

Mental and Physical Rotation: Shared and Distinct Contributing Factors

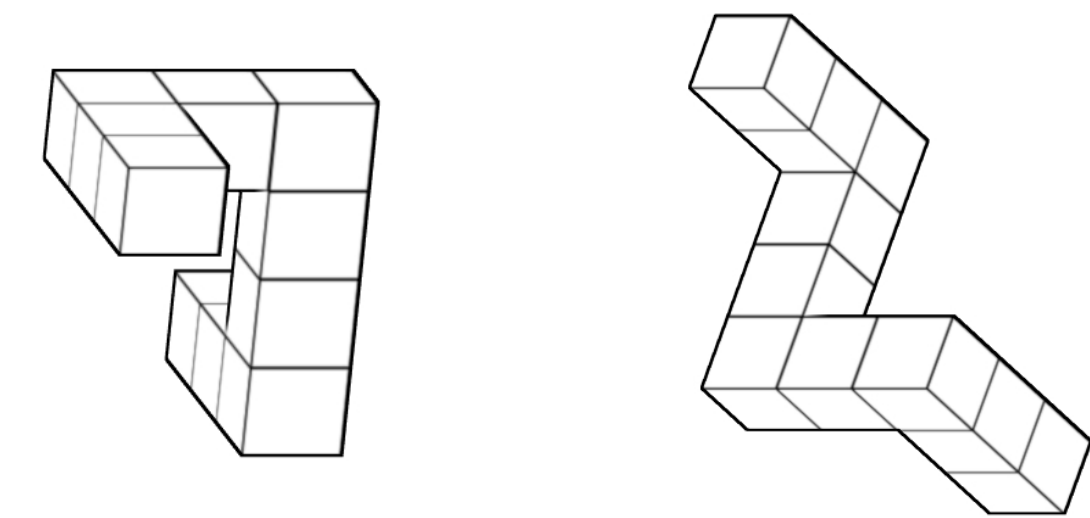
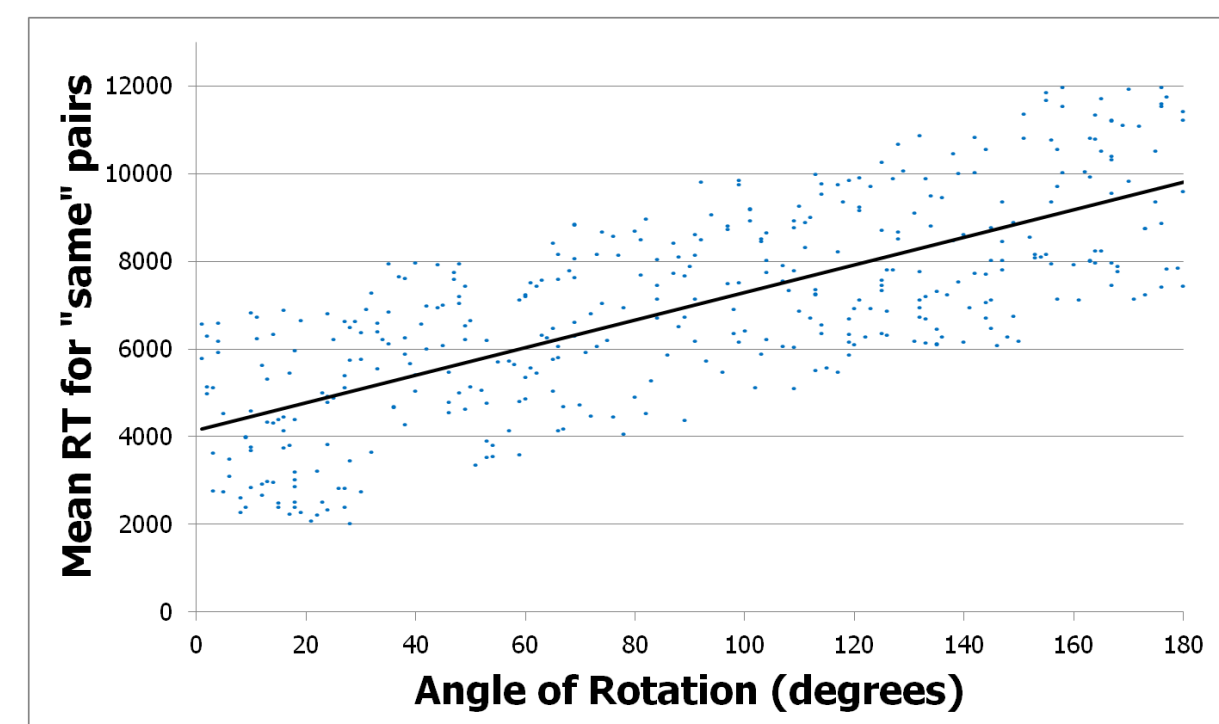
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Introduction

The classic mental rotation result is the angular disparity effect (ADE) (Shepard & Metzler, 1971)

- ADE = a linear increase in RT based on angle of rotation
- ADE has been interpreted as mental rotation to a match



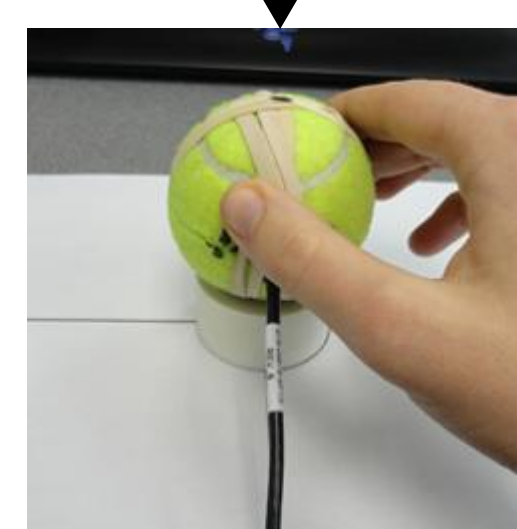
- Research from our lab (Gardony, Taylor, & Brunyé, under review) found:
 - Classic ADE in both mental (MR) & physical rotation (PR)
 - But, PR data suggests an interpretation contrary to "rotation to a match"
- To better understand the relationship between MR and PR, it is important to test how factors affecting MR performance influence PR processes
- For example, *emotional arousal* has been shown to improve MR performance (Borst, Standing, & Kosslyn, 2012) but how it affects PR has not been explored

