Effects of manual rotation experience on development of mental rotation strategies

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Introduction

- One hypothesis for how individuals recognize rotated objects is through the use of mental rotation. Previous research has shown that by 5-years-old, children report using mental rotation strategies to identify misaligned images (Ghent & Bernstein, 1961; Estes, 1998; Marmor, 1975)
- Other studies have shown that manual rotation training with older children and adults can facilitate object recognition across viewpoints (James, Humphrey, Goodale, 2001; Wiedenbauer & Jansen-Osmann, 2008)
- **Can manual training promote spatial processing skills in younger ages?**

Our experiments examined the effects of manual rotation training on 4- and 5-year-old children's spatial processing abilities.

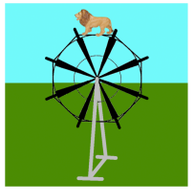
Experiment 1

Participants:

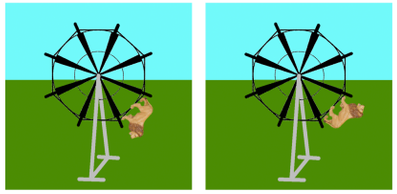
- 19 four-year-olds (M = 53.0mo, SD = 3.2mo)
- 19 five-year-olds (M = 66.3mo, SD = 2.7mo)

Procedure:

Experimenters presented participants with a picture book about animals riding a Ferris Wheel (FW). Each trial presented images of one animal sitting at the top of a FW. The participants were told that the FW goes around, and they will take a picture of the animal during the ride.



Then, participants were shown two images and asked to select the picture from the *same ride*.

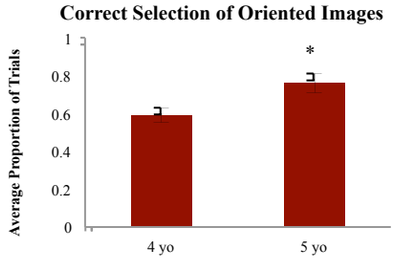


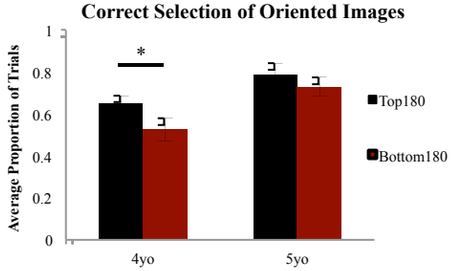
The two given choices were pictures of the same animal, but located at a different position on the FW. Only one image presented the animal facing the same direction as the starting picture. Results were coded based on participants' selections of the correct facing pictures and spontaneous rotational gesturing.

Results:

- Significant difference between age groups

(t = 1.97, p < .05)





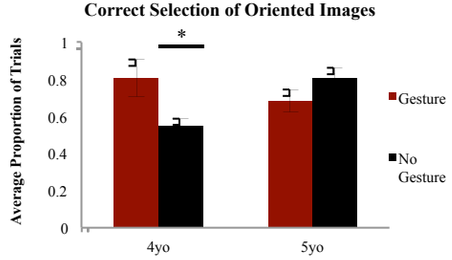
- 4yo: Significant difference between trials rotated in the top 180° and bottom 180°

(t = 2.93, p < .01)

Overall, 5-year-olds were significantly better at identifying the correct image from different orientations. Although they were not as successful, 4-year-olds were significantly better at selecting the correct image when it was rotated in the top 180° of the FW (±90° from the upright position).

- Significant interaction between Age Groups x Rotation Gesturing

(F = 7.95, p < .01)



Four-year-olds, who spontaneously produced rotational gestures, were significantly more successful at identifying the correct misaligned images. This suggested that manual rotation may have facilitated spatial processing skills.

Experiment 2 further investigated this hypothesis by training participants to use manual rotation and observing the effects on the spatial processing task.

Experiment 2

Participants:

- 22 four-year-olds (M = 55.3mo, SD = 3.0mo)

Procedure:

Procedure for Exp. 2 was the same as Exp. 1, with an additional training protocol. Participants were randomly assigned to one of four conditions: Active Rotation, Passive Rotation, Active Gesture, & Passive Gesture.

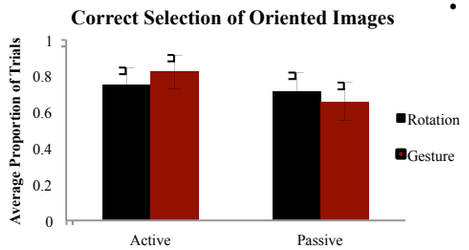
Active, Rotation Training: Participants manually rotated a 2D animal around the FW.

Passive, Rotation Training: Participants observed experimenters manually rotate a 2D animal around the FW.

Active, Gesture Training: Participants used their fingers to gesture the rotation motion of the FW.

Passive, Gesture Training: Participants observed experimenters gesture the rotation motion of the FW.

Results:



- No significant findings so far, but a trend towards active conditions resulting in more correct trials.

**More participants are needed for each condition

SUMMARY

In our task, participants were tested on their ability to match an image that was misaligned with the upright position. Correctly determining the right answer choice tested children's use of spatial processing abilities.

- Experiment 1 results revealed five-year-olds were more successful at identifying a misaligned image.
- Further, Exp. 1 four-year-olds were more successful at identifying images that were rotated ±90° from the upright image, suggesting that their spatial processing skills may be restricted to a limited range.
- Additionally, four-year-olds, who naturally produced gestures to illustrate the rotation motion, performed similarly to five-year-olds.
- Experiment 2 focused on teaching four-year-olds rotation/gesture actions to facilitate spatial transformations, but results are currently inconclusive.

Preliminary results suggest that there is a developmental change between 4- and 5-year-olds on our spatial processing task, and 4-year-olds may benefit from manual rotation training.

References:

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Funding was provided by NIH grant R01 HD057077-01A1 to James, Smith, & Jones

Acknowledgements: Thanks to CANLab members: Jessica MacLean, Preet Matharu, & JeanneMarie Heeb

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