

# Disentangling shift direction, object orientation, and object selection yields a large, reliable metric of object-based attention



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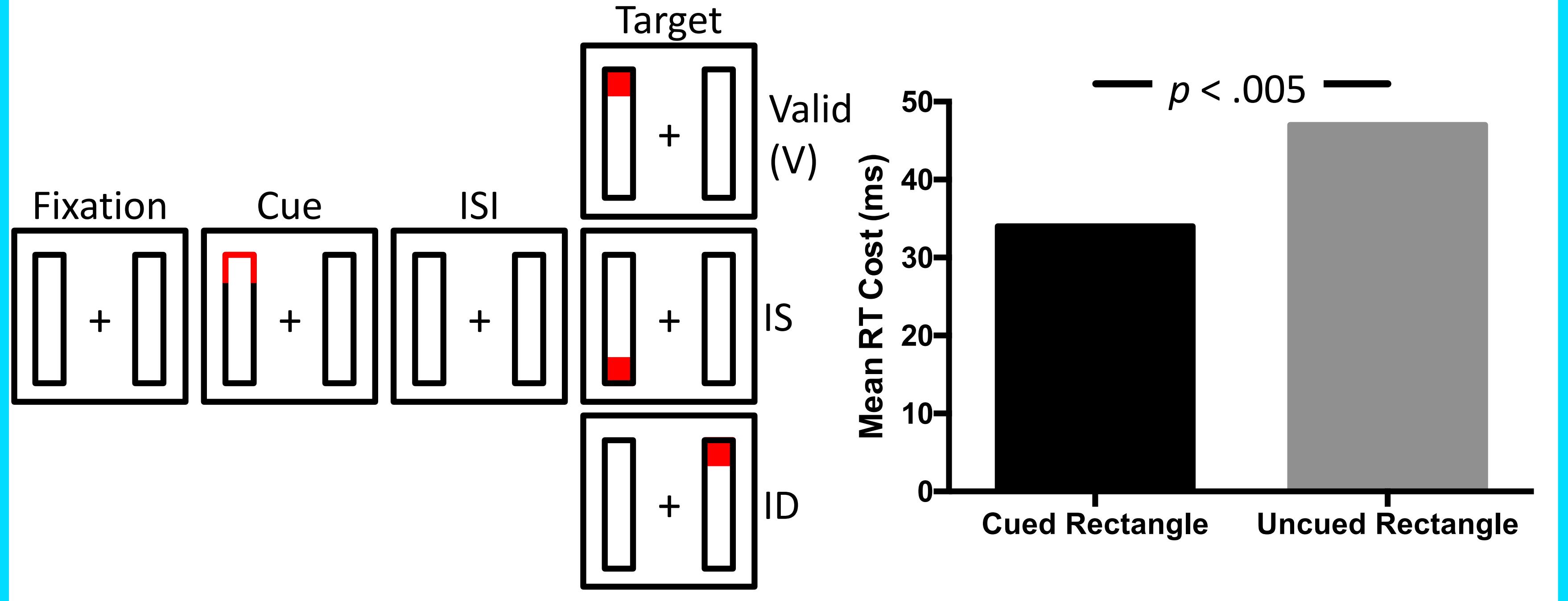
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## Introduction