PRIMARY QUESTIONS:

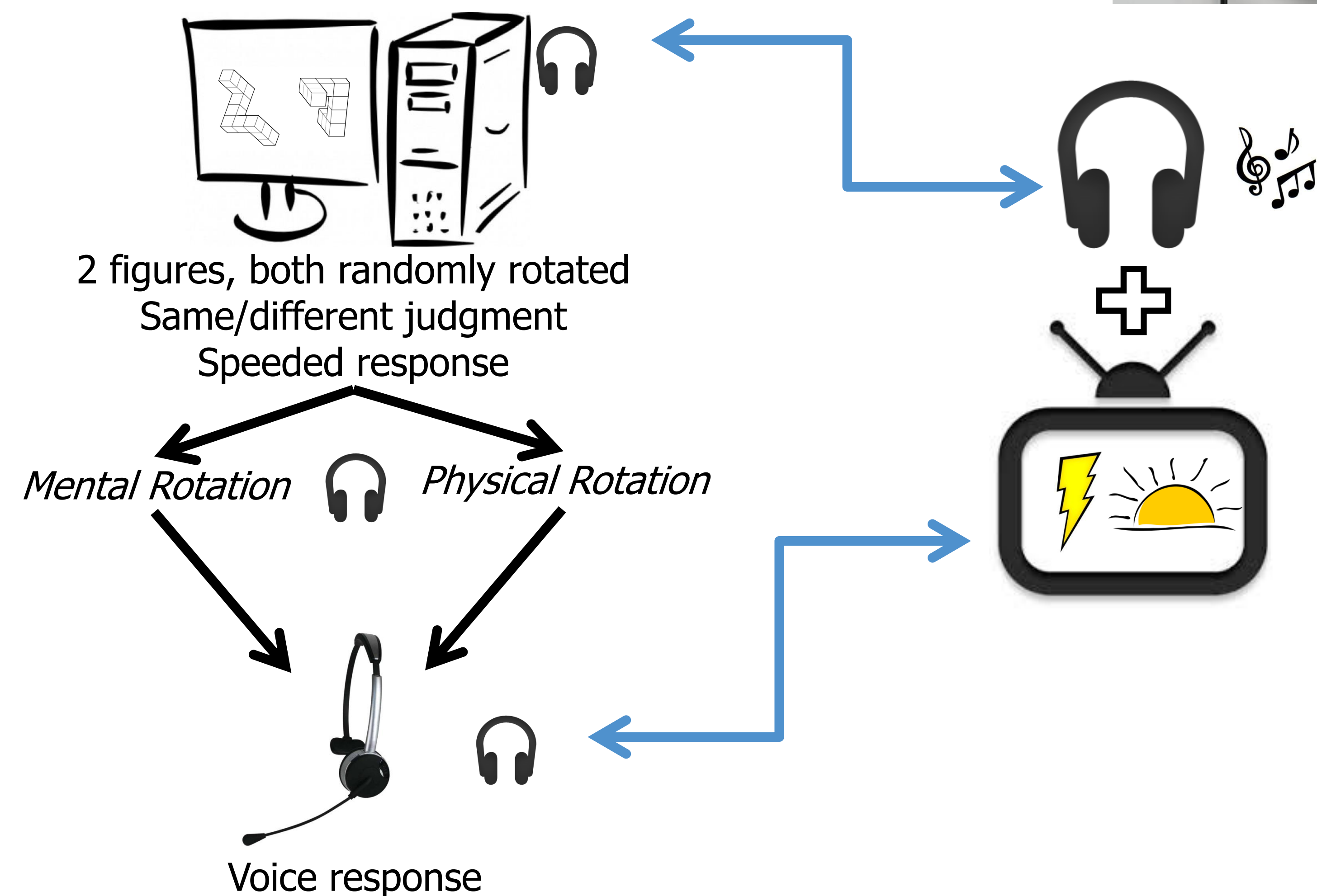
- What does physical rotation reveal about mental rotation?
- How does emotional arousal influence physical rotation?

Methods (Exp 1 & 2)

- **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
 - IAPS images (Lang, Bradley, & Cuthbert, 2008)
 - Musical stimuli (Husain, Thompson, & Schellenberg, 2002)

