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# Gaze strategies and grasping: Complex shapes

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### Introduction

When grasping a symmetrical object, gaze fixations cluster towards the top edge of the object, corresponding to the index finger position of a grasp line that falls across or close to the object's centre of mass (COM).<sup>1,2,3</sup>

However, these studies have all explored gaze fixations while grasping symmetrical objects,<sup>1,2</sup> whose COM also corresponds to the object's midline, or simple asymmetrical objects where participants have to grasp the object in a specific location.<sup>3</sup>

Previous studies have shown that participants produce grasp lines that fall close to or across an asymmetrical object's COM – regardless of object midline.<sup>4,5</sup> However, it is still not clear whether such dissociations are present in gaze fixation locations.

### Purpose

Is an object's horizontal midline or its COM the main focus of gaze fixations while grasping?

Gaze fixations and grasp positions were examined while picking up complex asymmetrical objects called Blake shapes and symmetrical objects whose COM did not coincide with the objects midline.

### Method

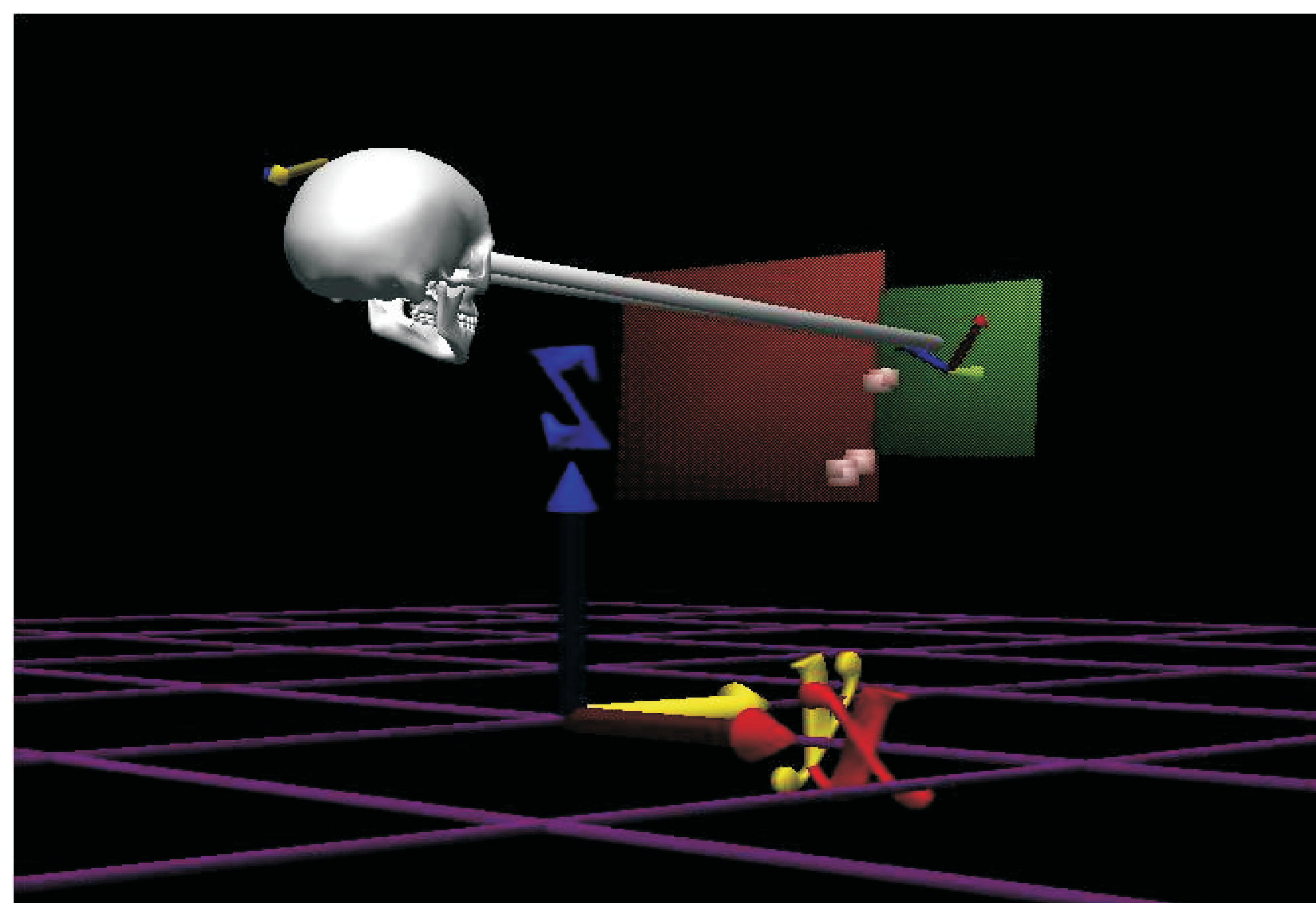
#### Participants

Ten right handed first year psychology students (8 female, mean age=21) with normal or corrected-to-normal vision participated in this experiment.

#### Materials and Procedure

Participants were required to reach out and grasp shapes whose COM was oriented to either the left or right of the object's midline.

Kinematic and gaze data from an Optotrak Certus and Eyelink II recording system were integrated into a common frame of reference via Motion Monitor software (Innovative Sports Technology).

