



Eye-hand coordination: Differential effects of obstacle position on reach trajectories, grasp and gaze locations

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INTRODUCTION

Traditionally, most studies of eye-hand coordination have involved solitary objects. In this study, we examine the effects of potential obstacles (NTO, non-target objects) on reach kinematics and gaze.

DATA COLLECTION

Subjects: Twenty (13 female, mean age 21) right handed individuals with normal or corrected to normal vision.

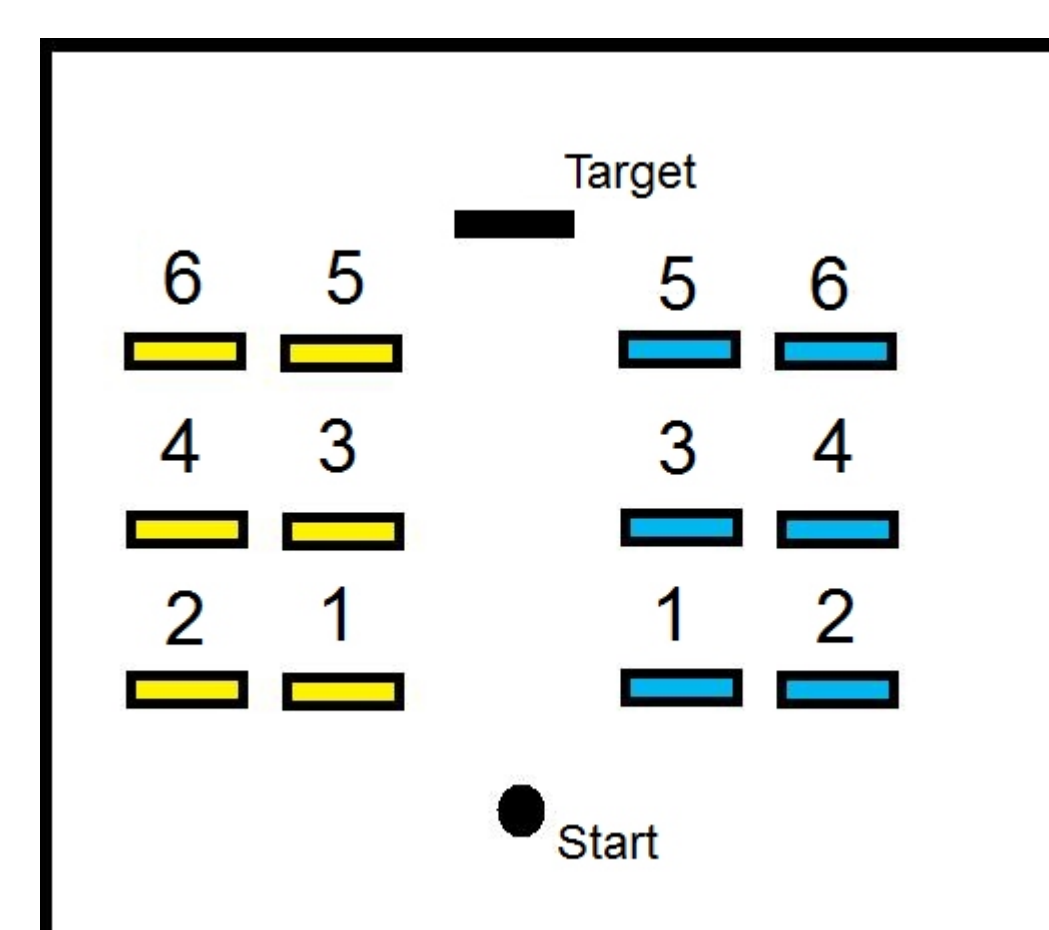
Figure 1: Equipment set-up



Eye position was recorded using an Eyelink 2 eye-tracker and grasp kinematics were recorded using an Optotrak Certus motion-tracking system. This data was integrated into the same reference frame via MotionMonitor software.