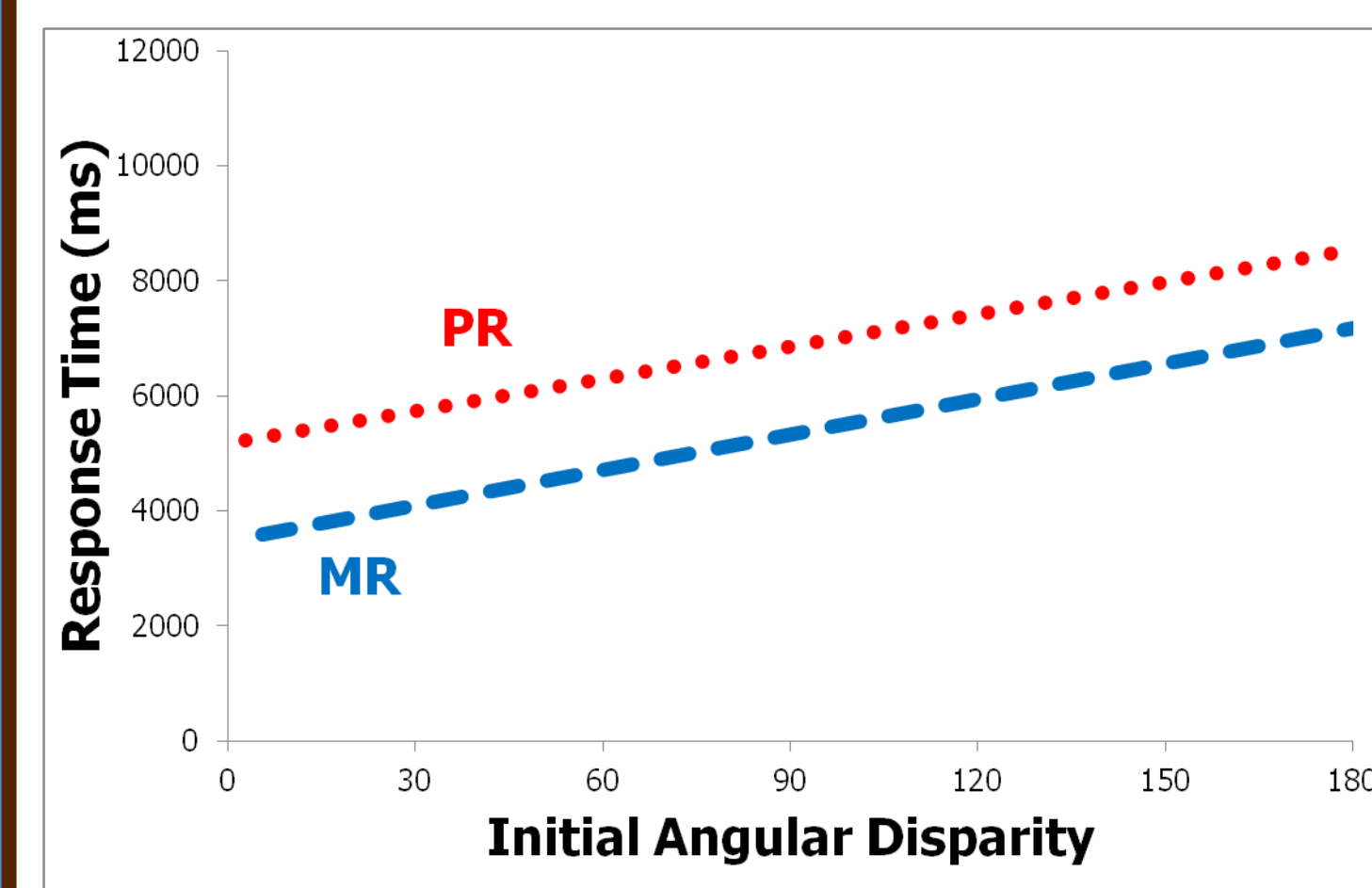


- **Sample & Procedure:**
 - **Exp 1:** n = 32 undergraduates: 16 male; M age = 19.47
 - **Exp 2:** n = 18 undergraduates: 6 male, M age = 18.9

