

# Hand-Target Proximity Improves Target Representation for Reaching

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## Introduction

Visual-tactile bimodal neurons code visual stimuli that appear on or near the hand (Graziano et al., 1994). There are a greater number of these neurons that have receptive fields very close to the skin than there are neurons whose receptive fields code far from the skin (Graziano & Cooke, 2006). In addition, the intensity with which individual neurons respond to nearby visual stimuli decreases as the distance between the hand and target increases (Graziano, 1999).

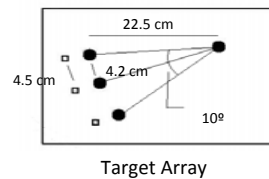
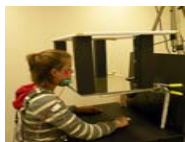
Together, these findings suggest that targets appearing near the hand should be coded more robustly than targets appearing even a few centimeters away from the hand.

## Question

Does hand-target proximity influence visual target location processing in healthy undergraduates?

Prediction: If hand-target proximity influences visual representation of target location, reaching accuracy and variability will depend on the distance between the hand and target.

## Methods



Target Array

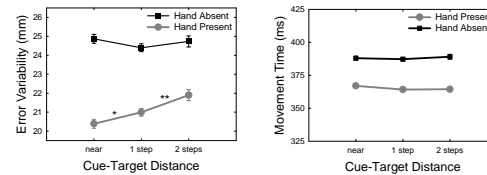
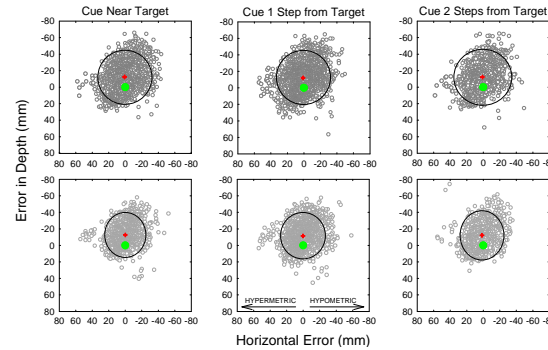
Participants performed open-loop reaching movements from the start location to one of three (3) pseudorandomly-presented targets.

A cue appeared in one of three (3) locations to the left of the target. On half the trials, the participant placed his/her index and middle fingers in this location.

Eye (EOG) and hand movements were tracked. Reaching movement time, precision, and accuracy was measured.

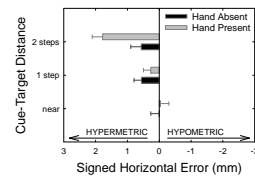
## Exp. 1: Hand-Target Proximity Effects on Reaching

Cue location varied trial by trial. Participants saw hand in cued location before each movement.



Error variability and movement time are reduced when hand is present in the display ( $p < .05$ ).

Error variability is lowest when hand is placed near the target ( $p < .05$ ).



Hand-target distance effects on movement accuracy are small.

## Conclusions

Hand-target proximity influences target location processing in healthy undergraduates. In Experiment 1, reaching variability and movement time were reduced when the hand was placed in the display, and variability was lowest when the hand was placed near, rather than far, from the target.

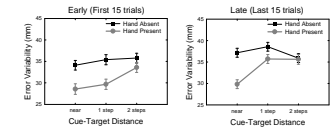
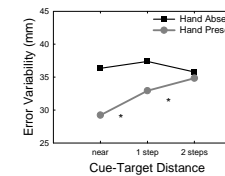
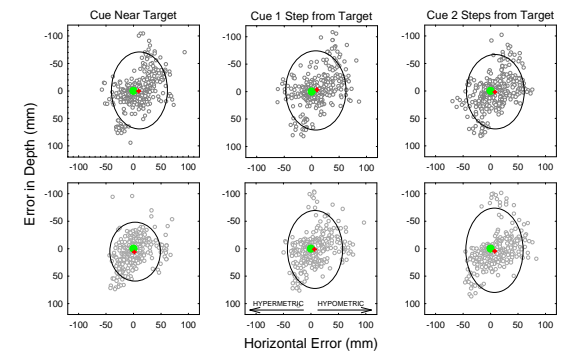
In Experiment 2, we ruled out concerns about whether visual memory about the position of the hand influenced near-hand target processing by removing participants view of their hand for relatively extended periods of time. Error variability was still lowest when the hand was placed near, rather than far, from the target.

Finally, participants in Experiment 2 improved their accuracy by ending their movements closer to both the target and the hand. This pattern indicates that participants are not reducing variability by treating the hand like an obstacle that must be avoided.

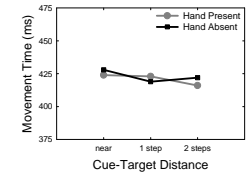
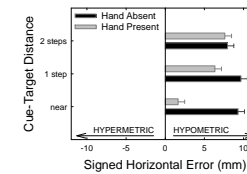
This pattern of data is consistent with electrophysiological results showing that regions very close to the skin are represented more robustly by bimodal visual-tactile neurons than are regions far from the skin.

## Exp. 2: Effects Dependent on Visual Memory?

Cue location was blocked. Participants saw hand in cued location at the beginning of each 30-trial block only.



Error variability is lowest when hand is placed near the target ( $p < .05$ ). This finding does not change over time.



Accuracy higher when hand is placed near the target ( $p < .05$ ). Participants do not treat the hand as an obstacle.