EXPERIMENTAL TASK

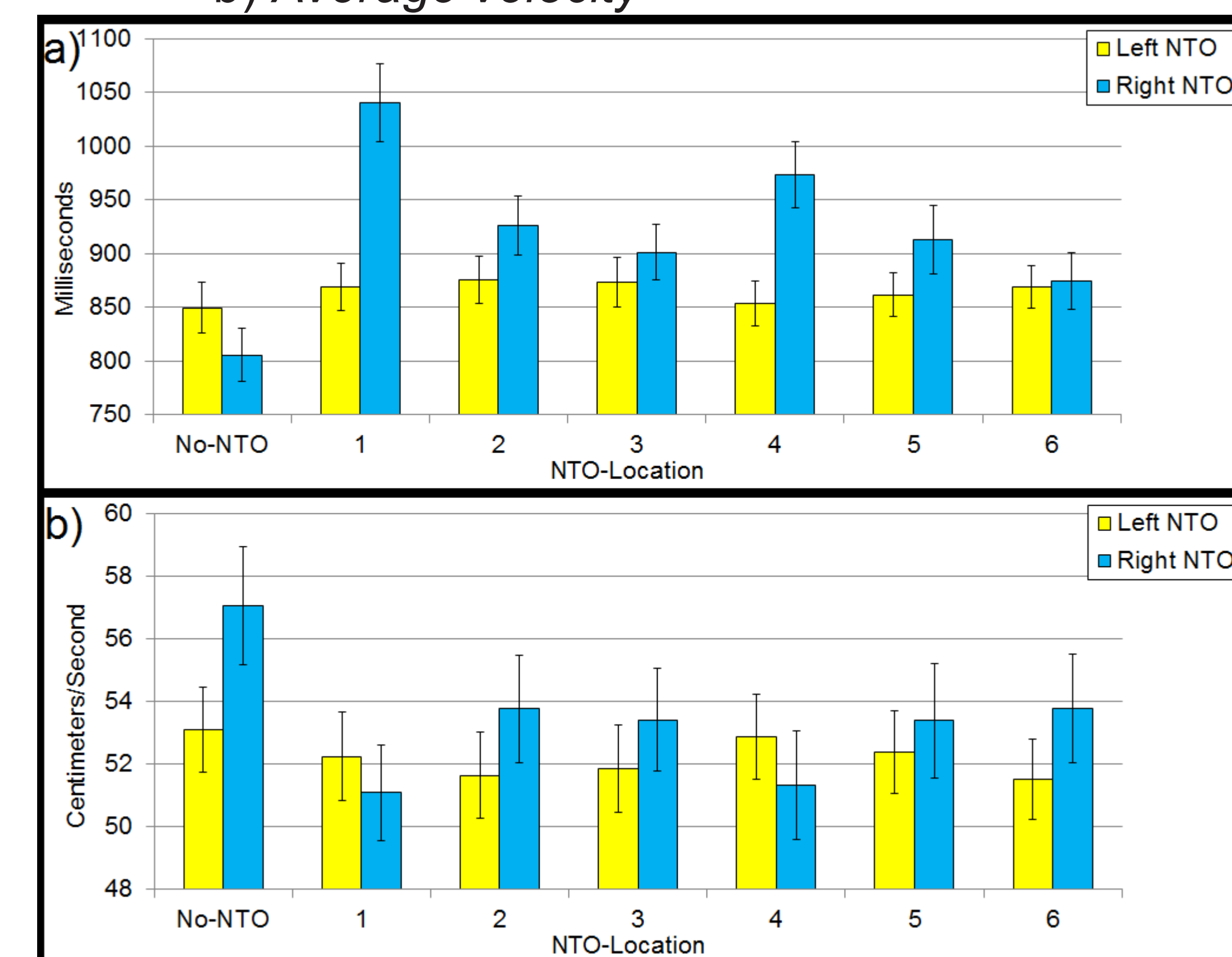
Figure 2: NTO locations



NTO location was randomly varied among 6 possible locations to one side of the reaching hand, with obstacle-less control trials mixed throughout.