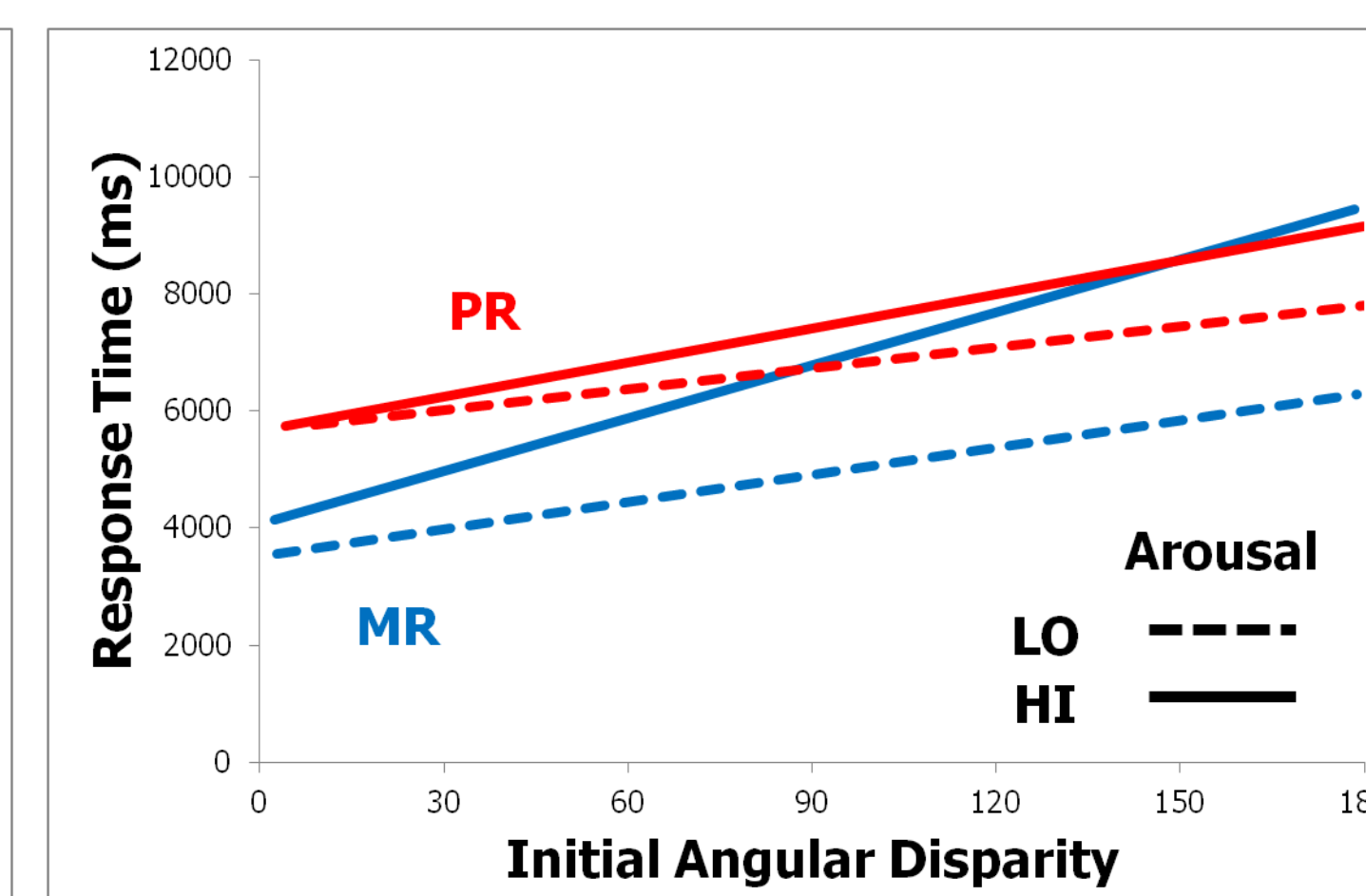


Results: Angular disparity effect

Exp 1



Exp 2

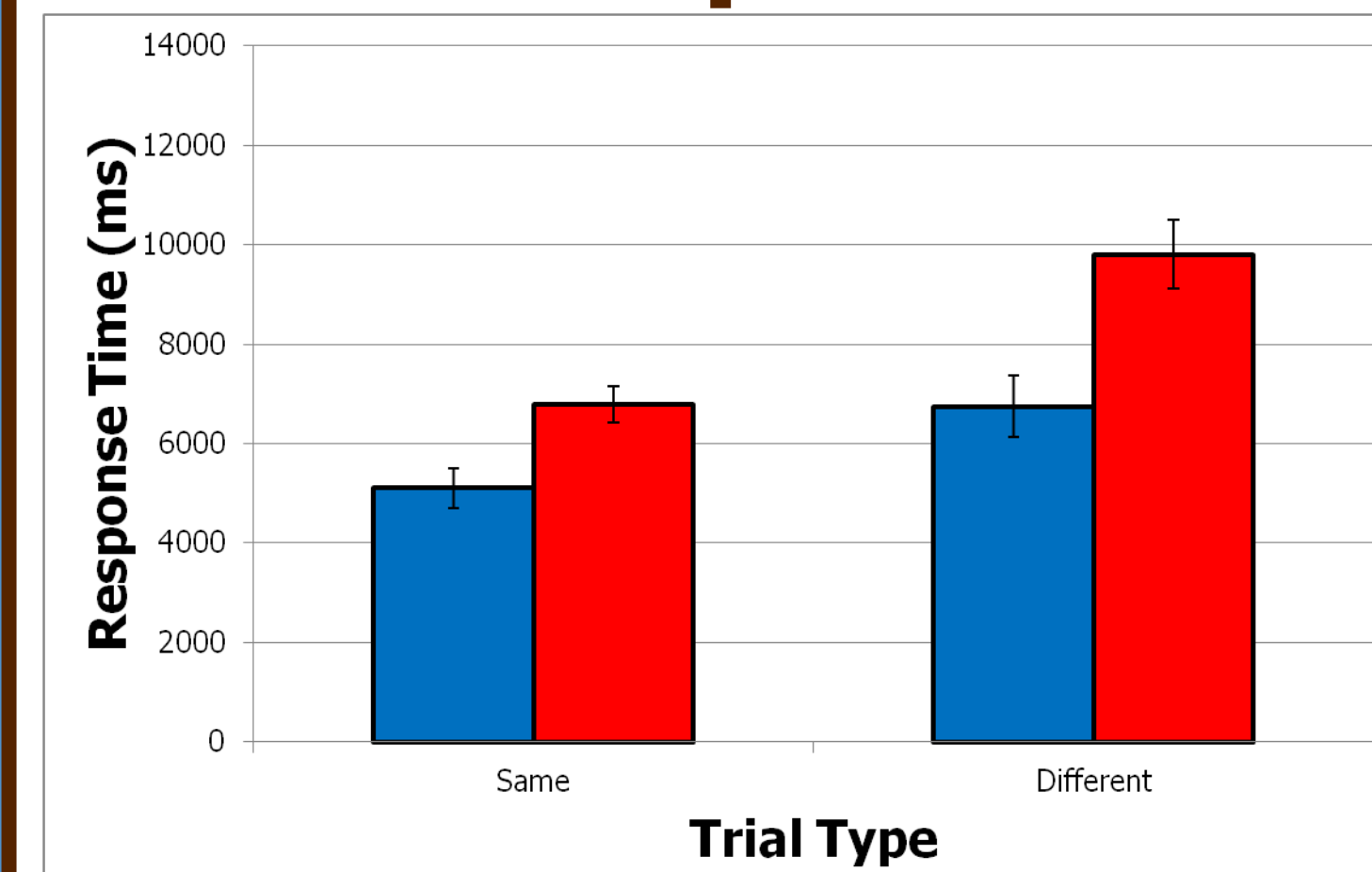


- Mental and physical rotation both show ADE
- Arousal appears to impair rotation performance (MR & PR)

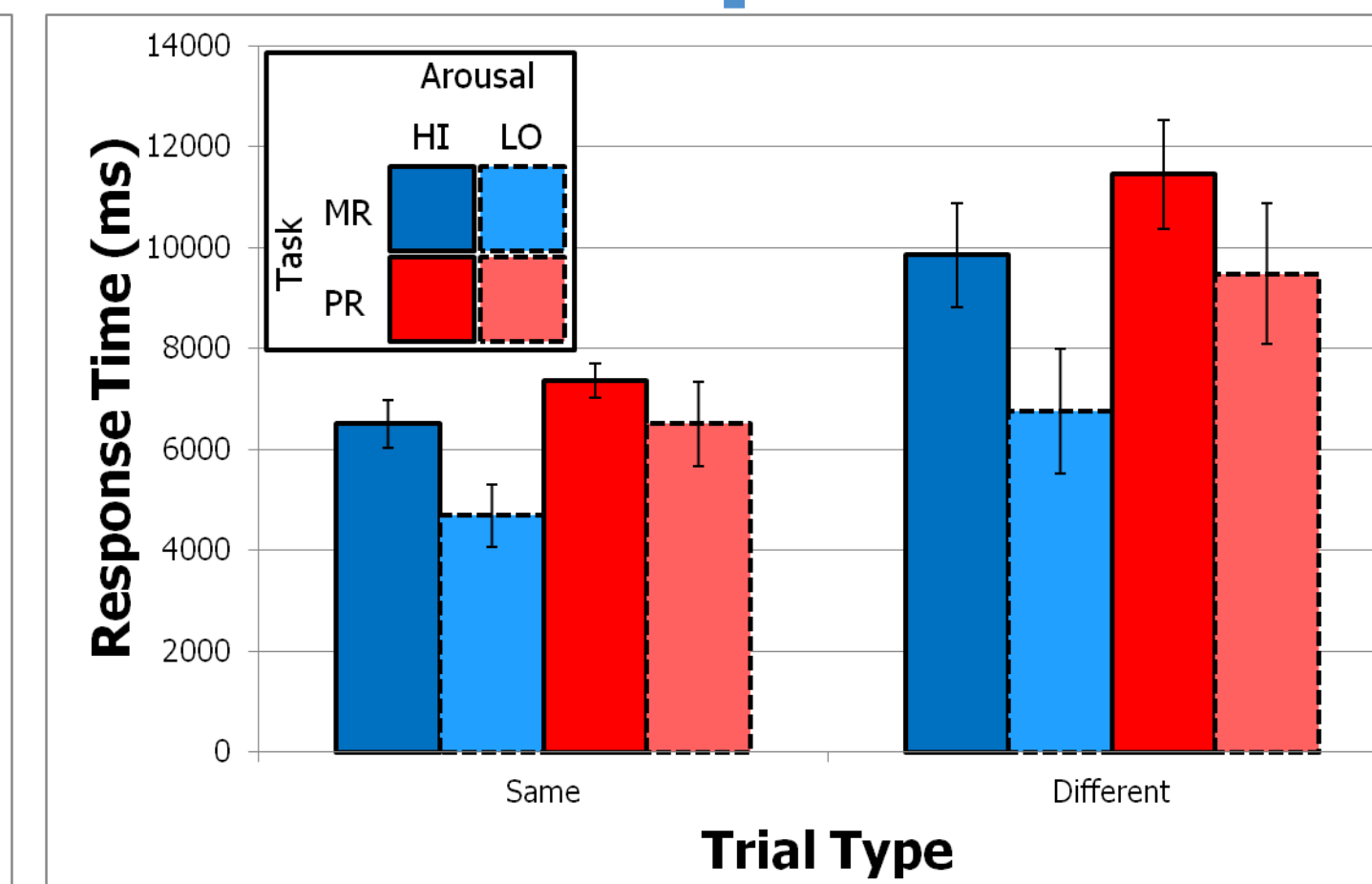
ADEs and arousal effects suggest similarities between MR and PR

