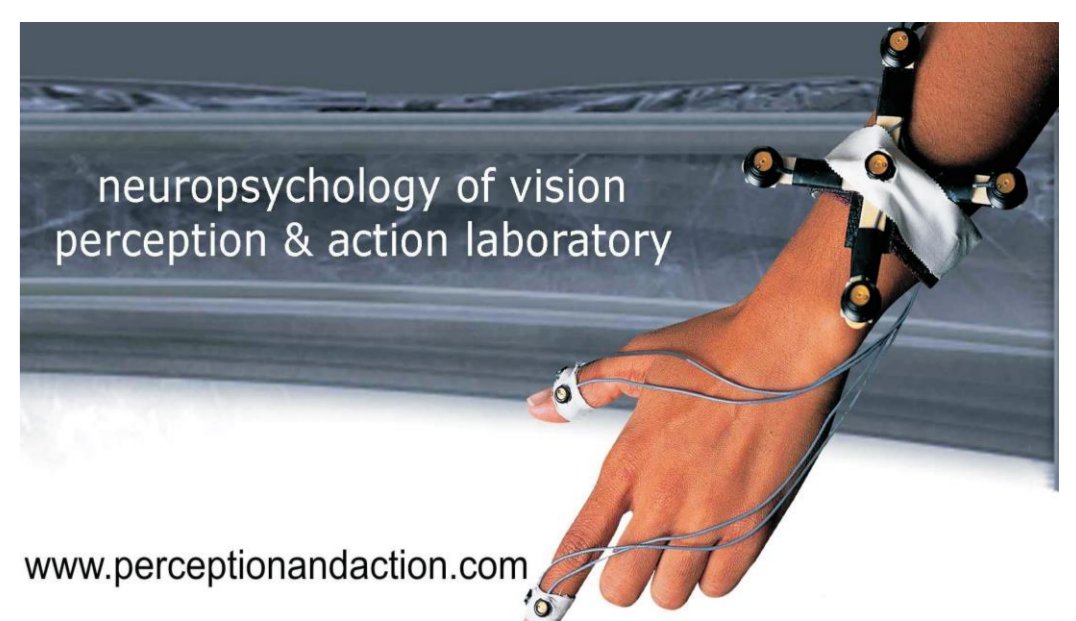


Grasping 2-D Targets in Motion: The Influence of a Preferable Central Grasp Location on Eye-Hand Coordination

Ryan W. Langridge & Jonathan J. Marotta

Perception and Action Lab, Department of Psychology, University of Manitoba, Canada



Introduction

When grasping a target, the grip is centered over the target's midline and fixations are directed toward the index finger's eventual contact point^{1,2,3}. When the target is positioned at non-central locations, digit placement is biased toward 'convenient' locations in the direction of the reaching hand (e.g. right side of a target positioned to the left)². Without an ideal midline location to place the digits, gaze and digit placement are shifted rightward, regardless of target position².

When grasping horizontally moving targets, gaze and digit placement are more accurate when grasping leftward moving targets^{1,2,3}, potentially to compensate for the target's movement away from the reaching hand, into the contralateral hemisphere⁴. Where do we direct our gaze and place our digits when grasping moving targets without an ideal central grasp location? Does the position of the target at the time it is grasped influence these positions?

Data Collection

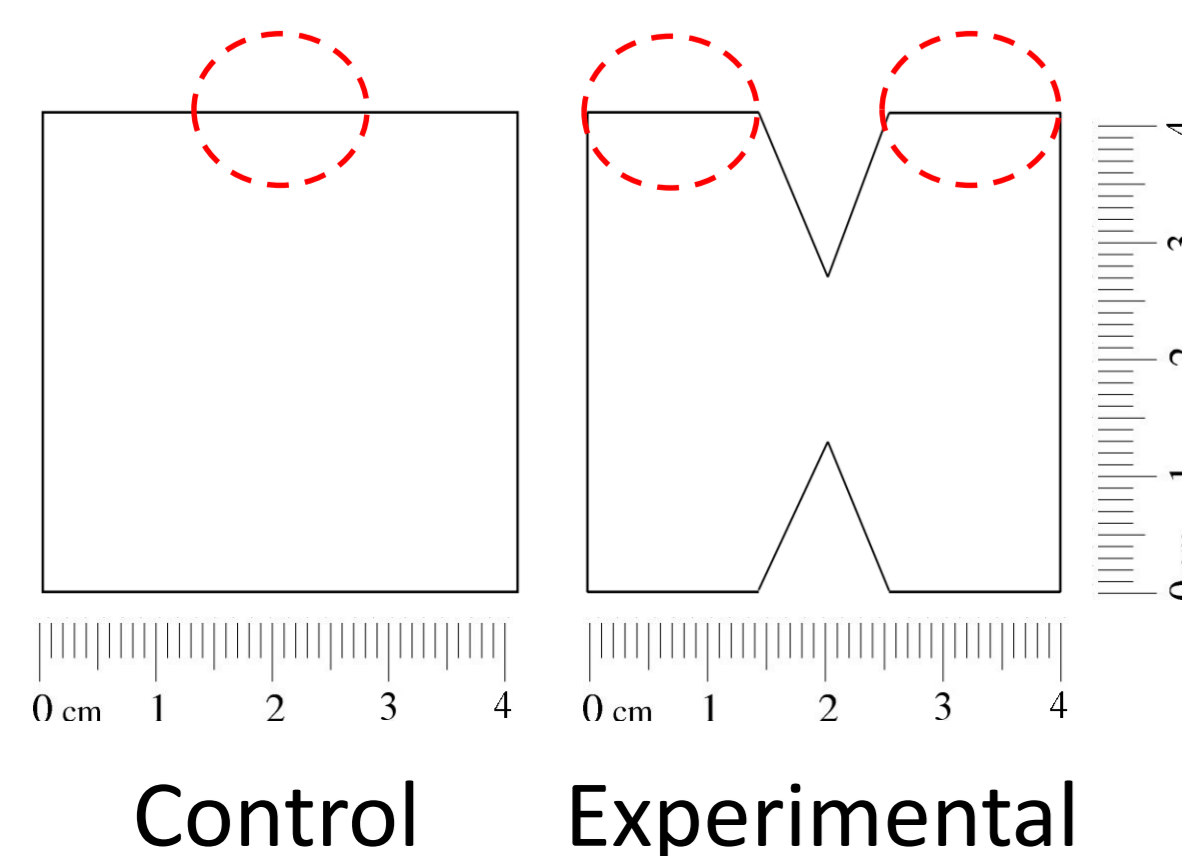
3-D position data from an Optotrak Certus and Eyelink II were integrated into a common



