

# The role of Binocular Information in the Control of Perception and Action

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## INTRODUCTION

Neurobiological studies revealed that object attributes are encoded by two separate visual pathways in primate brains.

- **Ventral visual stream:** extracting object features from its surrounding and generating an object centered (allocentric) representation of the object.
- **Dorsal visual stream:** extracting object features necessary for visuomotor behavior and generating viewer centered (egocentric) object representations.

To investigate this dissociation, Aglioti et al. (1995) studied perceptual judgements and grasping actions towards the center circles of the **Ebbinghaus** illusion:

- Perception was reliably deceived (size misjudgements)
- Grasping was not affected (correct grip aperture to grasp)

## RESEARCH QUESTION

We investigated perceptual judgements and pointing movements towards edges of a trapezoid window. The trapezoid window depicts geometrical information suggesting a slanted display. Viewed monocularly, it provides a powerful depth illusion, whereas the window is perceived as a flat object when viewed binocularly.

We asked the following questions:

- Is there a dissociation between perception and action indicating separate involvement of the two visual streams?
- What is the effect of mono- and binocular vision on pointing?

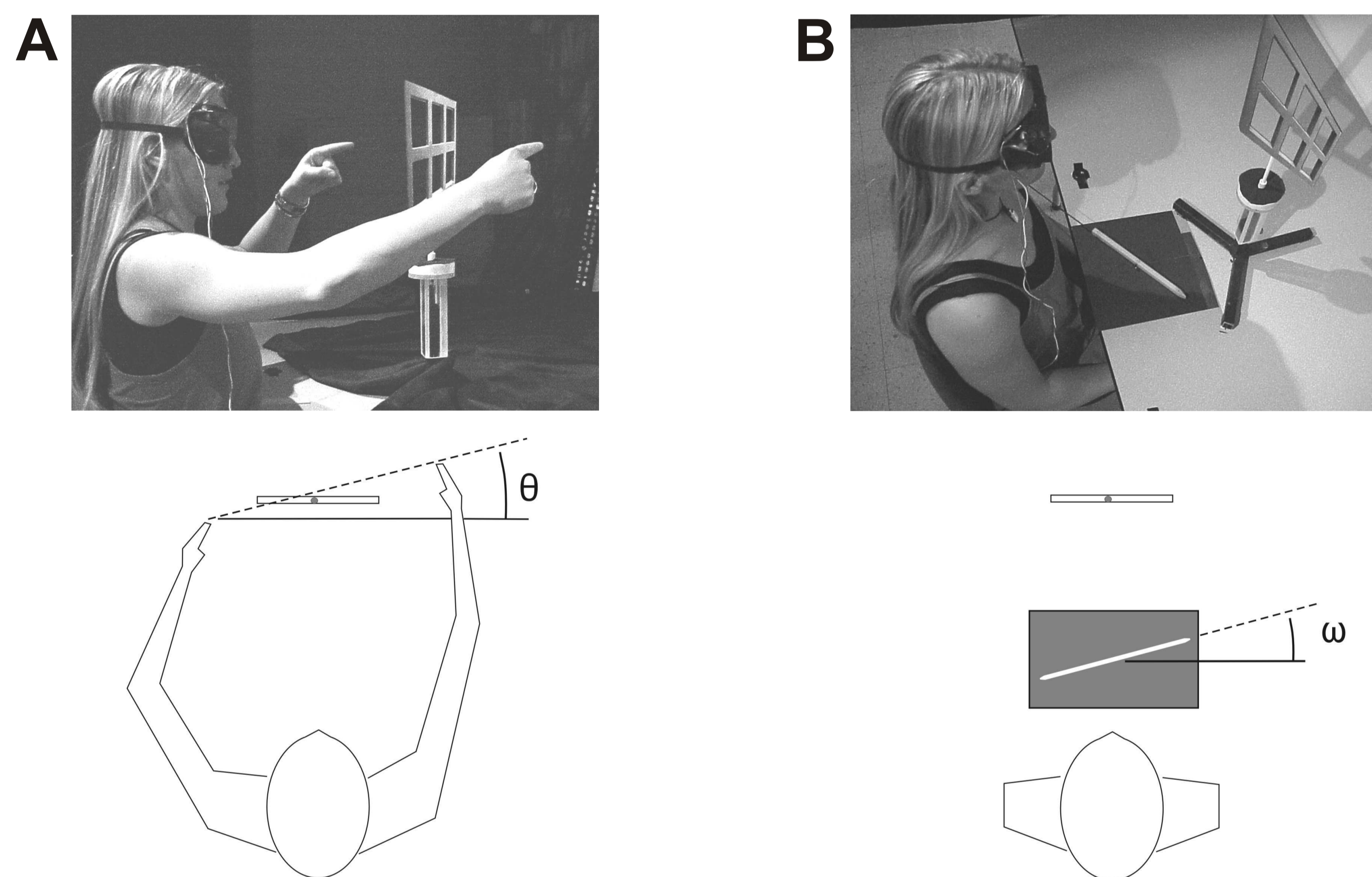


Figure 2. Experimental setup for the Motor Task (A) and the Perceptual Task (B).

## METHOD

Participants sat in front of the display, wearing LCD goggles with independent eye shutters.

**Pointing Task:** point with your index fingers to the side of the display without touching it as soon as one or both of the eye shutters opened up. Finger movements were recorded at 120 Hz using a 3D optoelectronic camera system.

We measured visual reaction time, movement time, and the angle formed by the two fingers with respect to the frontal plane when pointing at the display ( $\theta$ ).

**Perceptual Judgement Task:** Report the experimenter to stop turning the dial when the dial takes the orientation of the display in front of you. We measured the angle of the dial ( $\omega$ ).

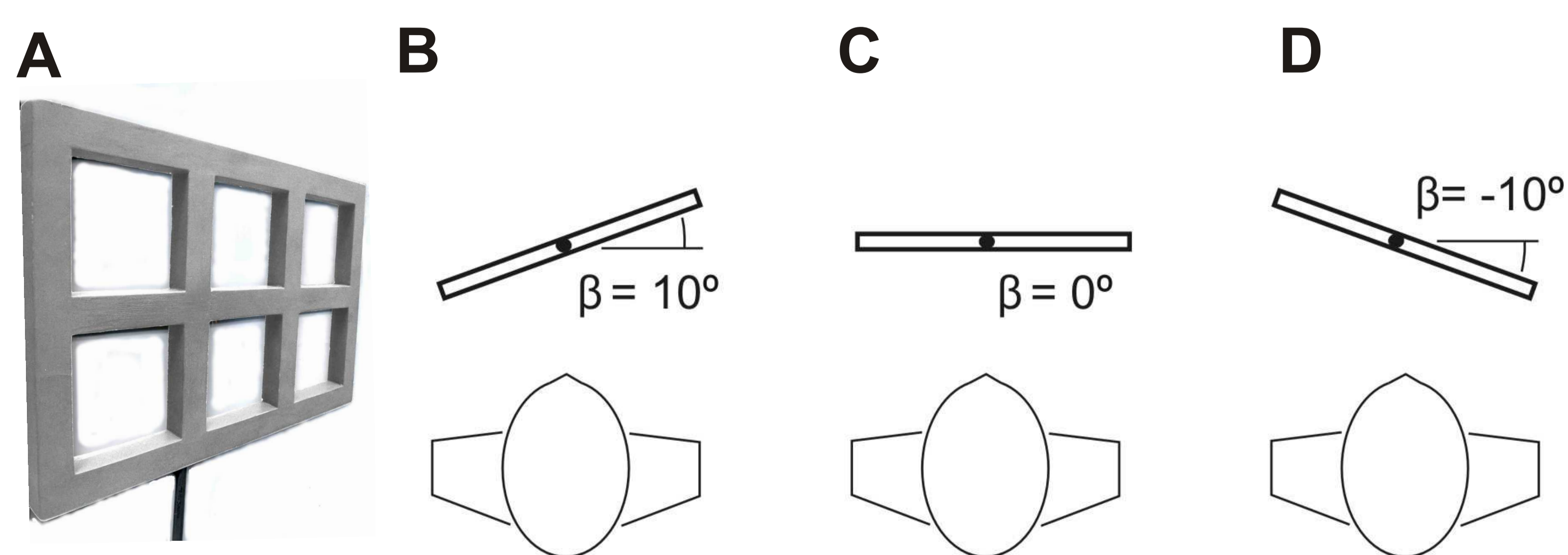


Figure 2. Trapezoidal display (A), and the orientation of the display at 10 deg (B), 0 deg (C) and at -10 deg (D).

## RESULTS

- Monocular vision affects both perceptual and motor performance.
- Binocular vision largely affects perceptual performance, but has small effects on motor performance.
- Changes in display orientation affects perceptual performance in both viewing conditions, but motor performance only during monocular vision.

