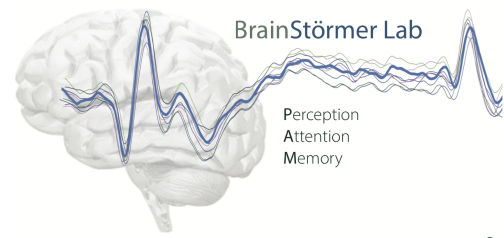


# Quantifying the effects of feature similarity on attentional selection using psychophysical scaling



UC San Diego

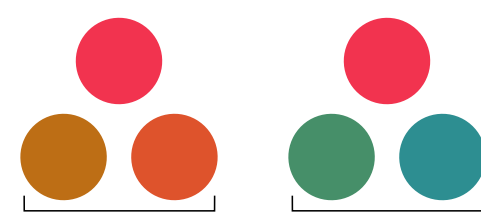
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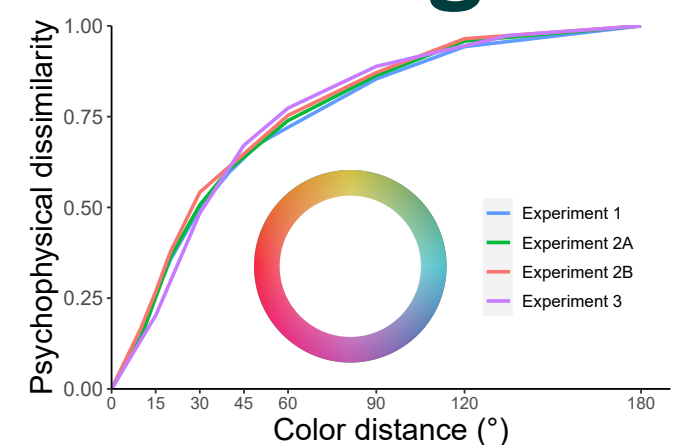
## Background

- Many models of attention cite the importance of target-distractor similarity, though few experiments have attempted to quantify this<sup>1,2,3,4</sup>
- There is little evidence for how similarity impacts attentional efficiency across different tasks or different measures (e.g., search slopes vs response times)
- Other studies have relied on distance between targets and distractors in a given stimulus space<sup>5,6</sup>, which may not map linearly to psychophysical estimates of similarity<sup>7</sup>

## Psychophysical Scaling



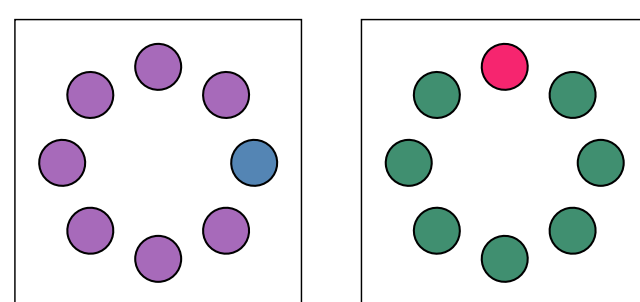
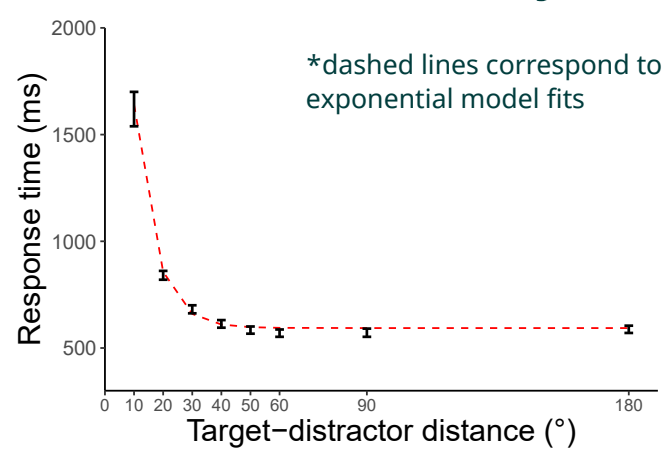
Which of the two bottom circles is most similar to the top?



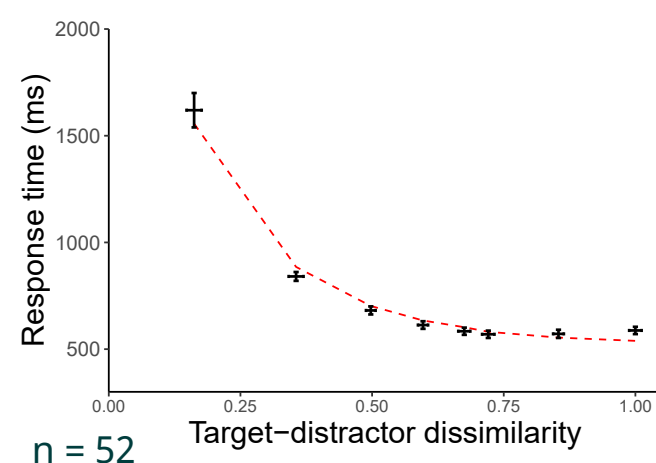
Does psychophysical dissimilarity better predict attention performance?