Results: Response Time

Exp 1



Exp 2

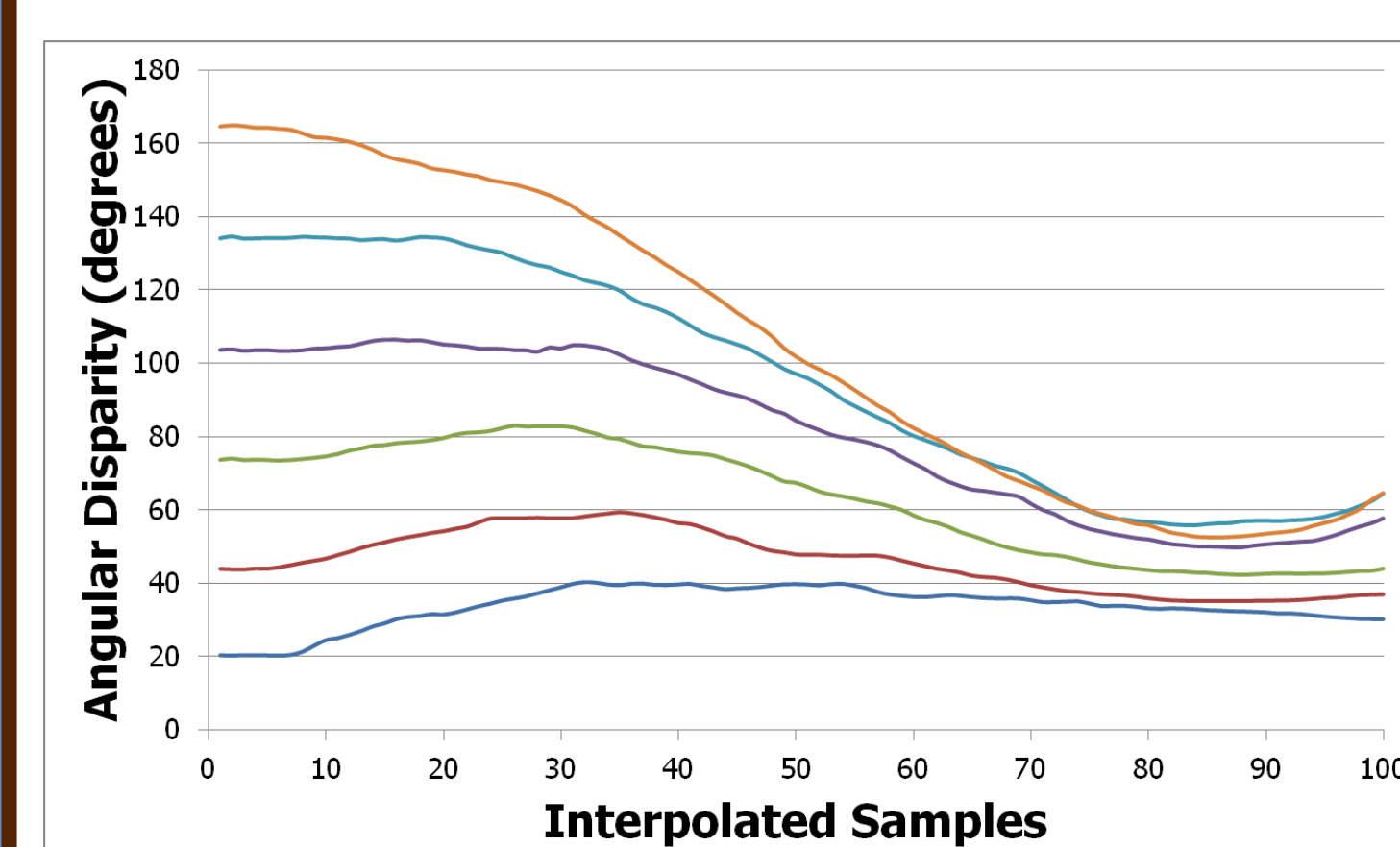


- Physical rotation slower but more accurate – a speed accuracy tradeoff
- Heightened arousal marginally slows rotation performance