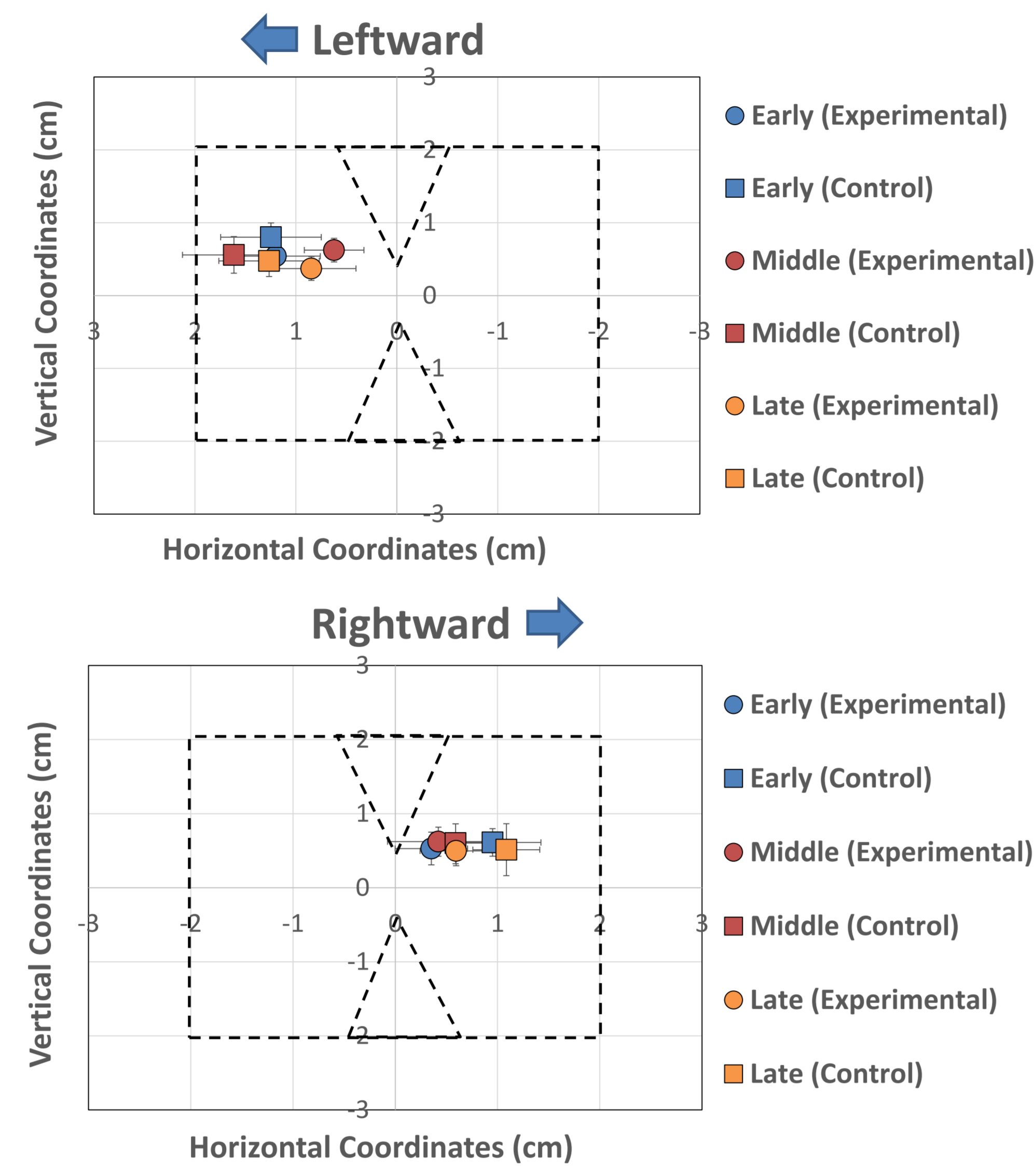
reference frame using Motion Monitor software (Innovative Sports Training). All participants were right-handed and had normal or corrected to normal vision.