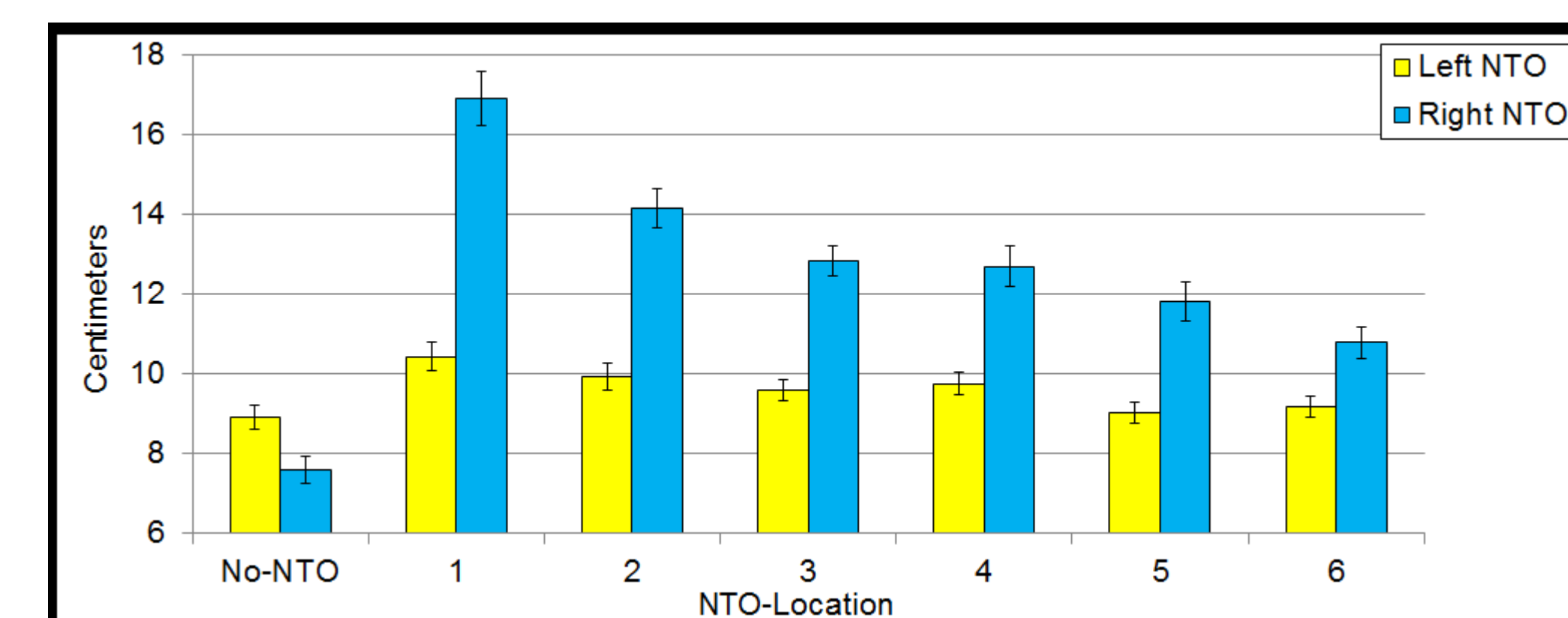
REACH MECHANICS

Figure 3: a) Reach duration
b) Average velocity



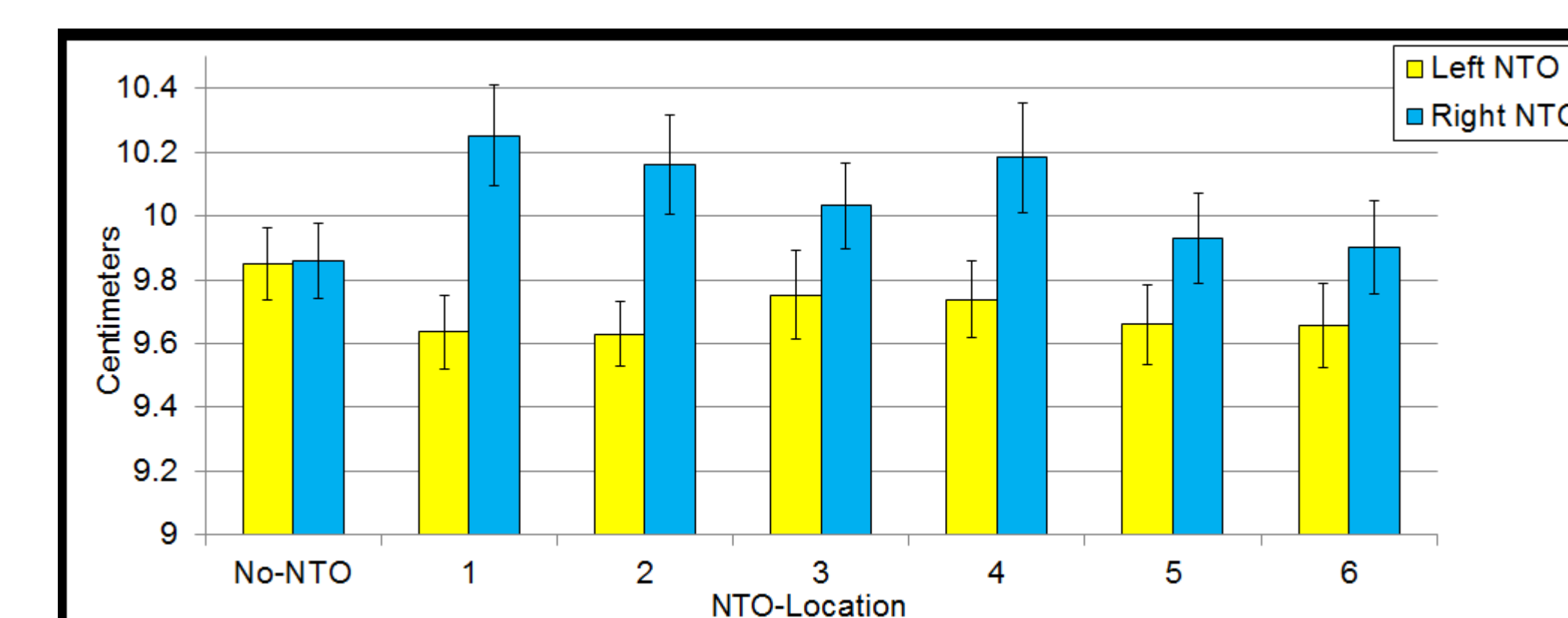
- In all conditions, no differences were found among left side NTO locations.
- For right side NTOs, more physically invasive positions produced greater impacts on reach duration and velocity.