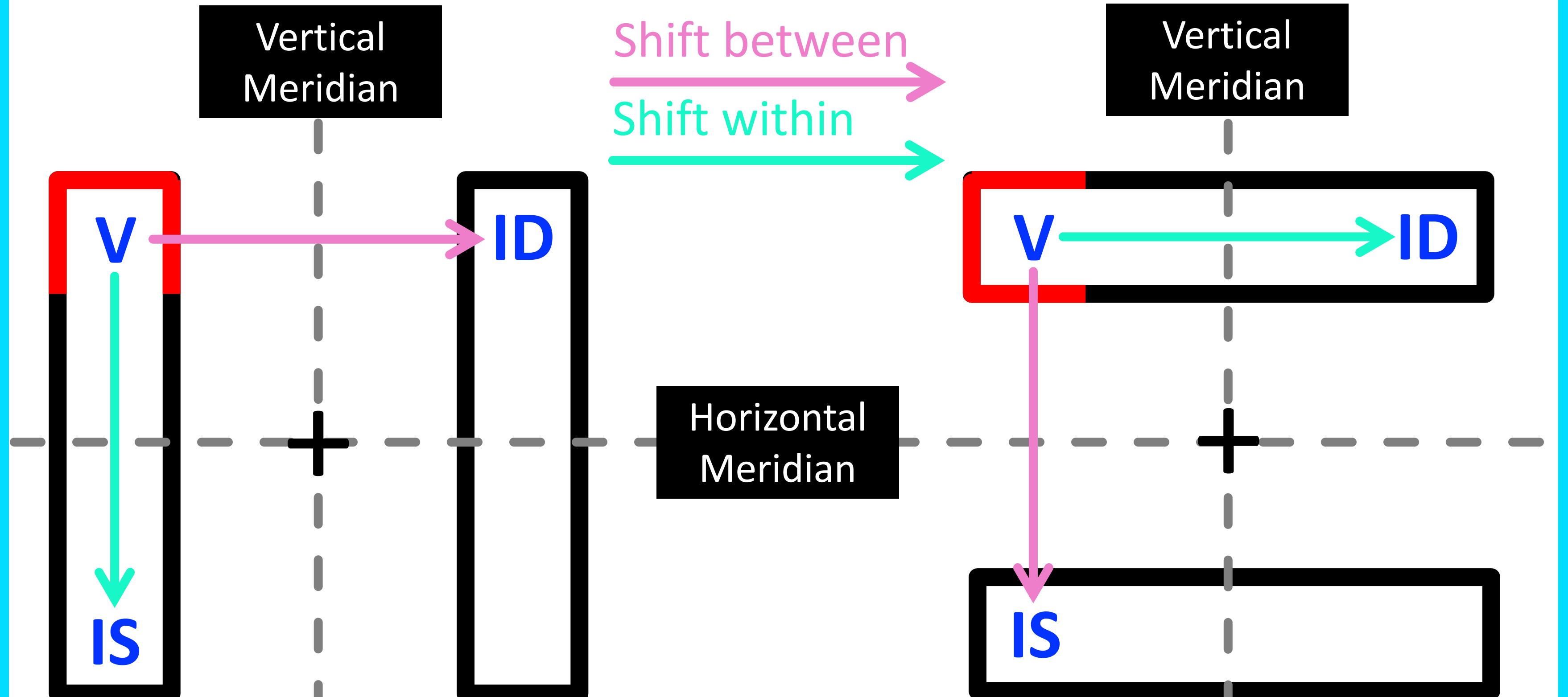
- Object-based attention (OBA) preferentially enhances visual information within boundaries of attended vs. unattended objects<sup>1</sup>
- Double-rectangle cueing paradigm developed by Egly et al. (1994) exhibits enhanced performance at invalid-same (IS) vs. invalid-different (ID) location (approx. 13 ms), known as the **same-object advantage**<sup>1</sup>



- Same-object advantage is small, inconsistent, and unreliable: studies have failed to show an effect<sup>2,3</sup> or have found a **same-object cost**<sup>4-6</sup>
- Larger object-based effects (OBEs; i.e., same-object advantage) for horizontal objects vs. vertical objects, driven by few participants (15%)<sup>6</sup>