Experimental Design

Control or Experimental targets translated horizontally across a computer screen (10 cm/s). 25 Participants (21 Female, ages 16-32 years, $M = 19.72$ years) were cued at early, middle, or late stages of target travel, resulting in right-handed grasps occurring at either the left, right, or center of the screen.

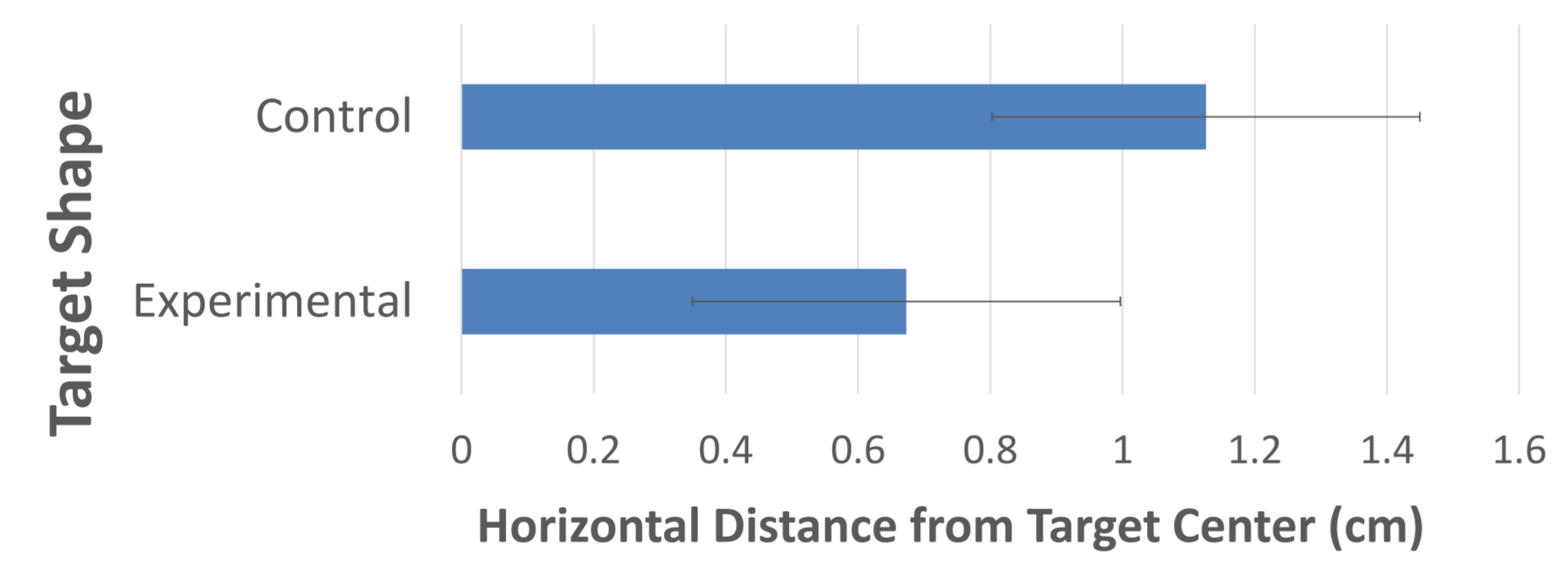


Fixations at Movement Onset