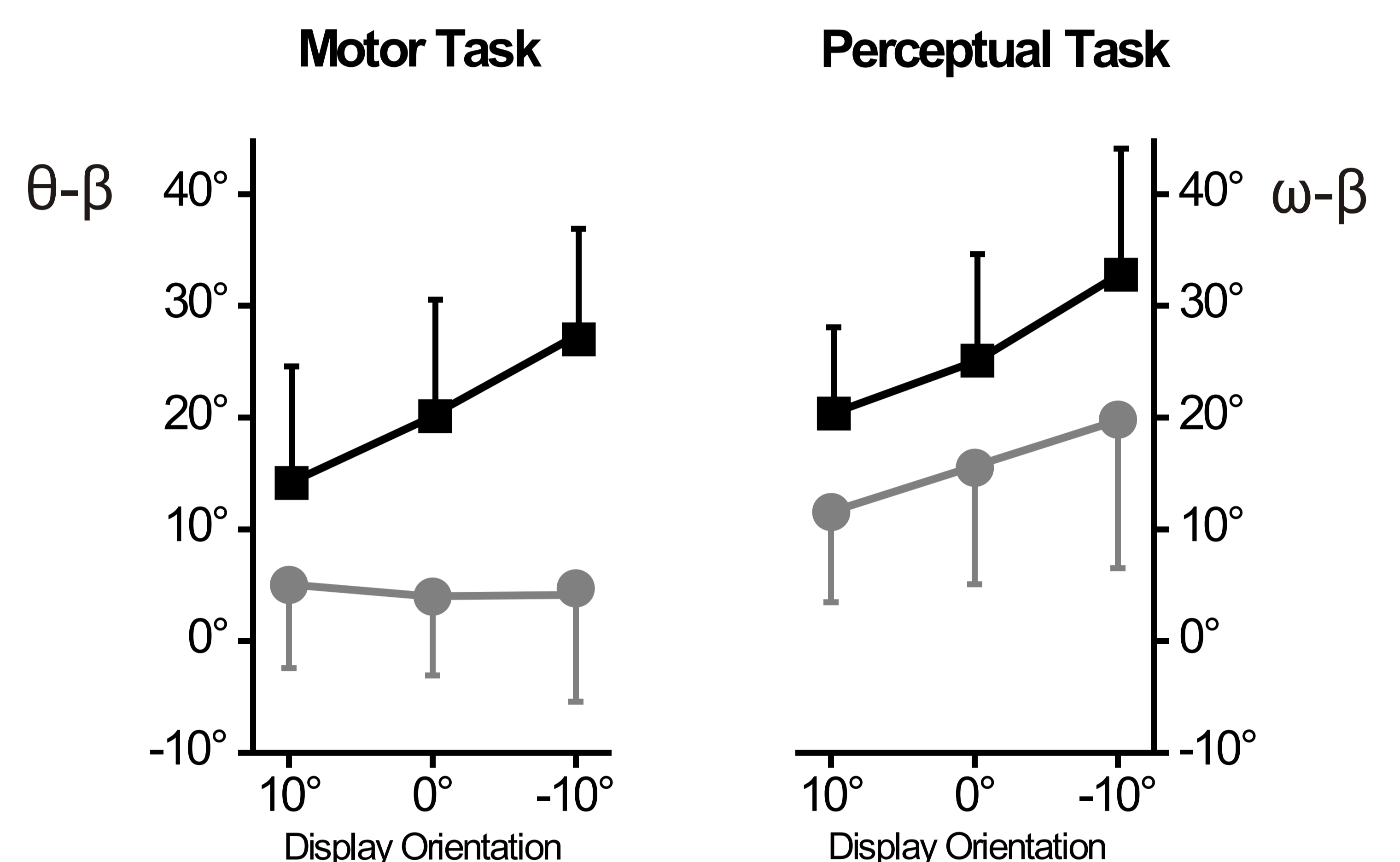


Figure 4. Error towards the display as a function of orientation for the pointing task (Motor Task) and the perceptual judgement task (Perceptual Task)

- During monocular vision Reaction Time decreased for both hands.
- During monocular vision Movement Time decreased for the left hand, but increased for the right hand. This effect can be attributed to differences in trajectory length between the hands.