## Experiment 1

How does similarity affect visual search RT?



Examples of visual search trials with 40° and 180° distance

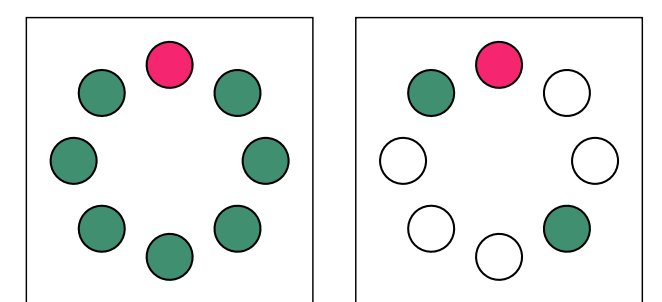
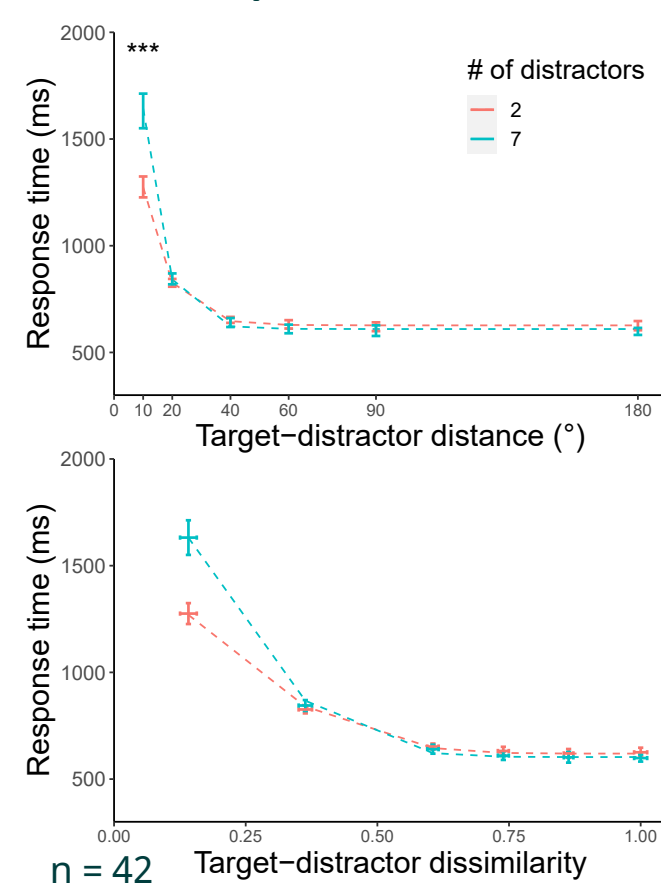


Search RTs were non-linearly related to both distance around the color wheel and psychological estimates of color similarity, and did not improve beyond 40-50°