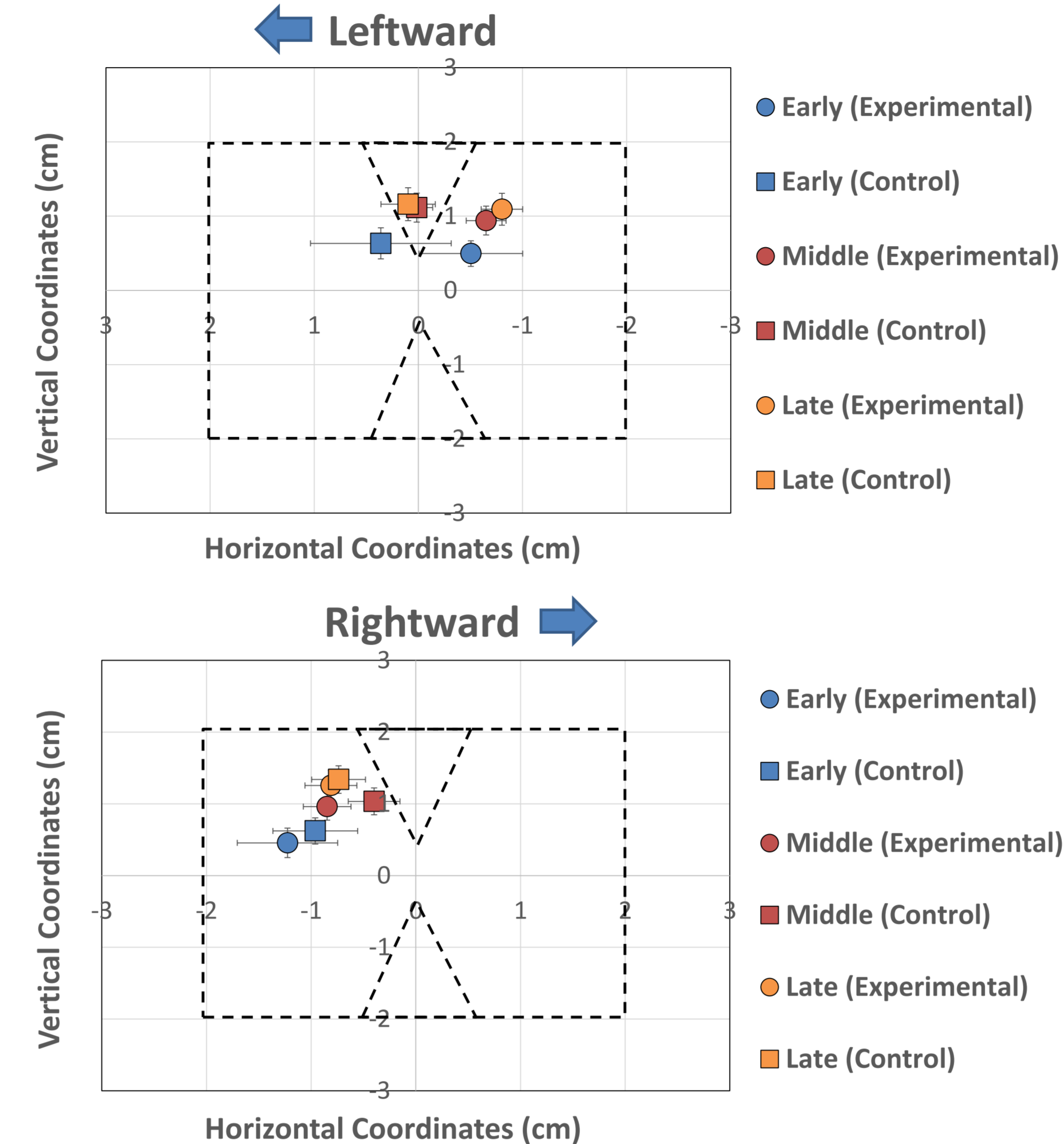
Fixations positioned closer to midline of Experimental targets [$F(1,24) = 15.35, p < 0.001$].

Influence of Target Shape



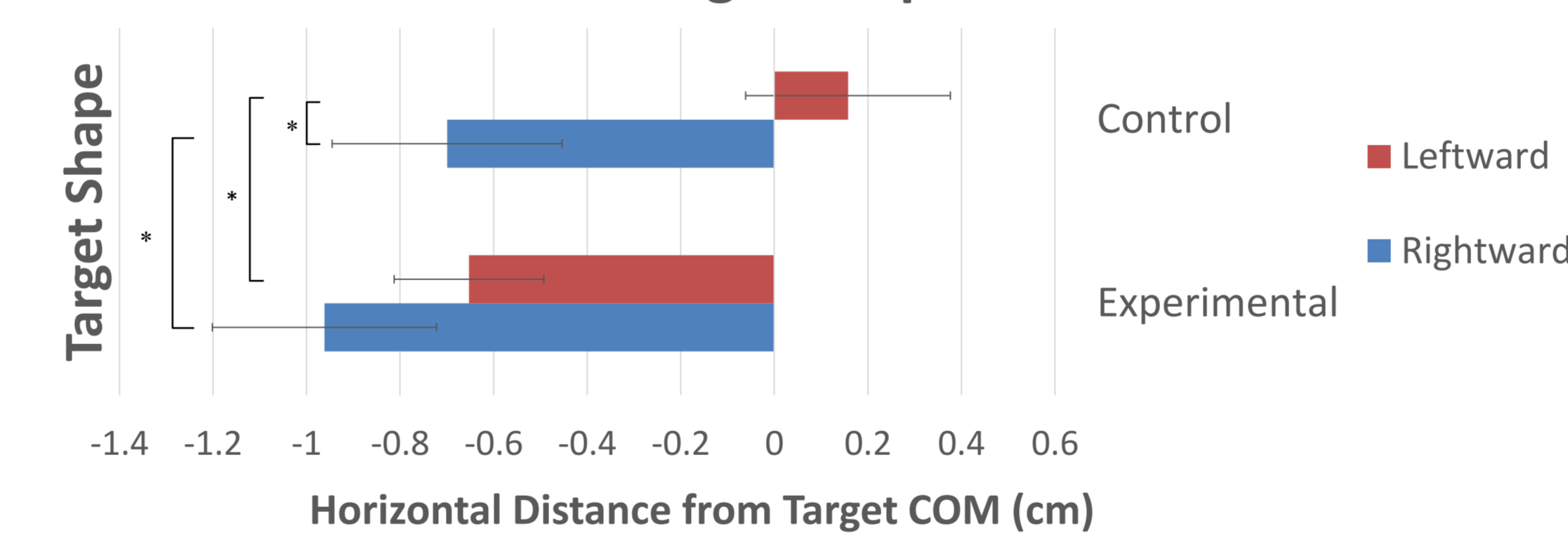
In contrast to Control targets, which elicited fixations toward their leading edge, the notches imposed on the Experimental targets may have provided additional information about the target's movement, drawing fixations toward the midline.