**These notoriously mixed findings ultimately encourage questions regarding the legitimacy of OBA**

**What are the sources of inconsistent OBEs?**



## Acknowledgments

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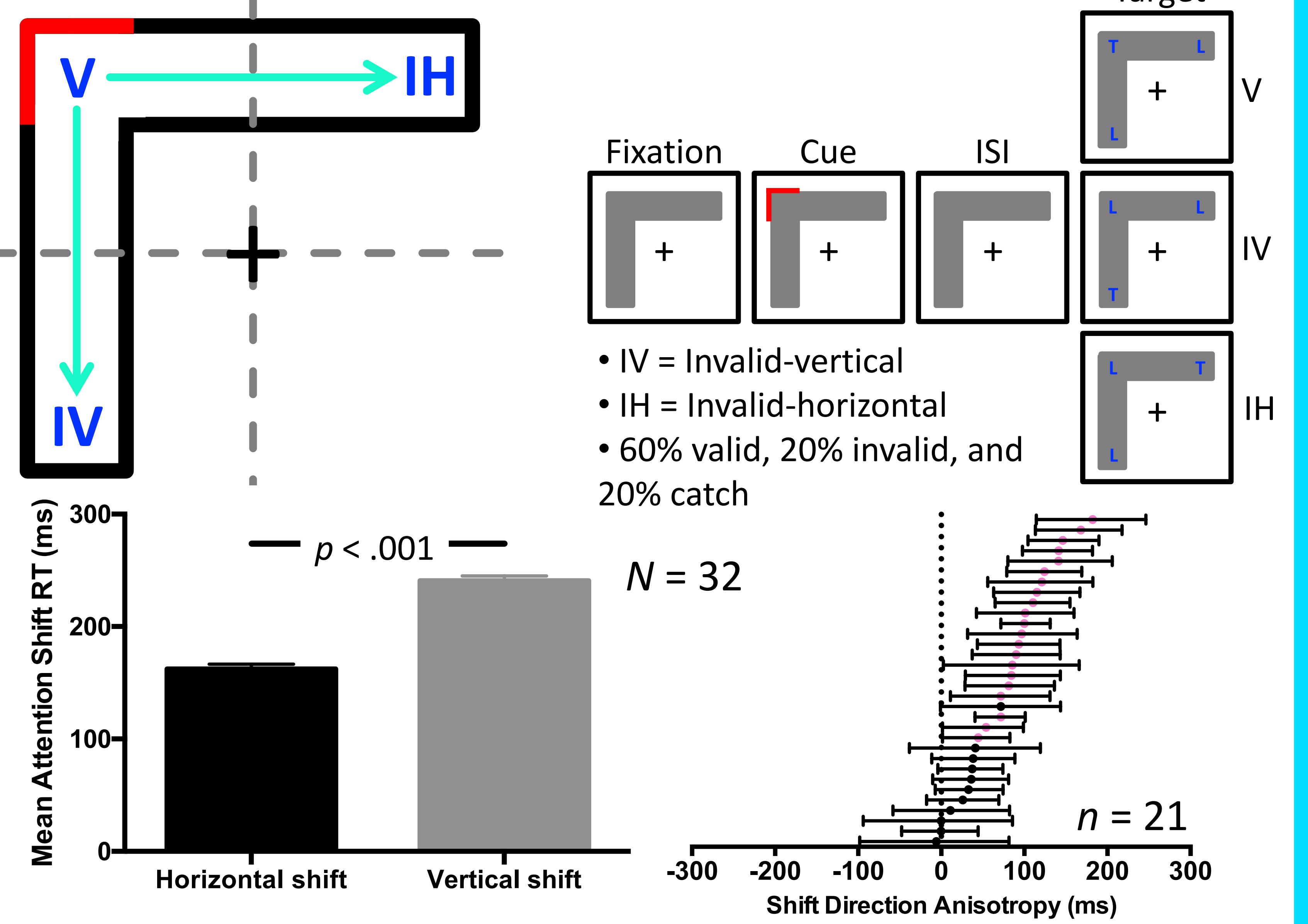
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## References

1. Egly, R., Driver, J., & Rafal, R.D. (1994). 5. Harrison, S. J. & Feldman, J. (2009). *JEP: General* *Vis Res*
2. Shomstein, S. & Behrmann, M. (2008). *AP&P* *PLoS One*
3. Chen, H. & Huang, L. (2015). *Vis Res* *7. Barnas, A. J., & Greenberg, A. S. (2016). *AP&P**
4. Davis, G. & Holmes, A. (2005). *Vis Cog* *8. Barnas, A. J., & Greenberg, A. S. (2020). *Vis Cog**