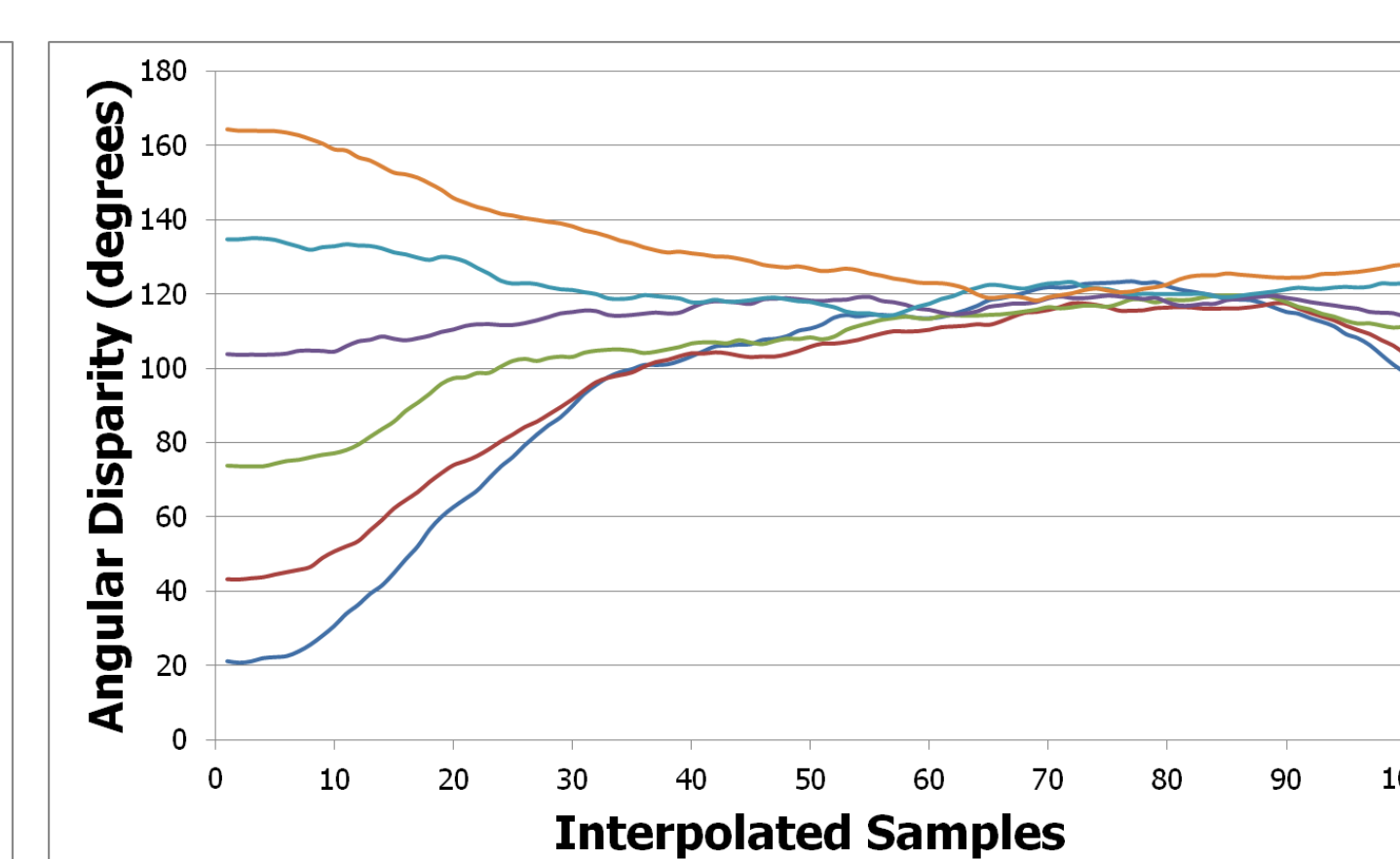
Results: Physical rotation over time

Exp 1

Same Pairs



Different Pairs



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

In both cases, rotation is not to a match but rather to a canonical view

- How might arousal influence this rotation behavior?