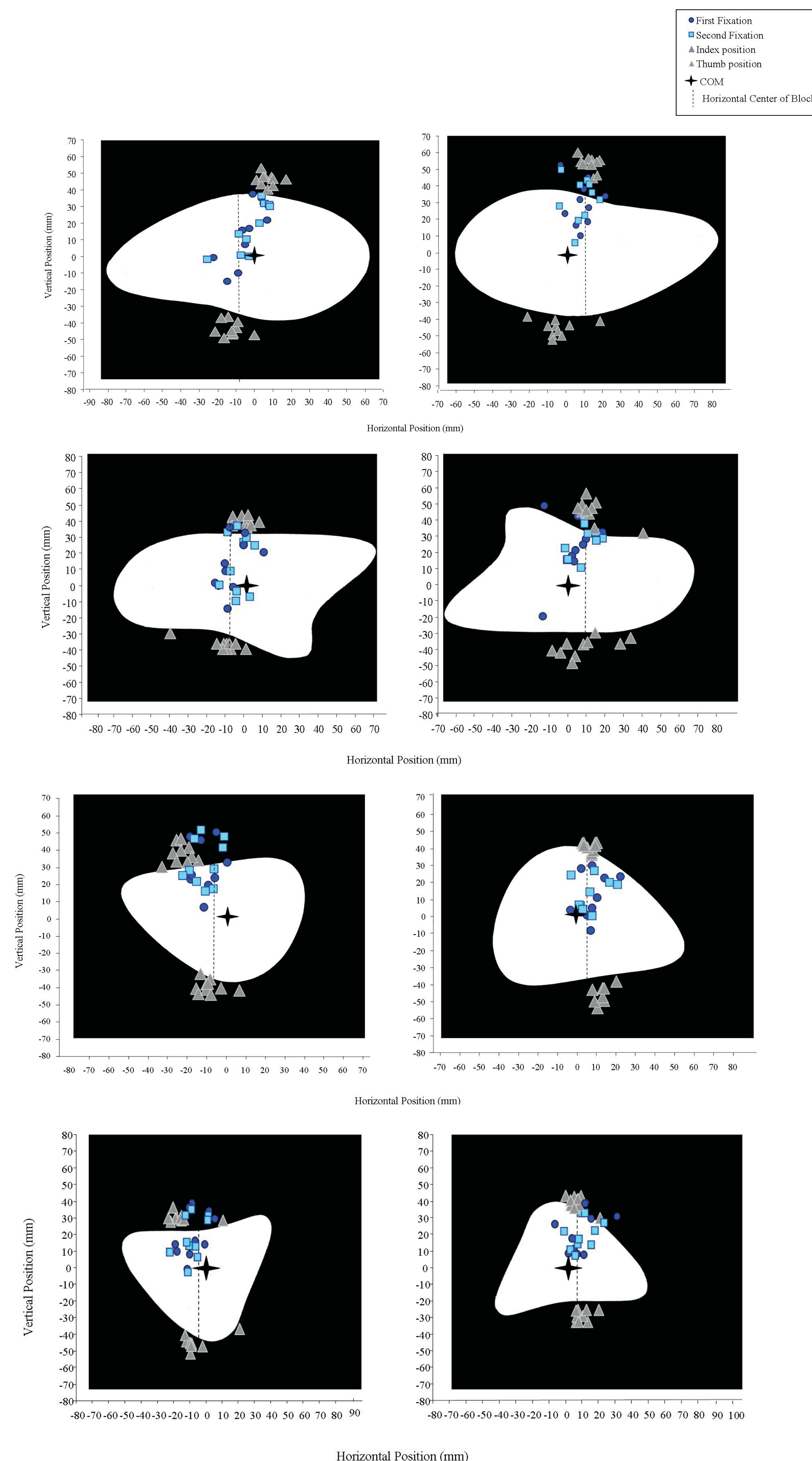


### Results

#### Grasping Asymmetrical Objects: Blake Shapes

First fixations were found to be significantly shorter (218 ms) in duration than second fixations (275 ms) on the objects.

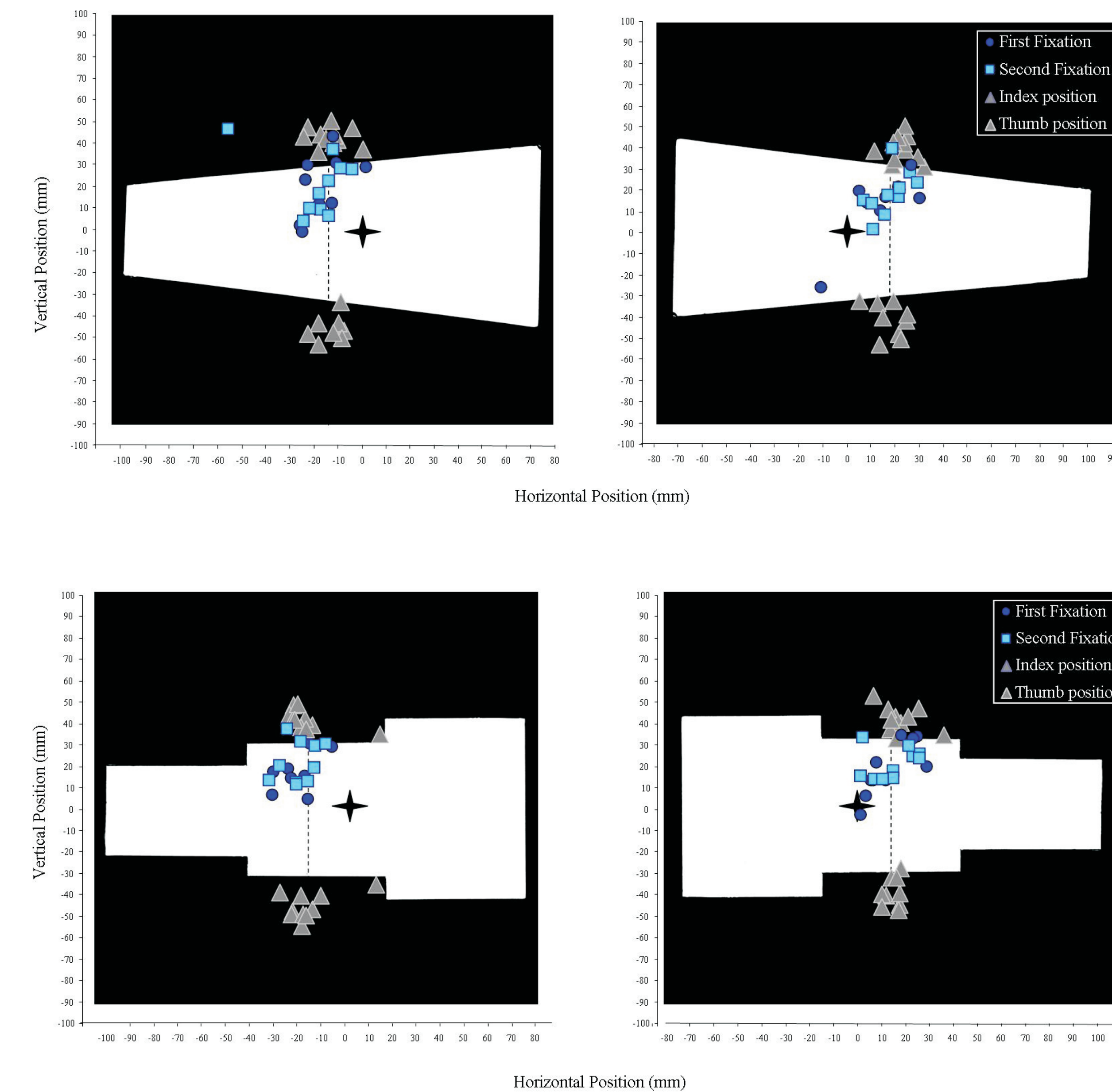
A main effect of orientation was observed for gaze fixation locations and finger positions ( $p$ 's < .001) along the X axis. Surprisingly, however, gaze fixations and finger placement were towards the horizontal midline of the blocks. In other words, when the COM was to the left (or right) of midline, fixation and finger placements were to the left (or right) of the COM – towards the midline. A shape by orientation interaction revealed that these differences were significant for all objects but the first shown below.



