Gaze strategies while grasping: What are you looking at?!

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Introduction

When you want to pick up an object, it is usually a simple matter to reach out to its location, and accurately pick it up. Almost every action in such a sequence is guided and checked by vision, with eye movements usually preceding motor actions.[1,2]

Research in this area has primarily been concerned about the sequence of movements in complex "everyday" tasks like making tea or tool use. Less emphasis has been placed on the object itself and where on it eye and hand movements are directed. Those studies that have, find gaze is typically directed to "target zones", obstacles, or future landing sites.[3,4]

In contrast, studies exploring eye movements during perceptual tasks, such as looking at computer-generated target shapes, show gaze locations concentrated near an object's centre of mass (COM).[5,6]

Purpose

To contrast fixation locations on real world objects during two tasks: perceptual estimations of size and reaching and grasping.

Method

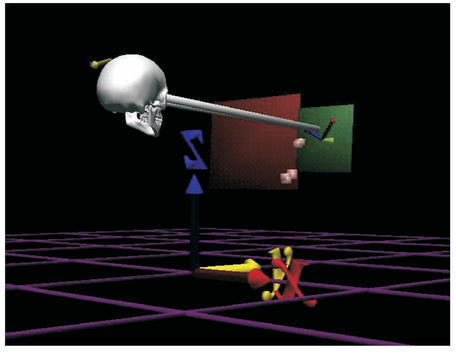
Participants

Nine right-handed first year psychology students (5 female, mean age=18) with normal or corrected-to-normal vision participated in this experiment.

Materials and Procedure

Participants were required to grasp and manually estimate the size of centrally placed 'Efron Blocks', which were presented vertically on a display board 55cm in front of them.

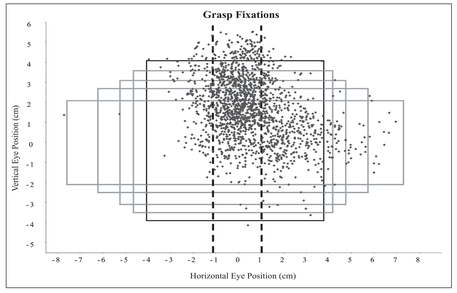
Kinematic hand and gaze data from an Optotrak Certus and Eyelink II were integrated into a common frame of reference via Motion Monitor software (Innovative Sports Technology) which spatially and temporally aligns eye, head, and hand data during the grasping and estimation tasks.



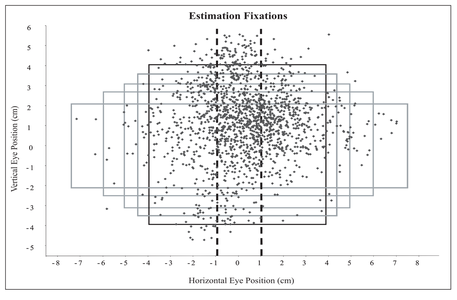
Results

Fixation locations in perception and action

Regions of Interest (ROI) encompassing the vertical centre of the block were established.



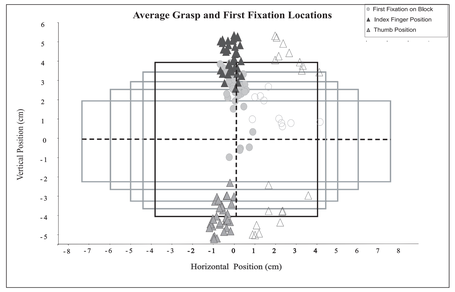
Significantly more fixations were within the ROI during grasping.



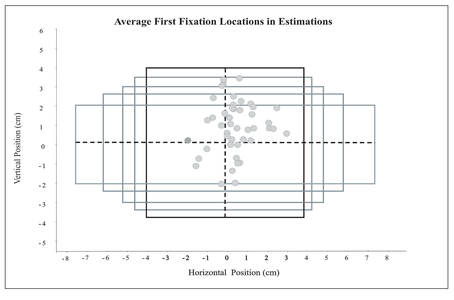
Estimation fixations were found to be more dispersed around the block area.

Do we grasp were we first look?

Stable grasp positions across the objects' COM were observed. Initial gaze position (first fixation) supports finger location in both horizontal and vertical dimensions of the block.



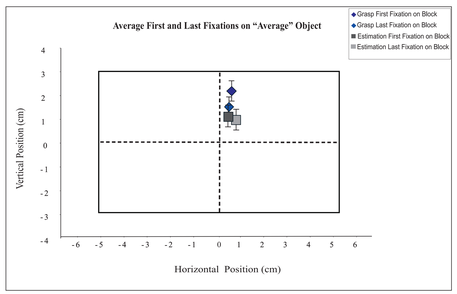
Two participants consistently grasped the blocks to the right of the midline, their first fixations on the block also support this rightward grasping bias along the horizontal axis.



In contrast to grasping, the position of first fixations on the block during estimations did not significantly increase with block size.

Do fixation locations change throughout the task?

First fixations on the object during perceptual estimations were found to be significantly closer to the objects COM than first fixations during grasping.



Differences in location between tasks at final fixation were not observed.

Conclusions

Our results demonstrate key differences in where people are looking during grasping and perceptual size estimation tasks on real world objects.

During grasping, fixations were found to be concentrated along the vertical center of the object. When these fixations were aligned to kinematic time points, such as the beginning and end of the movement, first fixations were located towards the top central edge of the block supporting finger placement.

Final fixations trended towards the objects COM, perhaps to monitor both edges of the object during finger placement.

The average fixation location during estimations was found to be above the objects COM. However, due to strict post-testing accuracy criteria that resulted in participant exclusion, task order was no longer counterbalanced. More participants performed the grasping task first which could have biased estimation fixations towards the top half of the object. Despite this bias, first fixations during estimations were found to be significantly closer to the COM when compared to first fixations during grasping.

Implications

These results demonstrate basic perception and action task differences in terms of where participants fixate on simple symmetrical objects when picking them up and estimating their size as well as how these fixation locations change throughout the task.

References

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Acknowledgments

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