Figure 4: Trajectory deviation



- Left side NTOs produced a significant deviation in trajectory only when placed closest to the start position.
- All right side NTOs produced greater deviations in reach trajectories than those generated in the no NTO control condition.

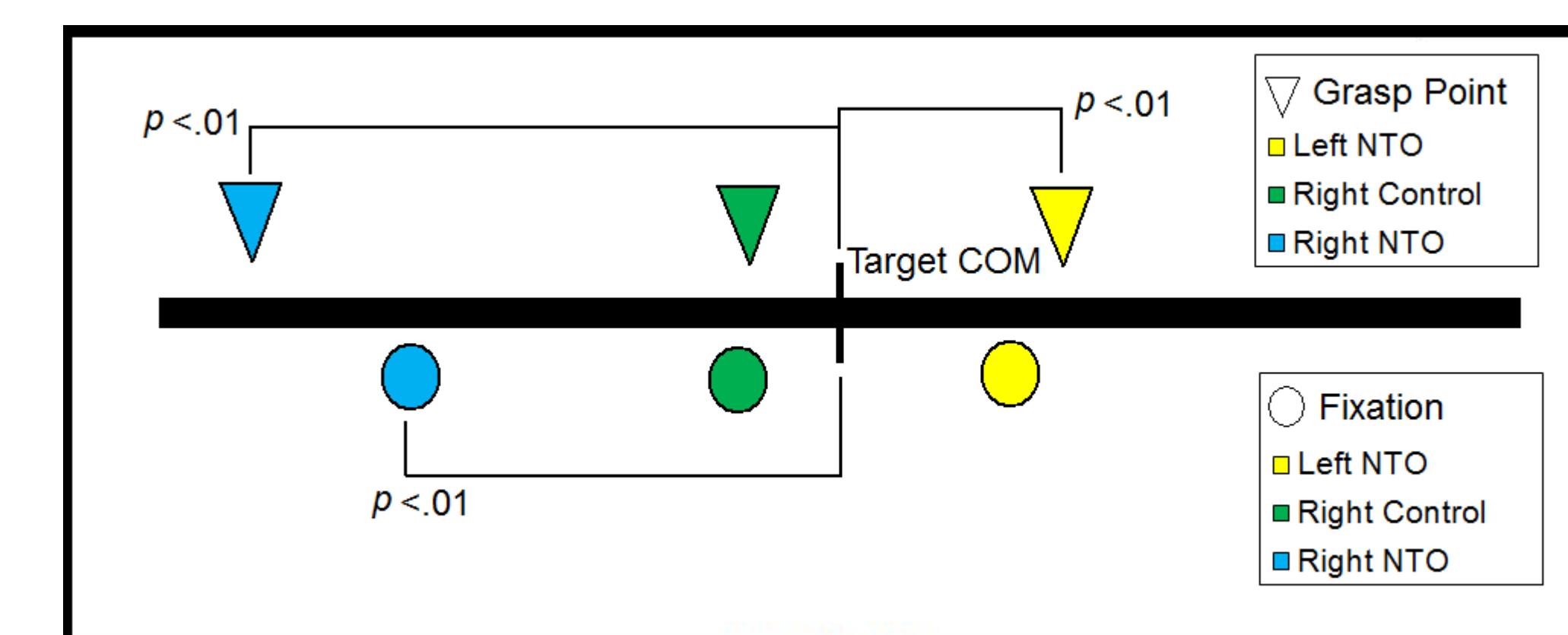
Figure 5: Mean grip aperture



- When the NTO was in the most invasive positions on the right side, MGA was larger.