#### Grasping Symmetrical Objects: Gradients in Size

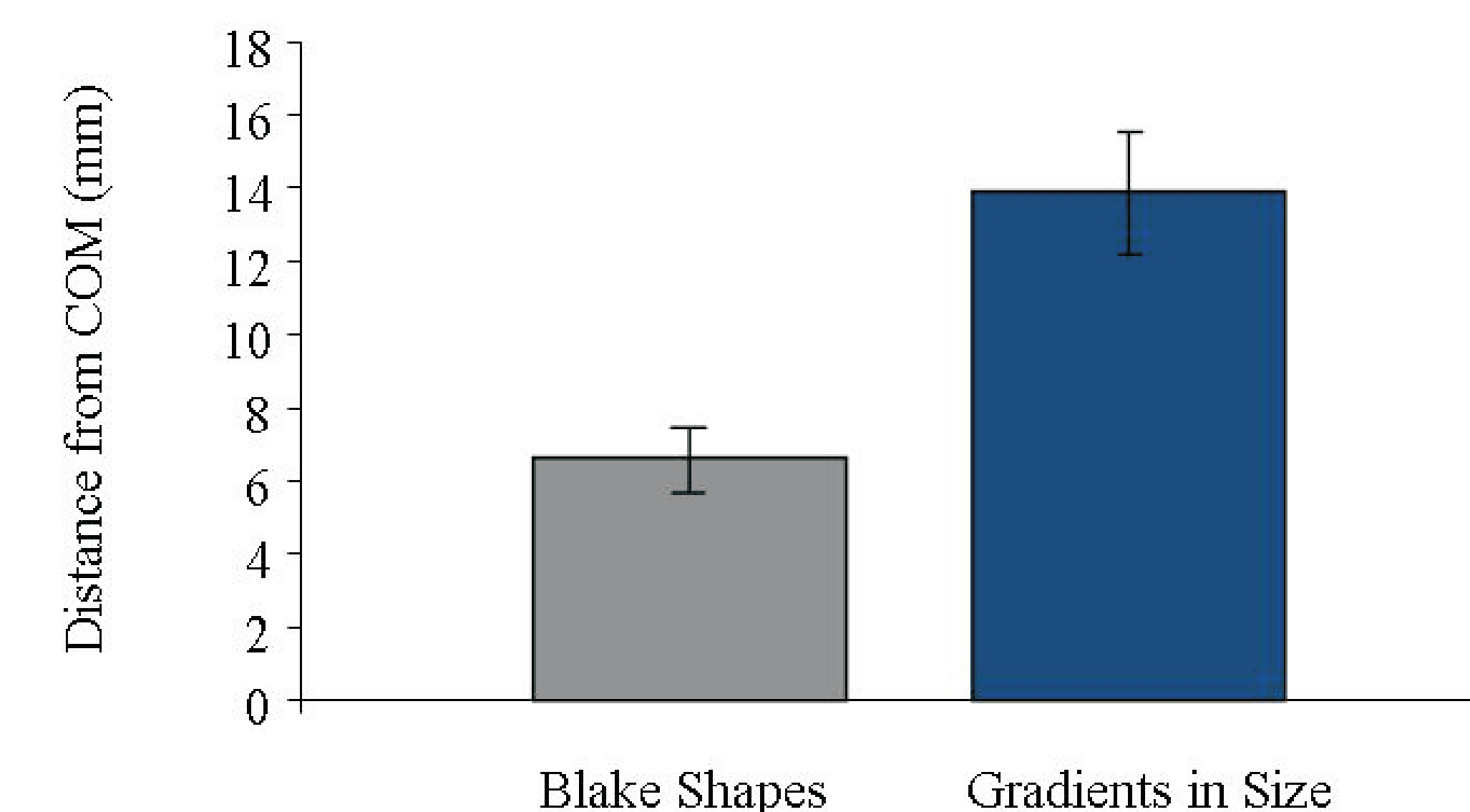
First fixations were found to be significantly shorter in duration (213 ms) than second fixations (280 ms)

