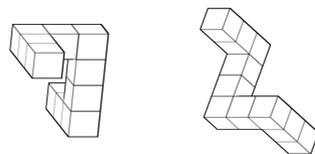
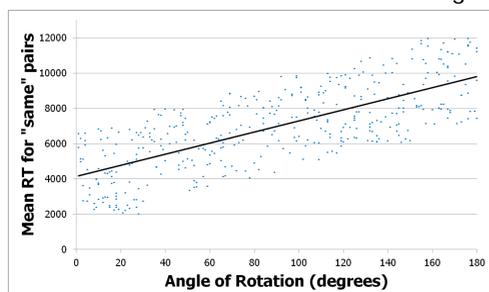


Introduction

- Is mental rotation akin to "motor rotation in the mind" (Cooper & Shepard, 1973; Wexler, Kosslyn, & Berthoz, 1998)? Shepard and Metzler (1971) had
 - Ps make same-different judgments for pairs of rotated abstract block figures
 - Measured RT
- These classic results showed the angular disparity effect (ADE) – a linear increase in RT based on angle of rotation



- The ADE has been interpreted as supporting "motor rotation in the mind," but how might people complete this perceptual judgment task when they can physically rotate the figures?

PRIMARY QUESTIONS:

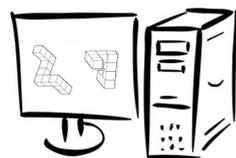
- How are mental and physical rotation similar?
- How do they differ?
- What can physical rotation reveal about mental rotation?

Methods

- Materials:**
 - 3D models of 30 Shepard-Metzler figures (Peters & Battista, 2008)
 - Experiment and stimuli presented in Vizard VR Toolkit
 - Figures physically rotated by handheld Intersense InertiaCube



- Sample & Procedure:**
 - n = 32 undergraduates: 16 male; Mage = 19.47
 - Spatial Questionnaires & OSPAN (Turner & Engle, 1989)
 - Mental and Physical Rotation Blocks



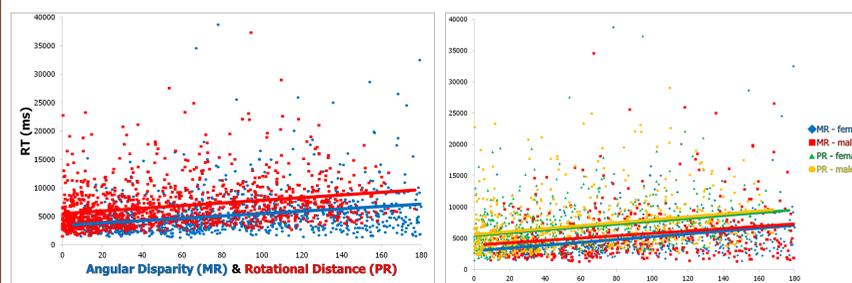
2 figures, both randomly rotated
Same/different judgment
Speeded response

Mental Rotation
Standard task

Physical Rotation
Physical rotation assists judgment

Voice response

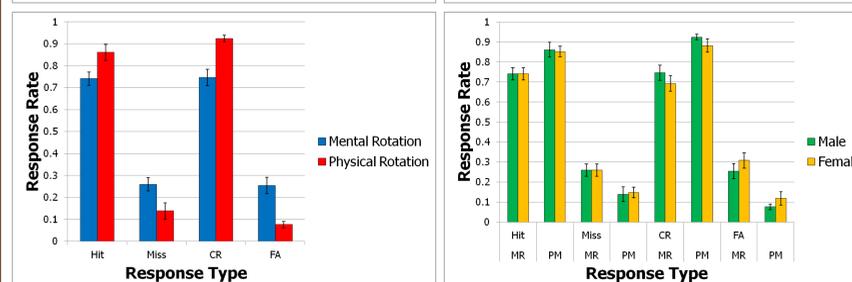
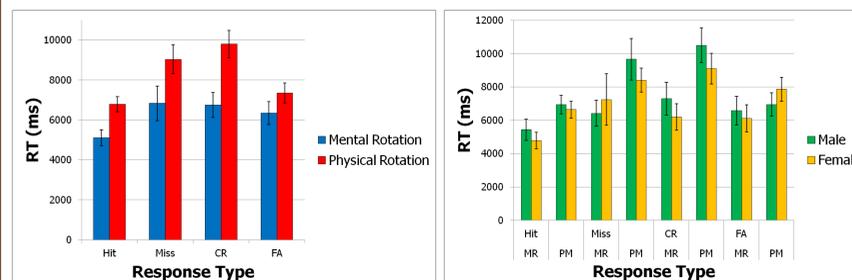
Results: Angular disparity effect