Results: Physical rotation over time

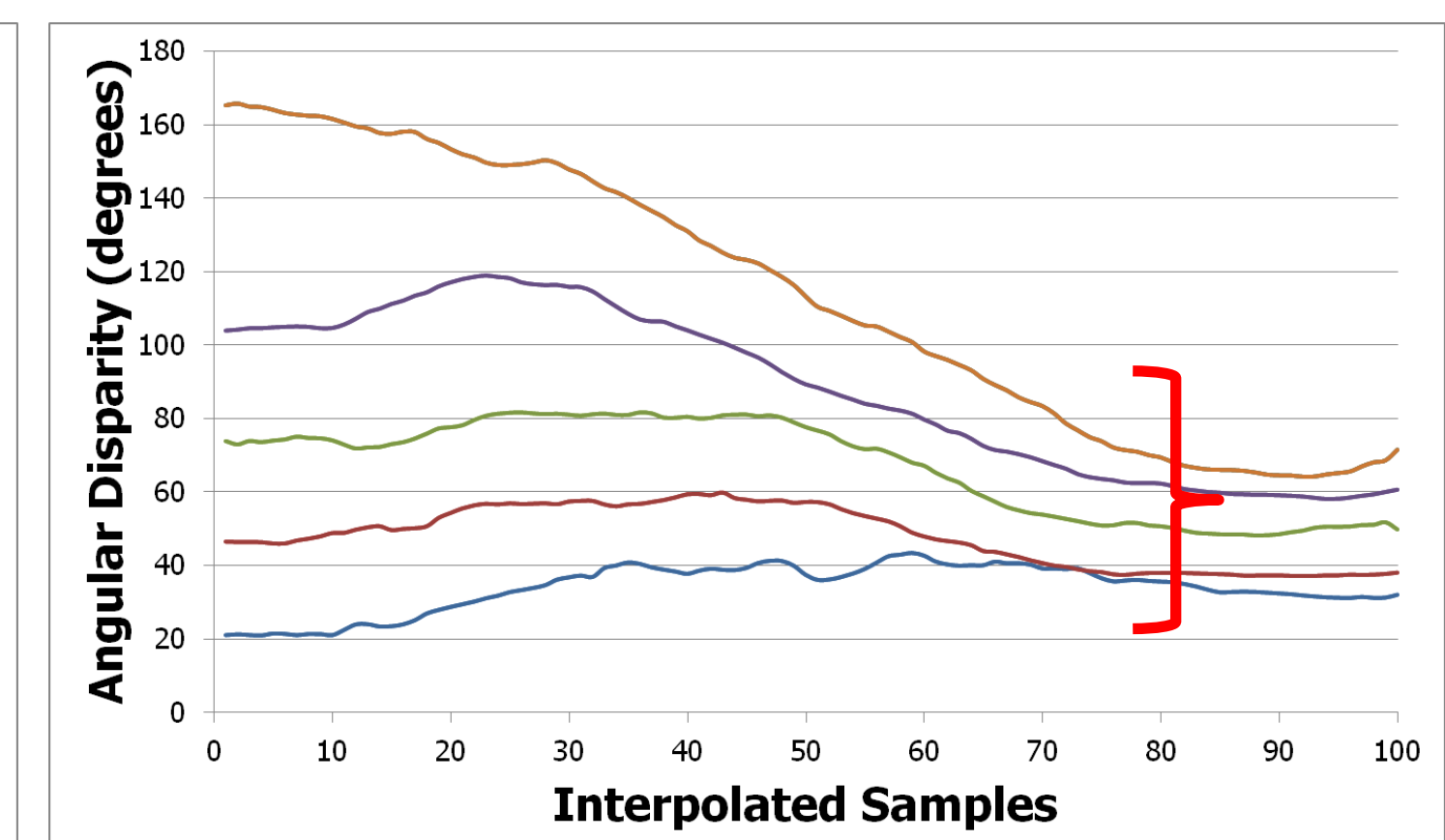
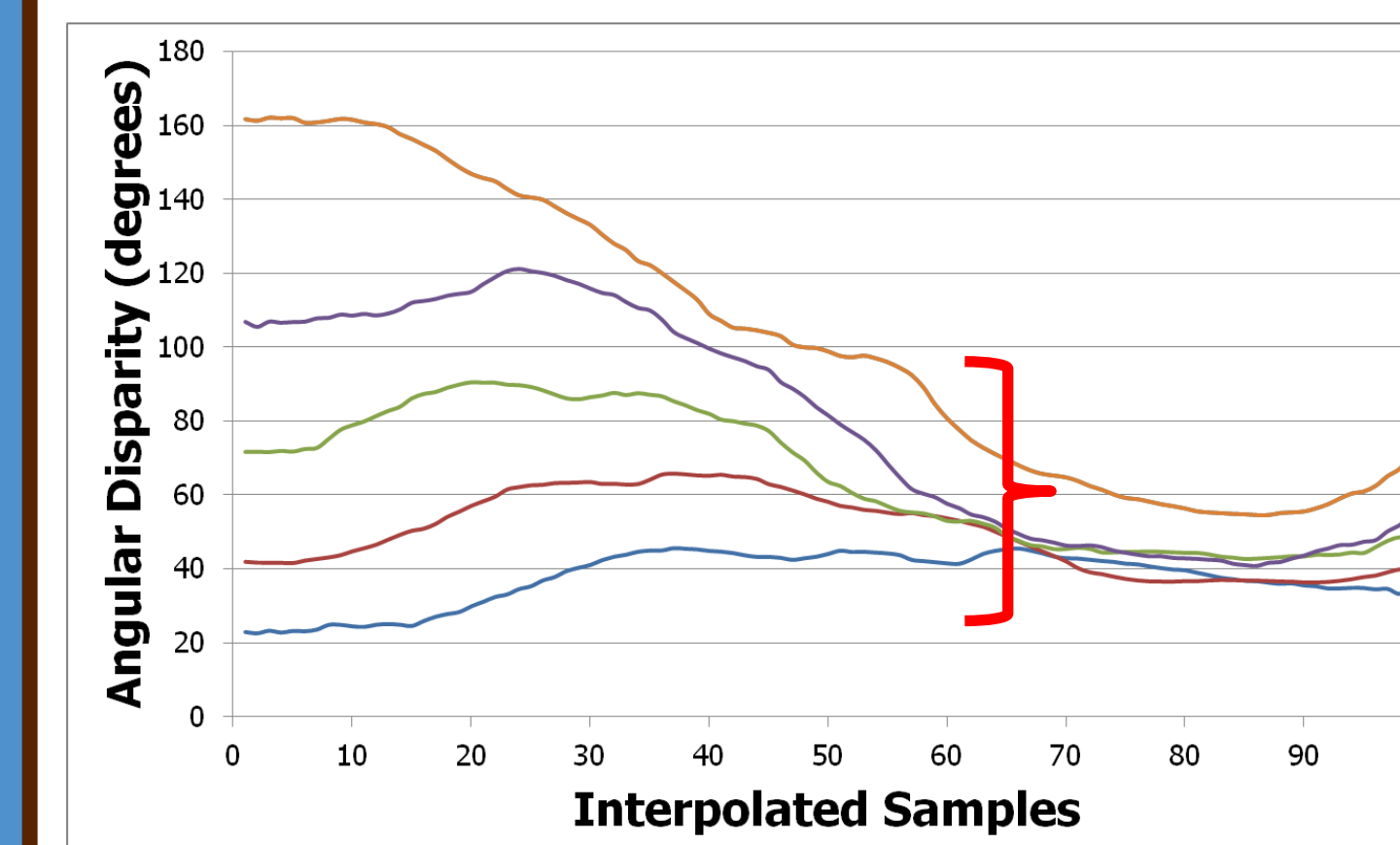
Exp 2