Fixations at Reach Onset



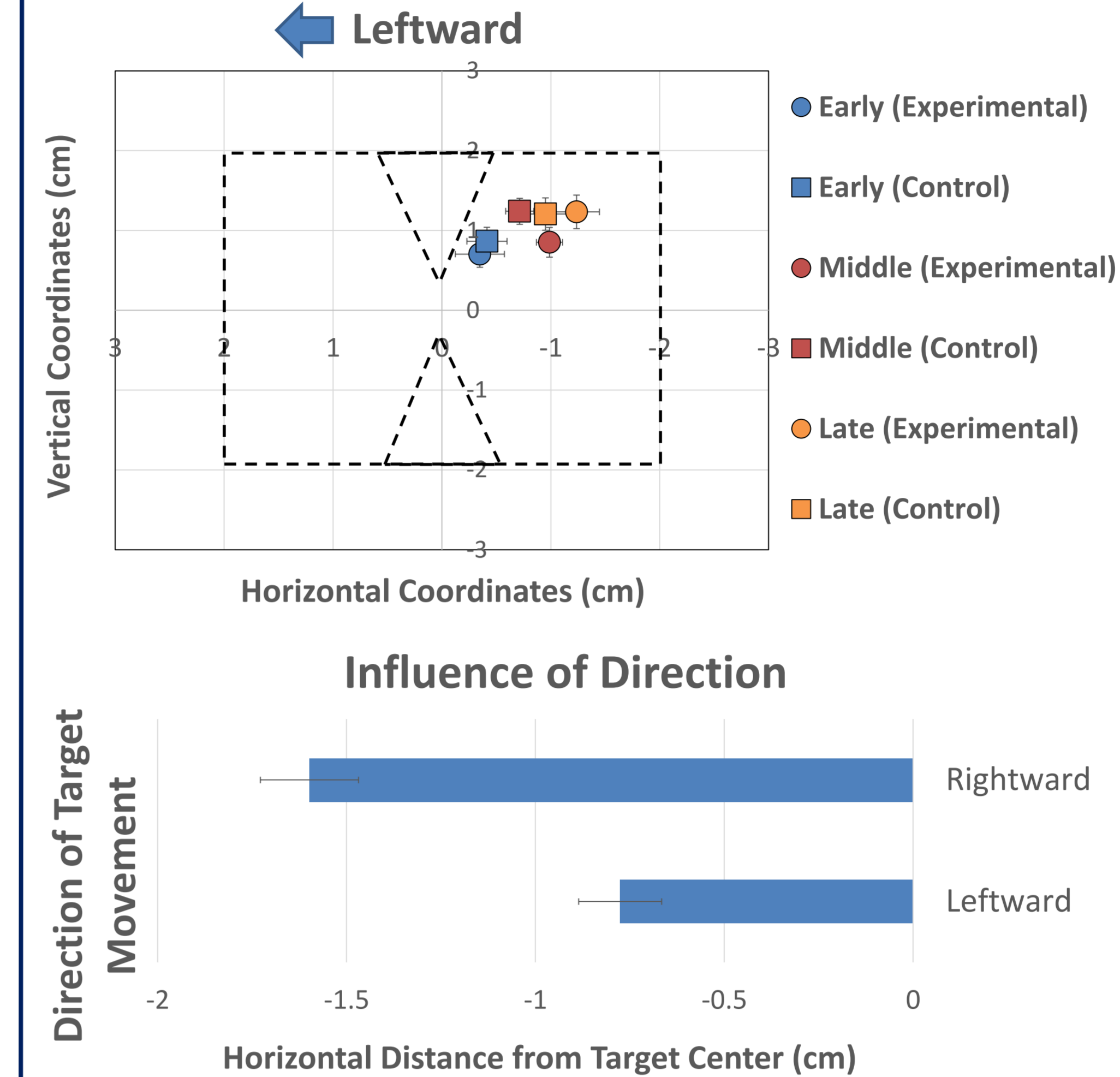
Fixations positioned behind the target's midline, except for Leftward moving Control targets [$F(1,24) = 7.71, p < 0.05$].

