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The Role of Visual And Proprioceptive Limb Information in Affordance Judgments and Action Capabilities

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Introduction

- In cases of visual-proprioceptive conflict, perceived limb location can be strongly influenced by visual information (Hay et al., 1965).
- In the mirror illusion, an unseen hand position is reported to be in the location portrayed by the mirror reflection of a viewer’s visible hand.
- The influence of visual information on perceived limb location has been called visual capture (Hay et al., 1965) in which visual information influences actions and perceptions when the seen (in the mirror) and felt (proprioception) position of the hand do not match.
- Past results suggest that visual information about hand position overrides the proprioceptive information when the hands were used to indicate perceived object length.
- Furthermore, previous research indicates that visual capture influences participants’ ability to represent object size with their hands, and also suggests that vision acts as a primary source of information about bodily location and may influence other body-based spatial judgments (Sitz, Barnas, Kunz, 2012).

Present Research and General Method

- The conflict between vision and proprioceptive information of limb location was further examined in three experiments by means of a task in which participants adjusted the physical distance of their unseen hand in the horizontal plane and sagittal plane during judgments of affordance and action capabilities.
- We predict that the visual capture of a mirrored hand position would significantly affect participants’ ability to perform affordance judgments and action capabilities with their hands.
- In each trial, participants viewed their visible hand and its reflection in the mirror, while their unseen hand was positioned at one of four locations behind the mirror.
- The visible hand was always positioned at 15 cm in front of the mirror, and so the unseen hand always appeared to be 30 cm from the visible hand, regardless of its actual location.
- While viewing their hand in the mirror, participants were instructed to perform simultaneous finger movements for 8 s with both hands to maximize the visual capture illusion.

Experiment 1 – Horizontal Plane: No mirror

- Participants viewed a series of tubes of varying lengths presented in ascending and descending order and called out the point at which they were no longer able to catch the tube given the current distance between their hands, whether felt or seen.
- Tube sizes = 15, 17.5, 20, 22.5, 25, 27.5, 30, 32.5, 35, 37.5, and 40 cm
- Significant main effect of hand condition:
  - F(2,24) = 3.74, p = .039
  - Significant main effect of hand aperture:
  - F(4,48) = 8.73, p < .001
  - Significant interaction between hand condition and hand aperture:
  - F(8,96) = 2.86, p = .007

Experiment 2 – Horizontal Plane: With mirror

- Participants viewed a series of tubes of varying lengths presented in ascending and descending order and called out the point at which they were no longer able to catch the tube given the current distance between their hands, whether felt or seen.
- Tube sizes = 15, 17.5, 20, 22.5, 25, 27.5, 30, 32.5, 35, 37.5, and 40 cm
- No significant main effect of mirror or no mirror:
  - F(1,19) = .10, p = .752
- Significant main effect of hand aperture:
  - F(4,76) = 115.46, p < .001
- No significant interaction between mirror and hand aperture:
  - F(4,76) = .41, p = .814

Experiment 3 – Sagittal Plane: With mirror

- Participants viewed an object presented at different locations in the sagittal plane on top of the mirror-box and repositioned their unseen hand such that it was underneath the object.
- Significant main effect of hand location:
  - F(2,36) = 8.13, p < .001

Conclusion and Discussion

- Results indicate that visual capture did not influence participants’ ability to perform affordance judgments with their hands in the horizontal and sagittal planes.
- Hand aperture (Experiment 2) and starting hand location (Experiment 3) did not influence affordance judgment errors.
  - In Experiment 2, participants tended to underestimate affordances, reporting they could not catch objects when they were, in fact, able to reach them.
  - In Experiment 3, participants tended to move their unseen hand too much from the starting location. In other words, participants overshoot the location of the target when moving their hand either forward and backward.
- Results from Experiment 2 suggest that vision is not a primary source of information about bodily location. Proprioceptive information may influence other body-based spatial judgments, including affordance judgments and action capabilities.
- Analysis should control for how long the visual capture illusion “latched on”, or persisted during each trial.
- Future research may examine additional effects of visual capture on specific action capabilities. The rubber hand illusion, which further exploits visual information, can be used in future experiments to determine the effect of visual capture on affordance judgments.

References

References available upon request.