Arousal

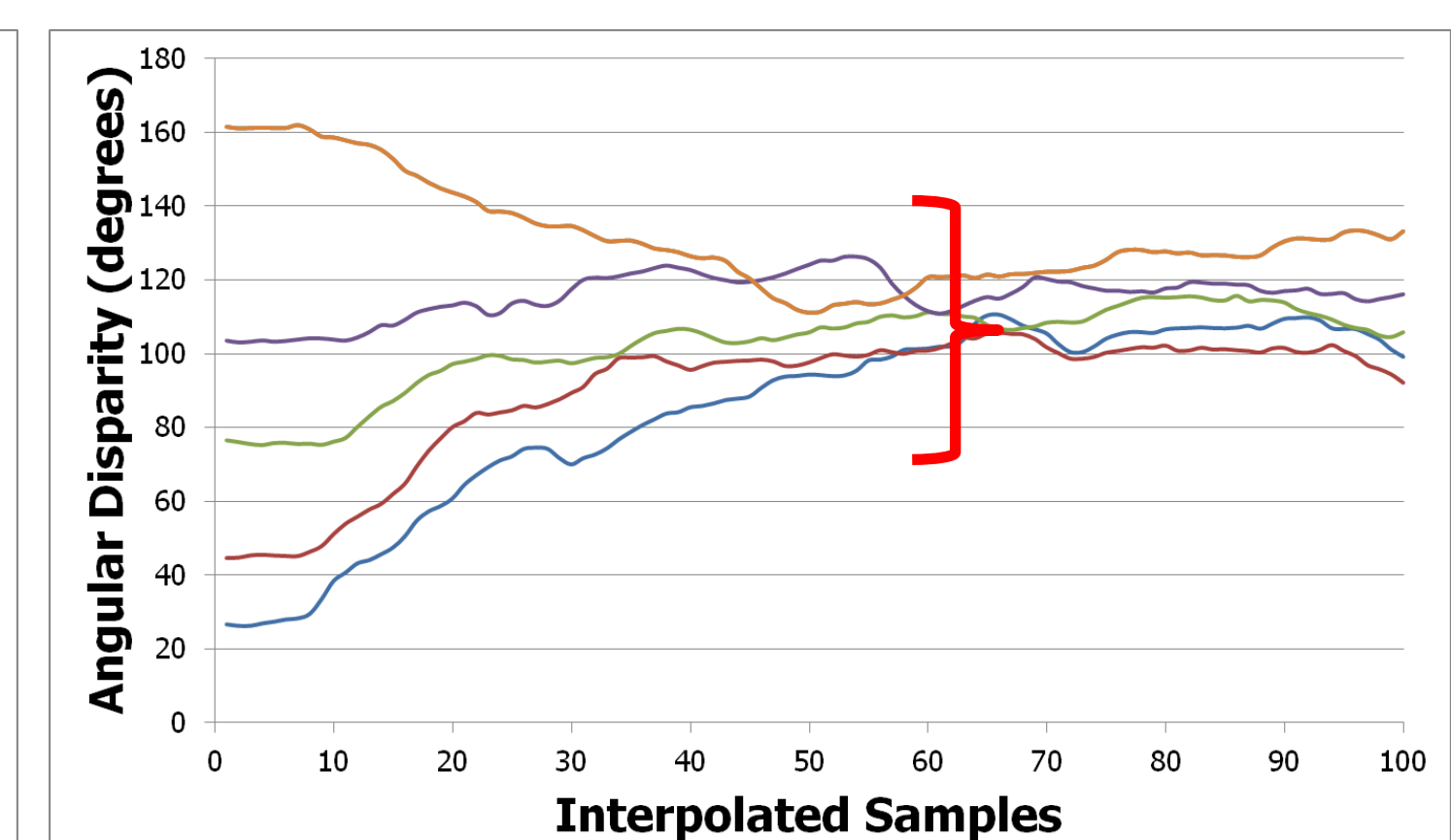
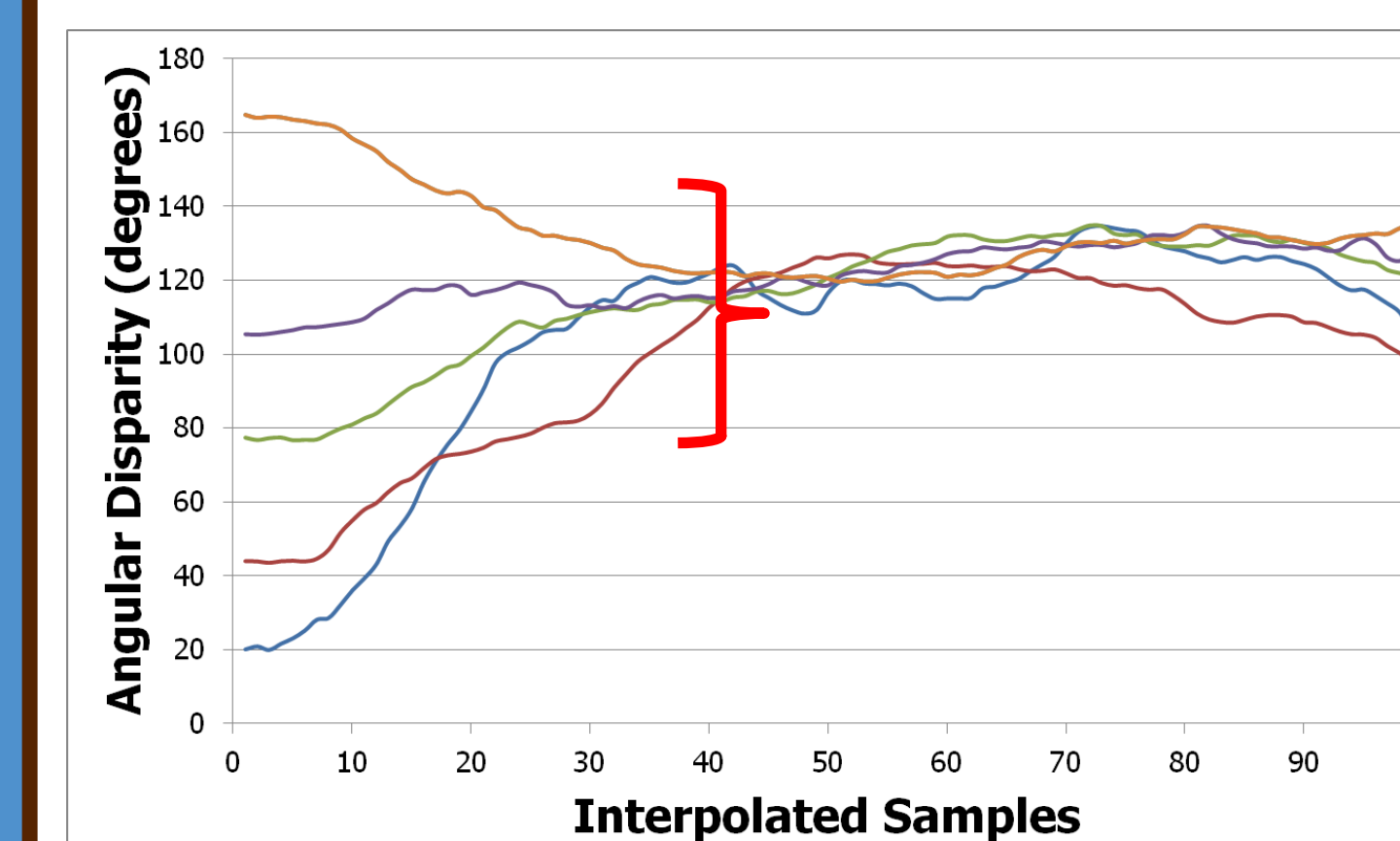
LO

HI

Same Pairs



Different Pairs



- Arousal delays rotational convergence for both same and different trials
 - Suggests arousal impairs the rotational process, not just the response

Discussion

- **ADE suggests shared processes between mental and physical rotation**
- **Physical rotation data suggest rotation is not to a match but to a canonical view**
- **Arousal impairs rotation by slowing rotational convergence**
- **Trends suggest arousal impairs MR > PR**
 - Is perceptual feedback protective?

- Results are contrary to Borst et al., 2012, why?
 - A role of valence?
 - Approach vs. Avoidance?

References

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