Influence of Target Shape and Direction



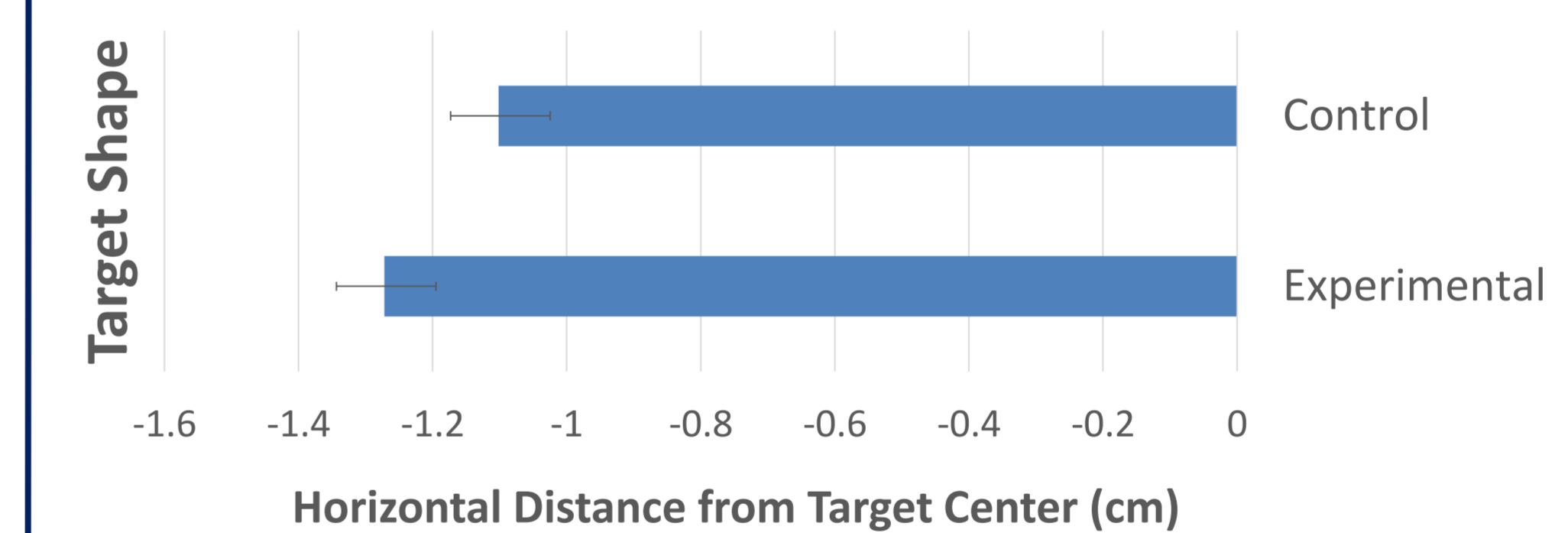
Fixations were positioned closer to the midline of Control targets compared to Experimental targets – representing a shift from regions providing information about target movement to areas that afforded stable digit placement.