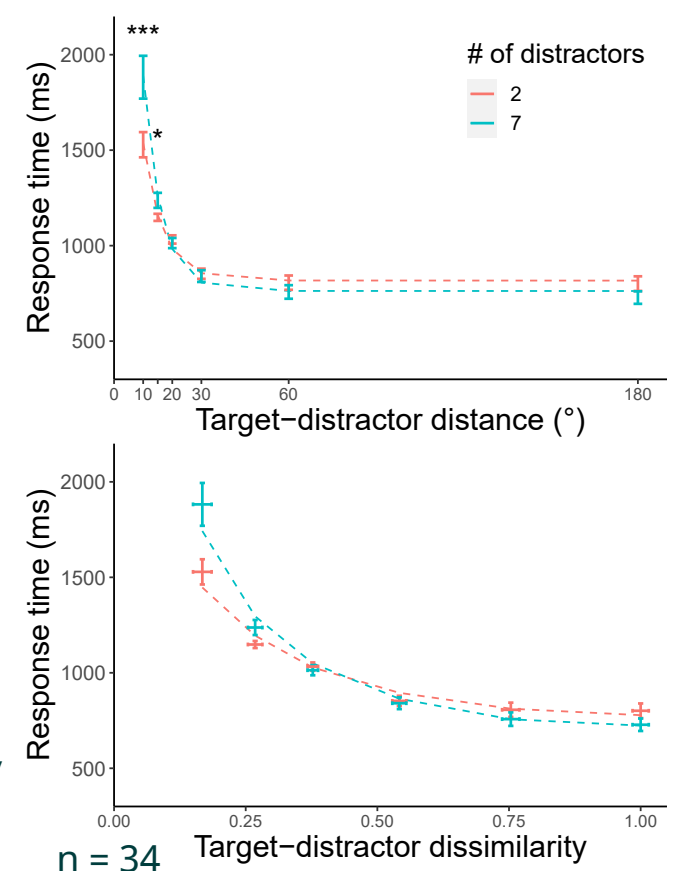
## Experiment 2

How does similarity interact with the number of distractors?

### Experiment 2A



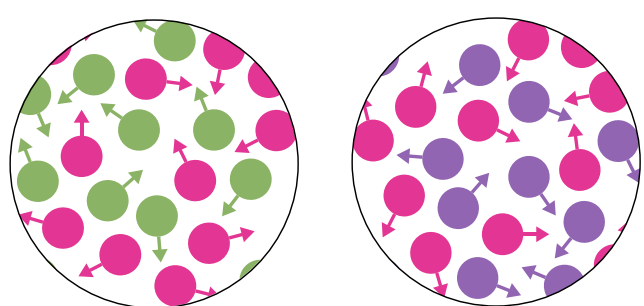
### Experiment 2B



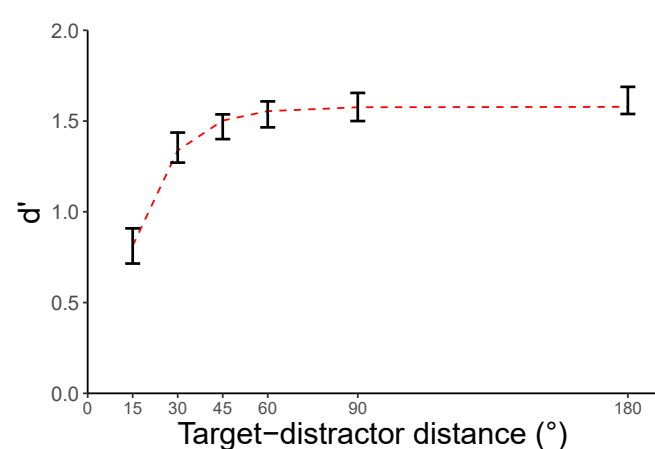
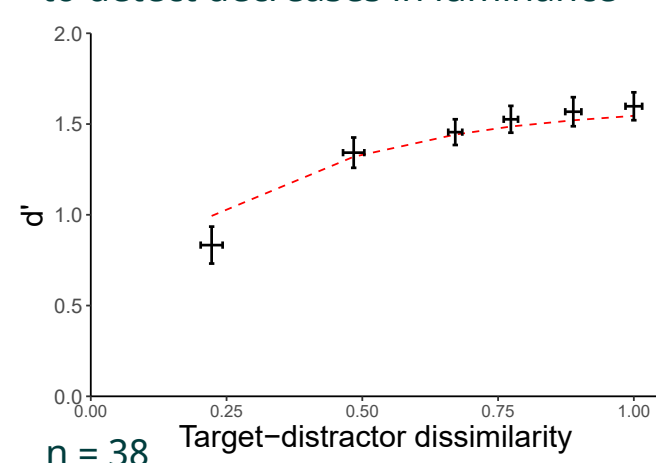
The number of distractors only mattered when they were highly similar to targets (10-15°)

## Experiment 3

Does the effect of similarity generalize from visual search to a sustained attention task?



Task: attend dots in the target color to detect decreases in luminance



Performance was comparable to visual search, with no improvement beyond ~30°

## Summary

- Comparable patterns of performance across visual search and sustained attention tasks, suggesting the effects of similarity generalize across different tasks
- Psychological similarity alone does not explain the non-linear relationship between similarity and attention
- Attention may act to exaggerate differences between targets and distractors, particularly for representations that are most similar<sup>8</sup>

## Acknowledgments

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## References

1. Duncan & Humphries, 1992. *Psych Rev*
2. Geng & Witkowski, 2019. *Curr Opin in Psych*
3. Wolfe & Horowitz, 2004. *Nat Rev Neurosci*
4. Lleras et al., 2020. *Att, Percept, & Psychophys*
5. Nagy & Cone, 1996. *Vision Res*
6. Arun, 2012. *Vision Res*
7. Maloney & Yang, 2003. *J Vision*
8. Barszcz, Chapman, Chunhuras, & Störmer, 2020. *Virtual VSS*