- Mental and physical rotation both show ADE
- No gender effect for mental or physical rotation
 - fails to replicate previous research (Kail, Carter, & Pellegrino, 1979; Collins & Kimura, 1997)

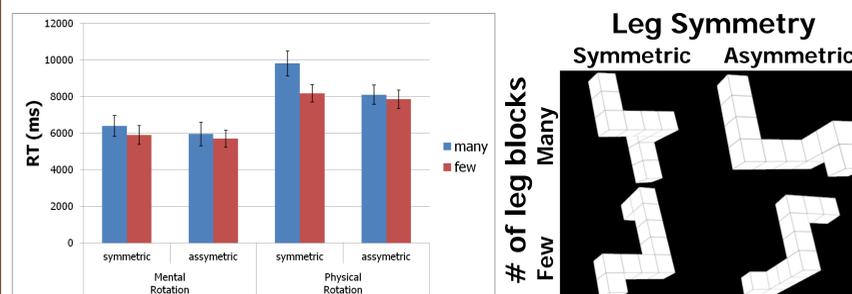
ADEs suggest mental rotation is like "motor rotation in the mind"

Results: RT and Accuracy



- Speed Accuracy Tradeoff
 - Physical Rotation slower but more accurate
- No gender effects

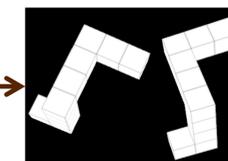
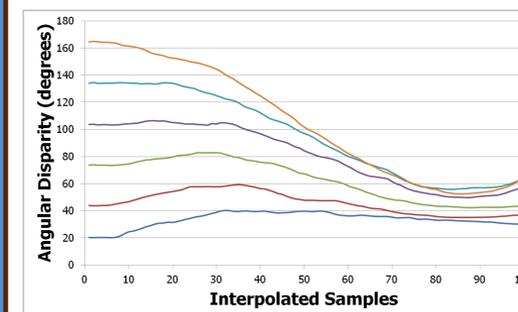
Results: Items Analyses



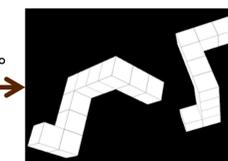
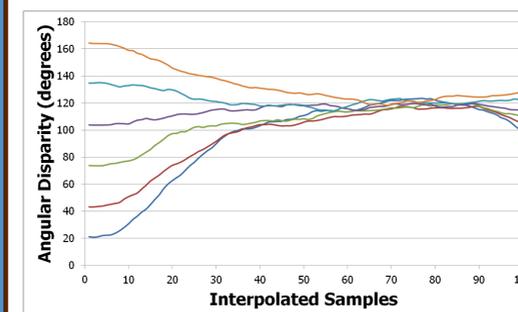
- Stimuli differences impair physical rotation to greater extent

Results: Physical rotation over time

Same Pairs (Hits)



Different Pairs (Correct Rejections)



- Different rotational behavior when figures same vs. different
 - Same trials settle on canonical differences
 - Different trials settle so that views accentuate differences

Discussion

- ADE suggests shared processes between mental and physical rotation.
- Within-trial rotation behavior suggests distinct processes.
- Results call into question the assertion that mental rotation is "motor rotation in the mind."

- Mental and physical rotation both demonstrate classic angular disparity effect
- Physical rotation is slower, but more accurate
- Physical rotation data suggest different processing strategies when making *same* vs. *different* judgments
- No individual difference effects (gender, WMC)

References

- Collins, D. W., & Kimura, D. (1997). A large sex difference on a two-dimensional mental rotation task. *Behavioral Neuroscience, 111*(4), 845.
- Cooper, L. A., & Shepard, R. N. Chronometric studies of the rotation of mental images. In W. G. Chase (Ed.), *Visual information processing*. New York: Academic Press, 1973.
- Kail, R., Carter, P., & Pellegrino, J. (1979). The locus of sex differences in spatial ability. *Attention, Perception, & Psychophysics, 26*(3), 182-186.
- Peters, M., & Battista, C. (2008). Applications of mental rotation figures of the Shepard and Metzler type and description of a Mental Rotation Stimulus Library. *Brain and Cognition, 66*, 260-264.
- Shepard, R. N., & Metzler, J. (1971). Mental rotation of three-dimensional objects. *Science, 171*(3972), 701.
- Turner, M. L., & Engle, R. W. (1989). Is working memory capacity task dependent? *Journal of Memory and Language, 28*(2), 127-154.