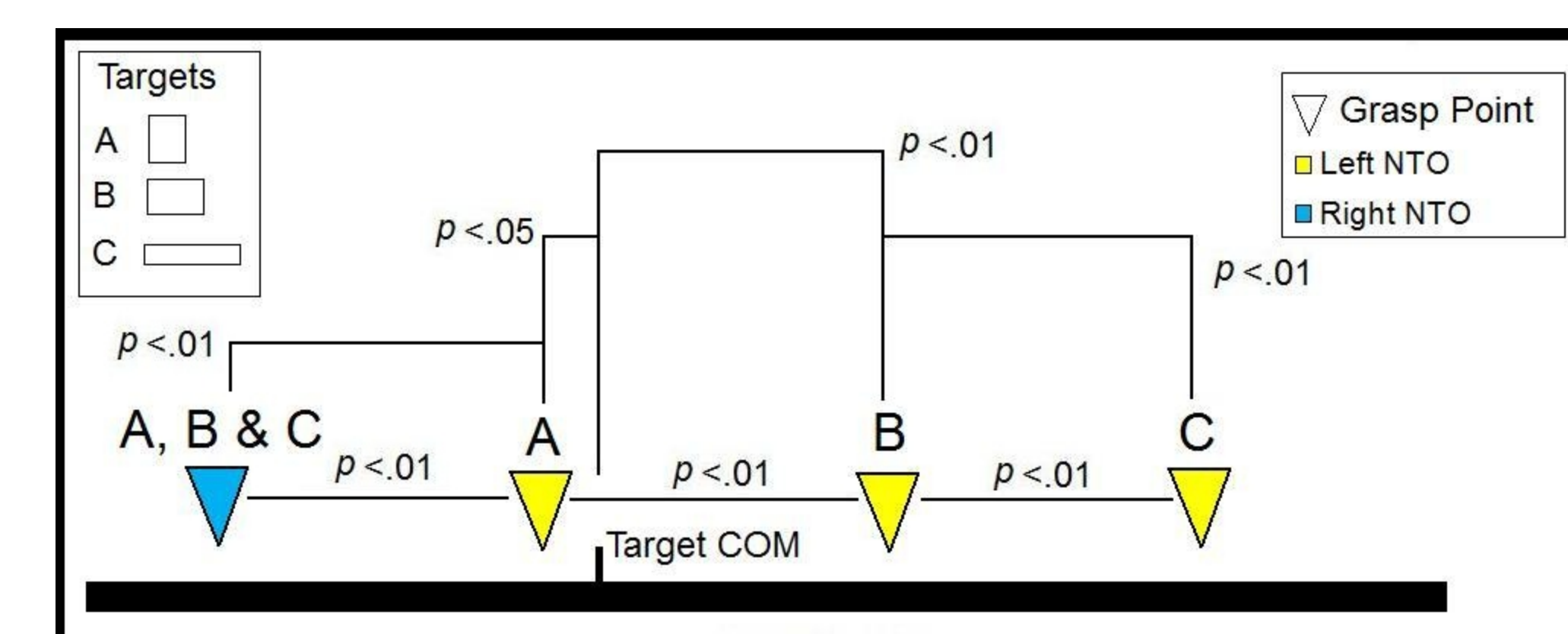
EYE-HAND COORDINATION

Figure 6: Final fixation and grasp location



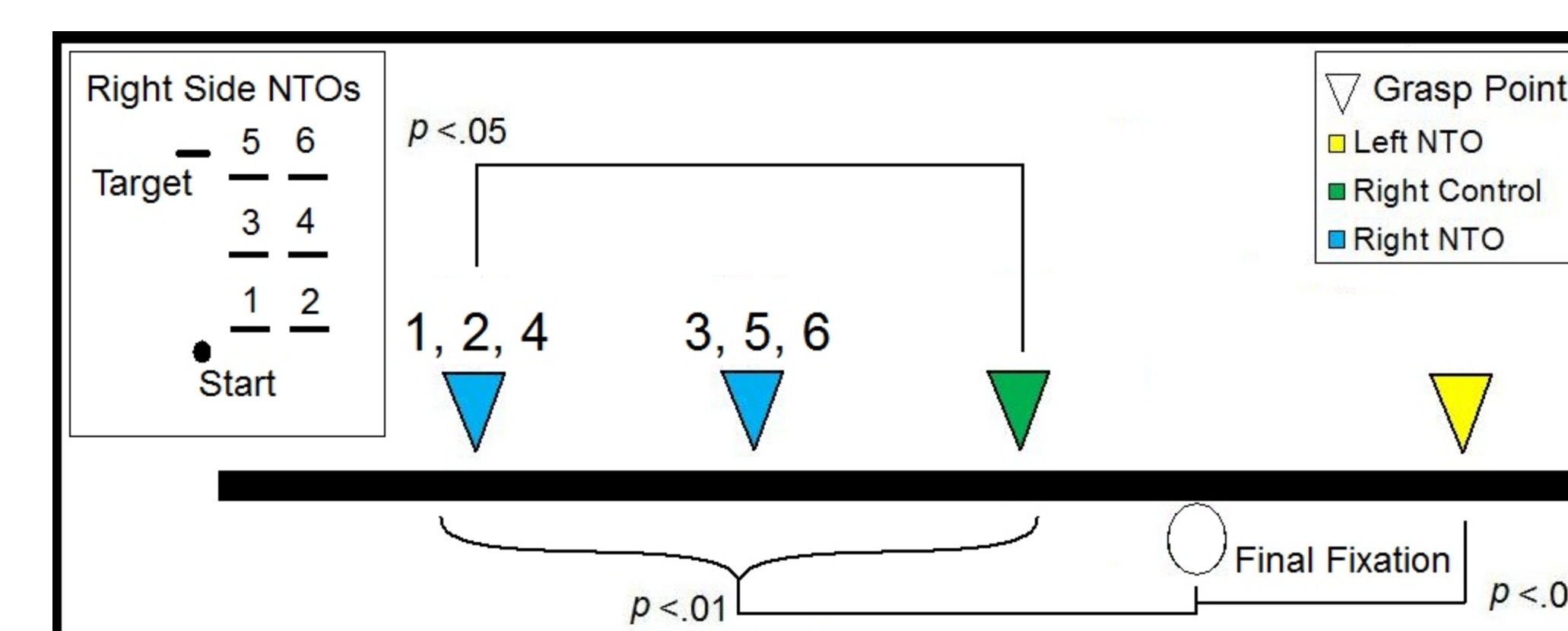
- For right side NTOs, final fixations and grasp location were "pushed" significantly to the left of the object's centre of mass (COM).
- For left side NTOs, only index grasp location was "pushed" to the right.

Figure 7: Grasp locations on target objects



- Effects seen from left side NTOs reflect effects of target shape, not NTO
- Consistent with grasping studies where NTOs are never present¹.

Figure 8: Grasp location compared to fixation



- The most invasive right side NTOs caused grasp location to be pushed further left from the final gaze fixation.
- The reaching hand was pushed leftward not only when compared to the target's COM, but also to the fixation point of gaze.

CONCLUSIONS

Right versus Left Side NTOs

- Top down "cognitive setting" different when NTO was exclusively to the right compared to left.
- Left side NTOs required only a single "setting" and are undifferentiated. Right side NTOs required trial-by-trial appraisal.

NTOs Push Gaze and Grasp Location

- Optimal avoidance trajectory planning² or attentional inhibition of target-irrelevant space³?
- Attention-for-Action.

Motor System is More Sensitive to NTOs

- Gaze informed the motor system with task relevant information⁴; served to highlight task relevant stimuli consistently.
- Motor system was tasked with avoiding NTOs; needed to be sensitive to environmental context.

REFERENCES

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THANKS TO

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