Fixations at Time of Contact

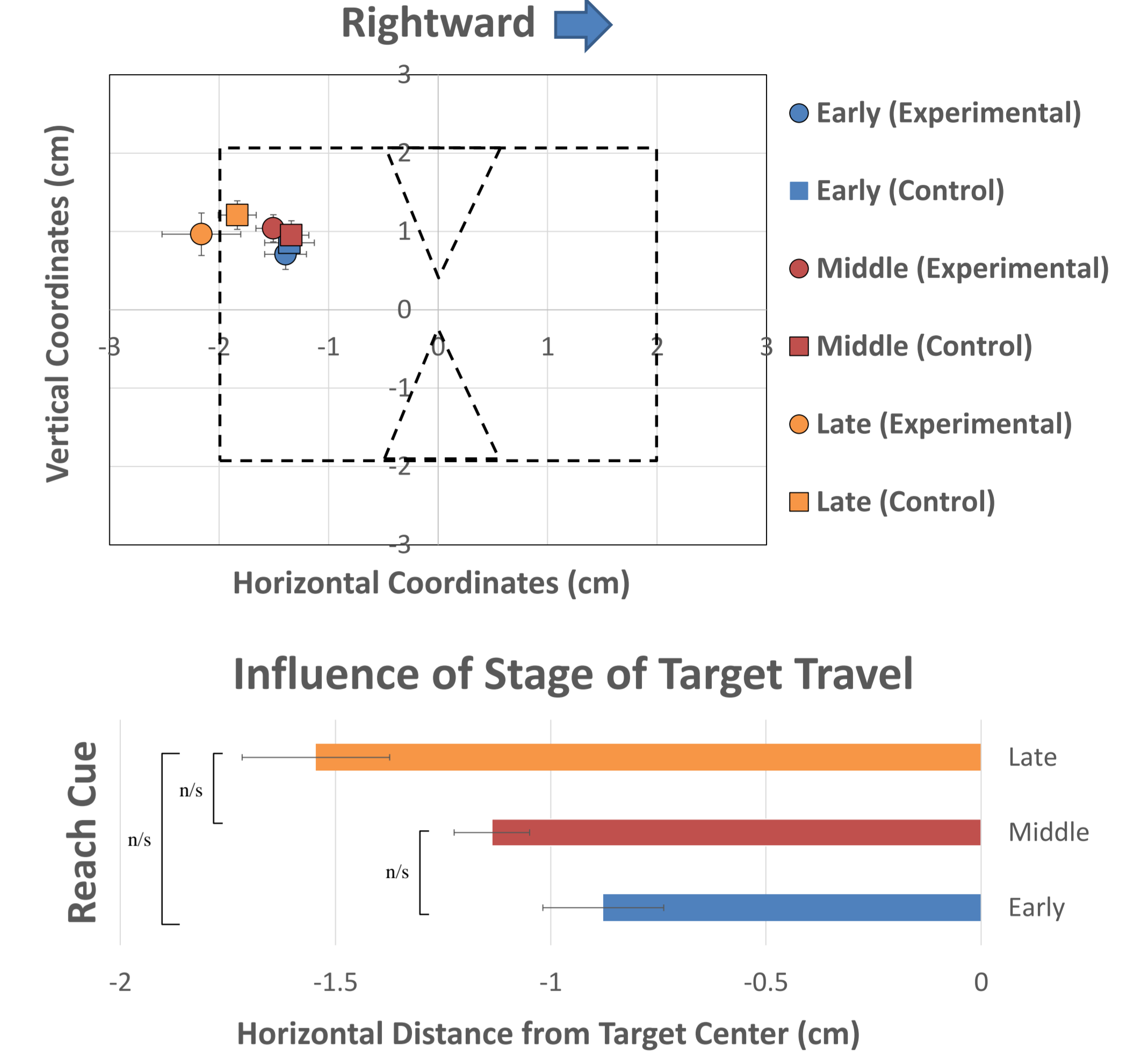


Gaze directed closer to midline of Leftward moving targets [$F(1,24) = 16.136, p < 0.001$]. Fixations corresponded to horizontal index finger placement, suggesting participants were grasping more central, stable positions when the target was moving leftward.

Influence of Target Shape



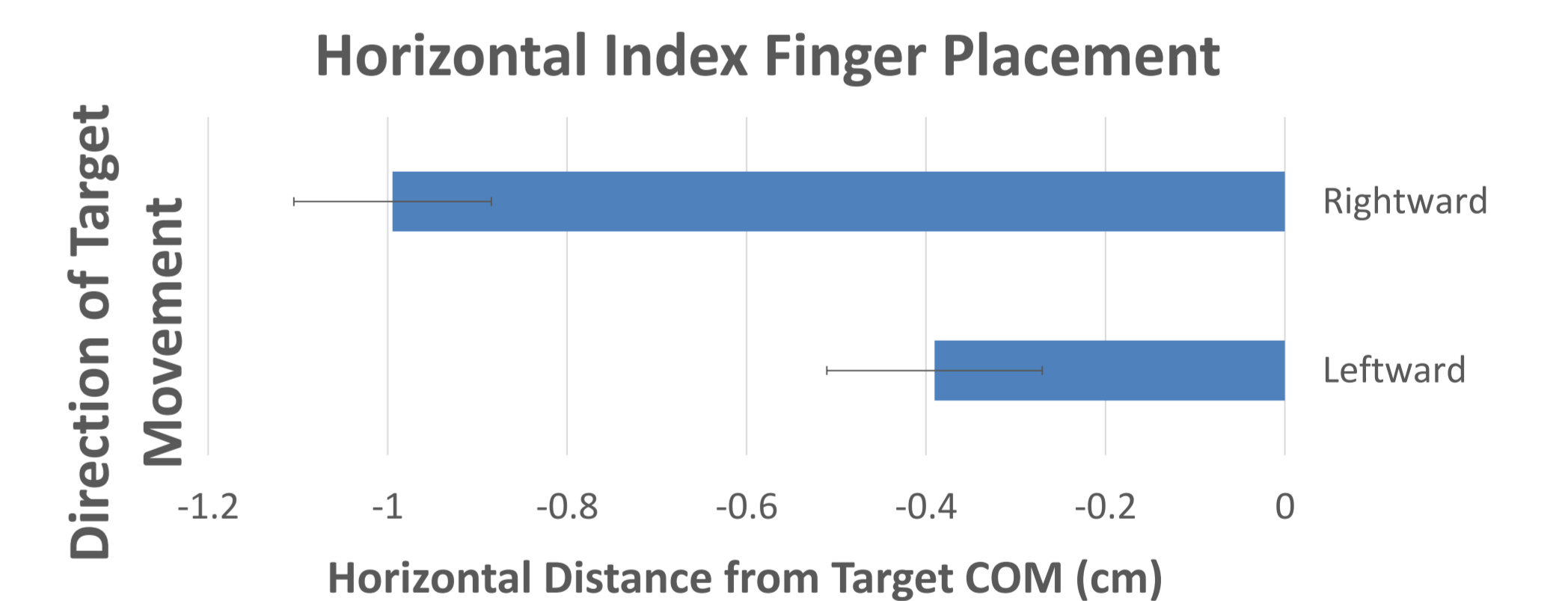
Gaze directed closer to midline of Control targets [$F(1,24) = 6.764, p < 0.05$]. Without a central location to place the digits, participants directed their gaze farther behind the target's midline.