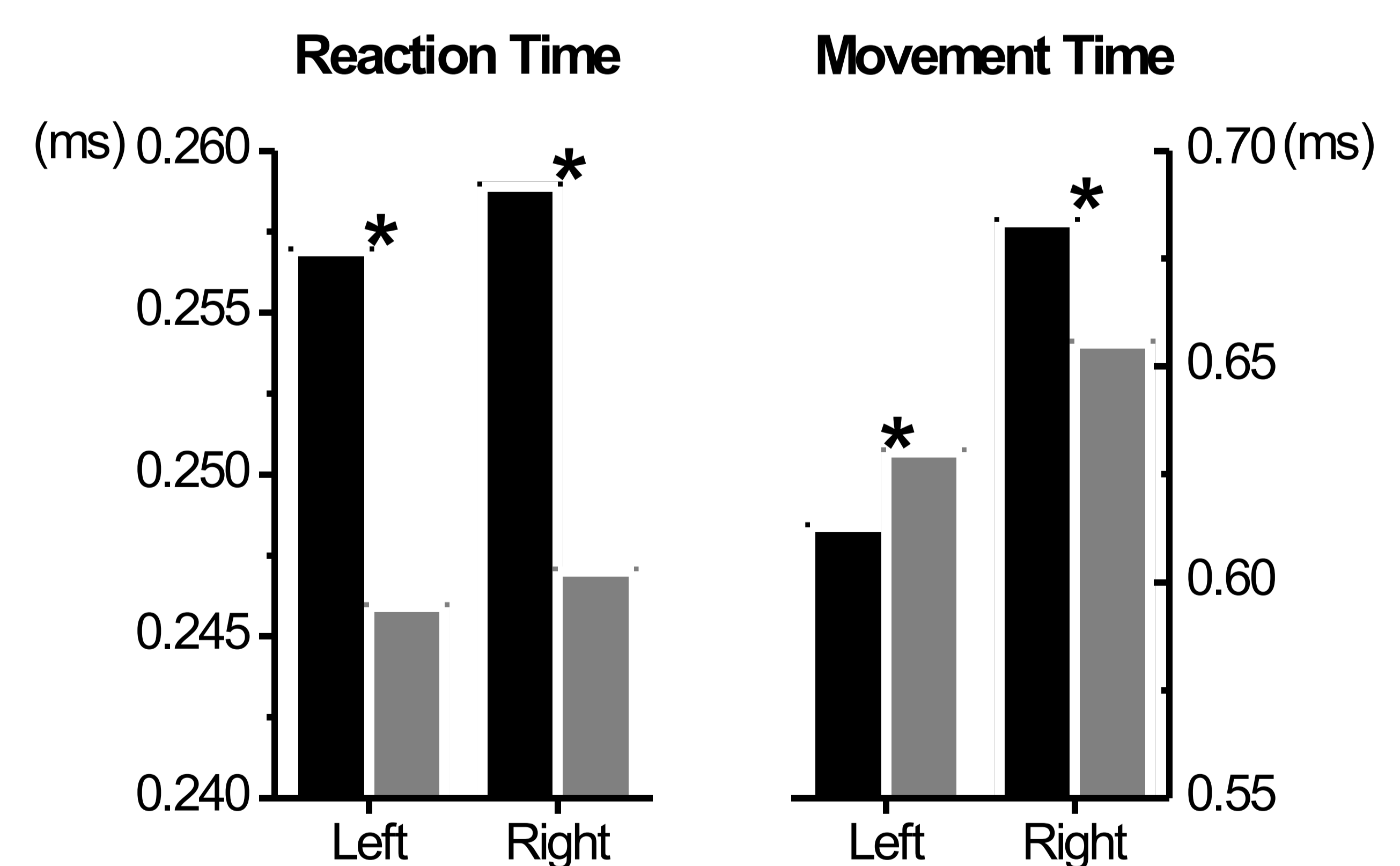


Figure 5. Reaction time and movement time differences between monocular and binocular viewing conditions, plotted for each participant.

## CONCLUSIONS

- The trapezoid window display induces errors in both perception and action (unlike the Ebbinghaus illusion).
- The increased reaction times for monocular vision may be due to longer visual processing time that is necessary to arrive at a stable perception of depth, or can be related to modifications of the motor plan. Our data indicates a change in visual processing time.

**Reference** Aglioti, S., DeSouza, J.F.X., & Goodale M.A. (1995). Size contrast illusions deceive the eye but not the hand. *Current Biology*, 5, 679-685.