A main effect of orientation revealed significant shifts in fixation locations and index finger placement along the X axis ( $p$ 's < .001). In both instances, shifts were seen away from the COM towards the horizontal center of the blocks.



#### Grasp Axis: Distance from COM

Overall, participants' grasp axis was shifted away from the object's COM towards the horizontal midline of the blocks. This shift was significantly smaller when grasping the Blake shapes ( $p$ =.001).



### Conclusions

For complex asymmetrical objects, participants look to locations along the top edge of an object, corresponding to index finger position of grasp lines that fall close to the objects' COM – with a small bias for positions towards the object's horizontal midline.

For symmetrical objects whose COM is different from the horizontal midline, gaze and grasp positions were concentrated along the horizontal midline.

Despite the complexity of the shapes, however, participants did not explore the object area in more detail. In both cases, first fixations were found to be significantly shorter in duration than final fixations, indicating that participants were spending more time looking at the shapes while positioning their fingers on the object.

### Shapes

In contrast to the Blake shapes, the symmetrical objects used in this study could be grasped at any location. This, combined with the fact that these objects were made out of a light-weight material where shifts in COM would not be noticed if the object was grasped at its midpoint, may have resulted in the similar grasp and fixation patterns observed with simple symmetrical objects.<sup>1</sup> If heavier objects were used, where differences in the COM would be more noticeable, it may result in gaze and grasp locations being more closely anchored to the COM. This issues will be explored in future studies.

### References

- Desanghere, L., & Marotta, J.J. (2008). Eye movements and visuomotor behaviour: What are you looking at?! *Journal of Vision*, 8(6), 299a.
- de Grave, D. D. J., Hesse, C., Brouwer, A.-M., & Franz, V. H. (2008). Fixation locations when grasping partly occluded objects. *Journal of Vision*, 8(7), 1-11.
- Brouwer, A., Franz, V. & Gegenfurtner, K. (2009). Differences in fixations between grasping and viewing objects. *JOV*, 9, 1-24.
- Lederman, S. J., & Wing, A. M. (2003). Perceptual judgement, grasp point selection and object symmetry. *Exp Brain Res*, 152(2), 156-165.
- Kleinholdermann, U., Brenner, E., Franz, V. H., & Smeets, J. B. (2007). Grasping trapezoidal objects. *Exp Brain Res*, 180(3), 415 -420.

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