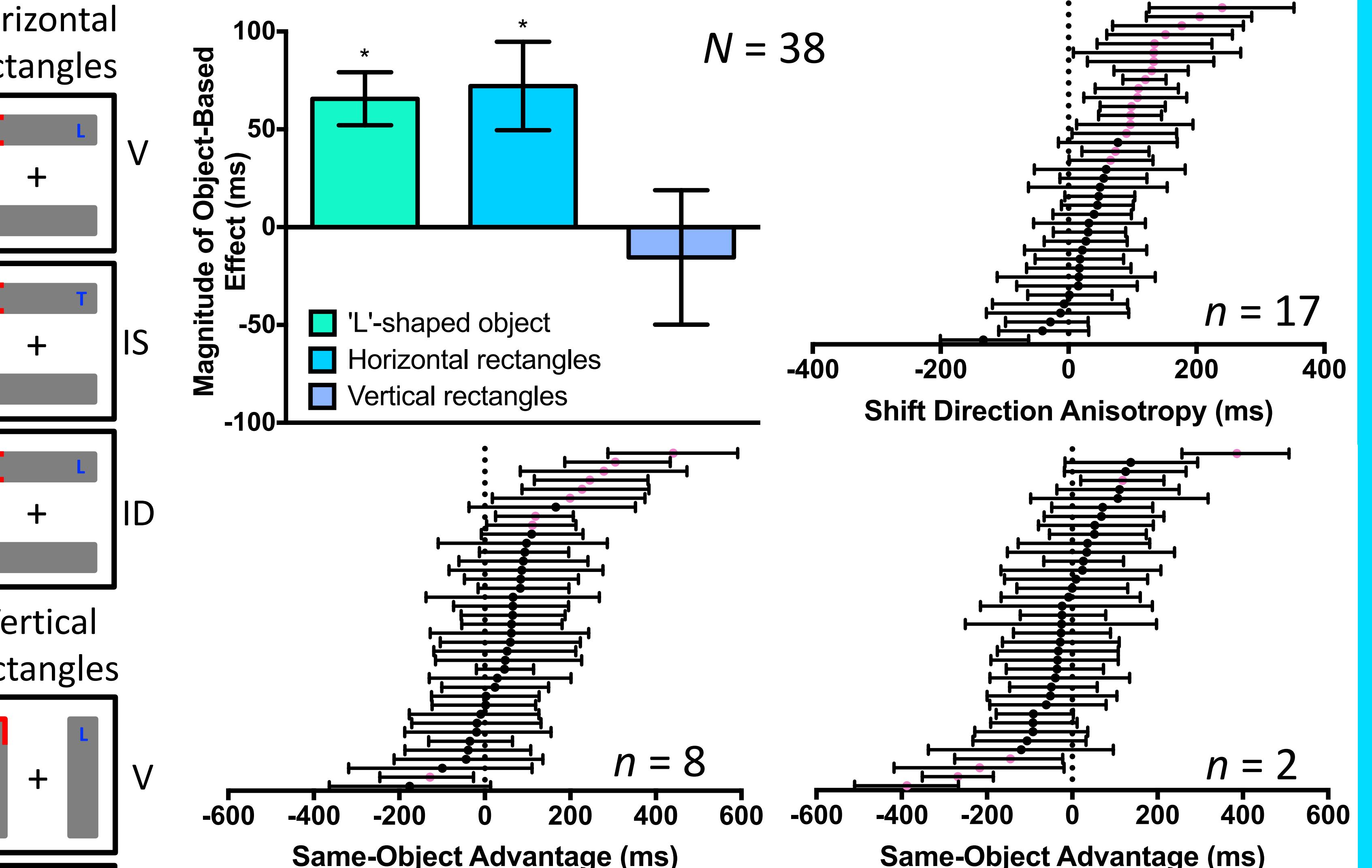
## Exp. 1 – Eliminating Confound

Paradigm eliminates confounds by restricting attention shifts across visual field meridians within one object