Gaze directed closer to the target's midline the earlier it was grasped [$F(1,20, 28.81) = 5.219, p < 0.05$].

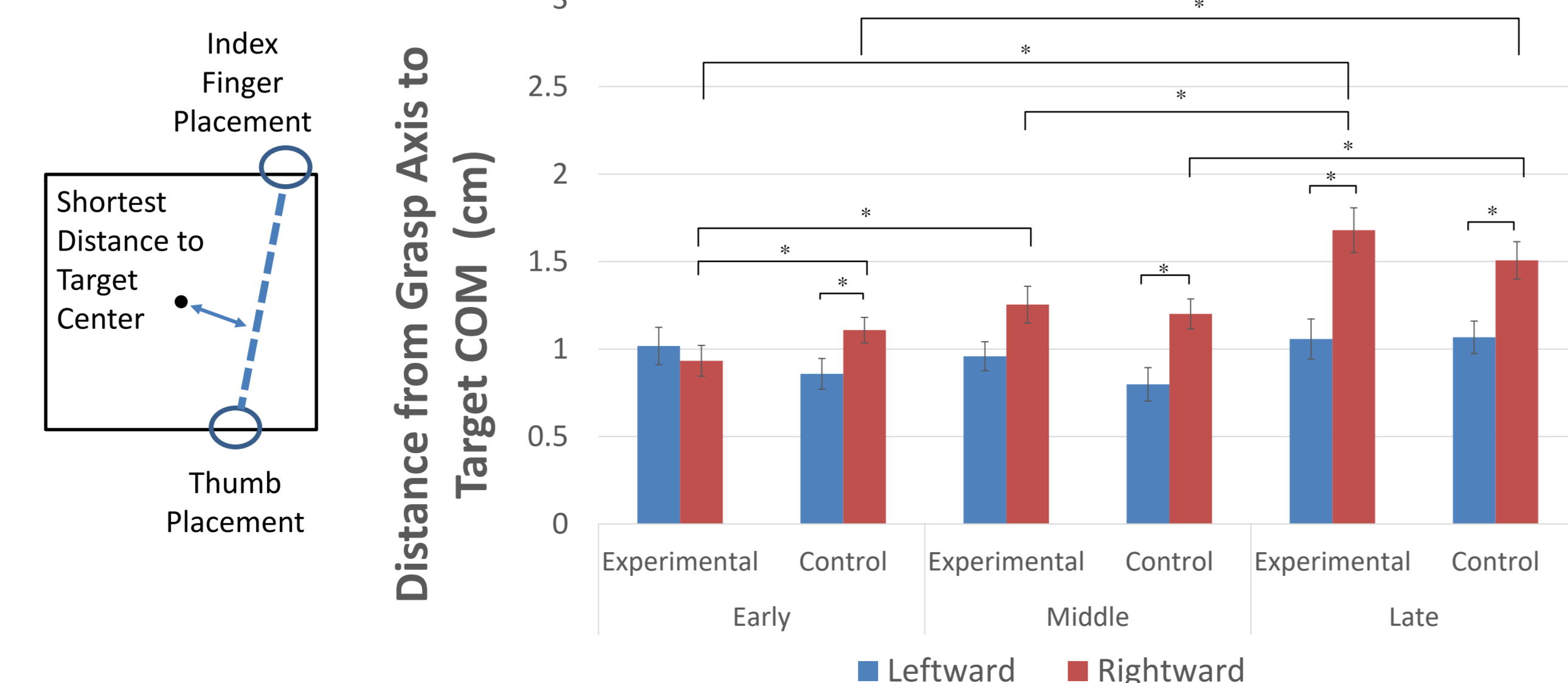
Index Finger Placement

Participants placed their index finger closer to the midline of Leftward moving targets [$F(1,24) = 8.889, p < 0.01$]. There was no effect of target Shape or Reach Cue.



Participants consistently placed their index finger at 'convenient', 'safe' positions behind the target's midline.

Grasp Stability



Grasps were generally most stable when grasping Leftward moving targets and targets grasped at earlier stages of travel [$F(2,48) = 3.270, p < 0.05$].

Conclusions

- Fixations at each timepoint were directed toward horizontal positions related to the current task requirements:
 - Movement Onset: Regions providing information about the target's movement.
 - Reach Onset and Time of Contact: Regions that afforded stable digit placement.
- When grasping targets without an ideal central location to place their digits (Experimental targets), participants fixated farther *behind* the target's midline, towards a more 'convenient', safer location.
- Participants consistently fixated and placed their digits *behind* the target's midline when grasping, however grasps were generally more stable (digit placement closer to the midline) when grasping *leftward* moving targets, especially at later stages of target travel.
- This leftward bias may indicate a compensatory strategy: It is more important to execute an accurate and stable grasp when grasping a target moving away from the reaching hand, into the contralateral hemisphere.

References

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