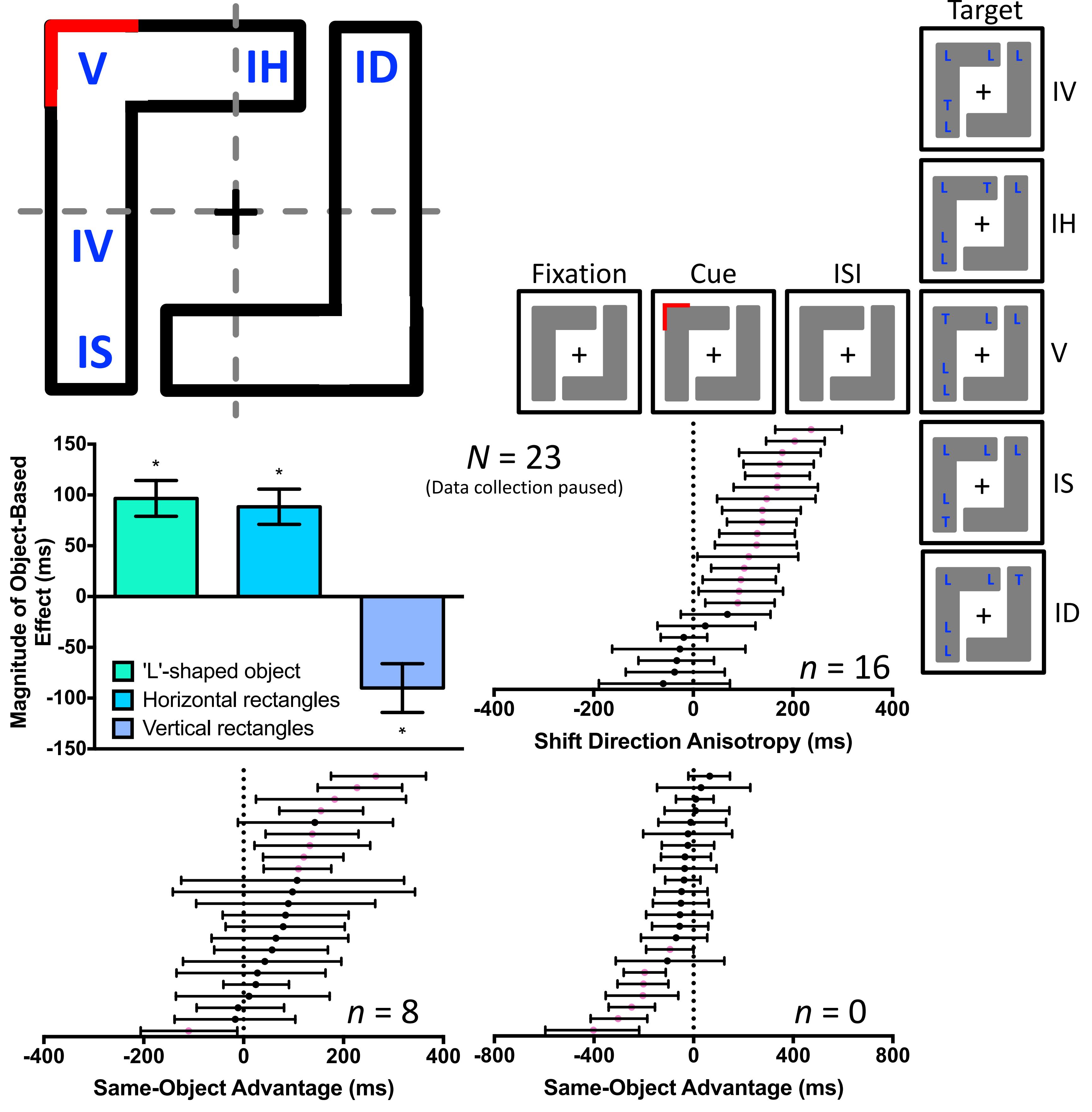
- Faster RTs to invalid-horizontal vs. invalid-vertical location (approx. 78 ms), referred to as the **shift direction anisotropy (SDA)**<sup>7,8</sup>
- 65% of subjects exhibited SDA; significantly larger proportion relative to same-object advantage reported by Pilz et al. (2012),  $p < 0.001$

## Exp. 2 – Comparing Paradigms



**SDA is a strong and reliable measure of OBA**

## Exp. 3 – Measuring Effects Simultaneously



- Utilizing two objects to measure both SDA and OBEs resulted in a similar pattern of results obtained in Experiment 2
- Significant SDA (approx. 97 ms); inconsistent OBEs that varied by object orientation (approx. 88 ms and -90 ms)
- Significantly larger proportion of subjects exhibited SDA (70%) vs. same-object advantage for either rectangle (35%),  $p = .019$

**SDA is more consistent than same-object advantage**

## Discussion and Conclusion

**Confound between shift direction, object orientation, and object selection might have caused past inconsistent and unreliable OBA effects**

- The SDA is larger and more prevalent than the same-object advantage, suggesting that **the SDA may be a more reliable and sensitive measure of object-based attention** than the traditional same-object advantage
- Stable and large magnitude effects of object-based attentional selection do exist when examined from a perspective that ameliorates significantly confounding factors
- These observations may lead to studies on the influence of individual characteristics on object-based attentional selection