

The Great Binocular Bake Off: Comparing Methods for Measuring Interocular Delays



Brooke Lim, Anna Kosovicheva
Department of Psychology, University of Toronto Mississauga

APPLY LAB



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Background

- Deficits in binocular disorders (amblyopia) are characterized by differences in spatial processing.
- However, previous work has shown deficits in temporal processing as well, including interocular delays.
- Many methods have been developed for measuring interocular delays, but they have not been systematically compared.

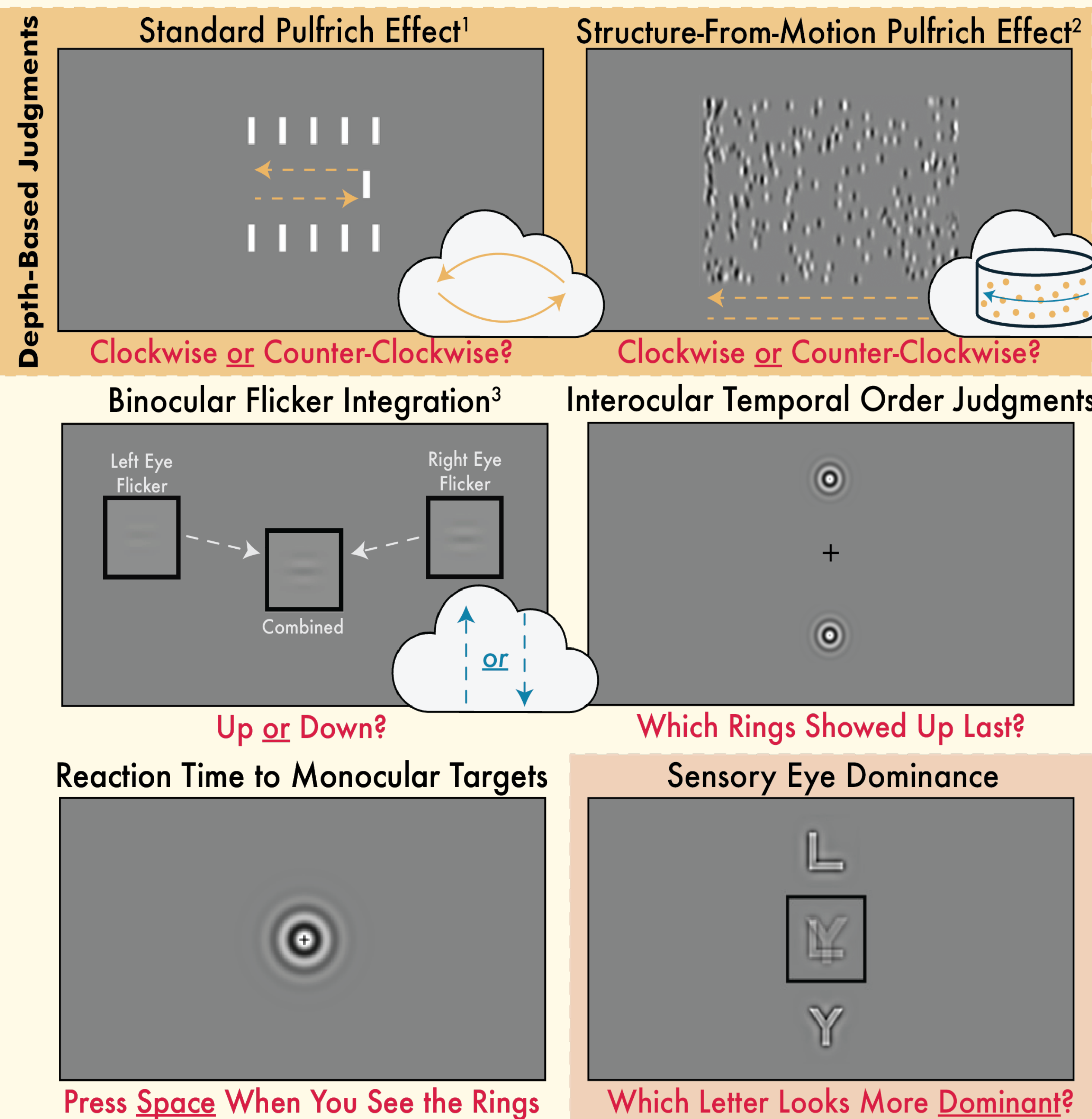
How consistent are methods that measure interocular delays:

- (1) With variation in normally sighted observers?
- (2) With a filter-induced delay to one eye?

Methods

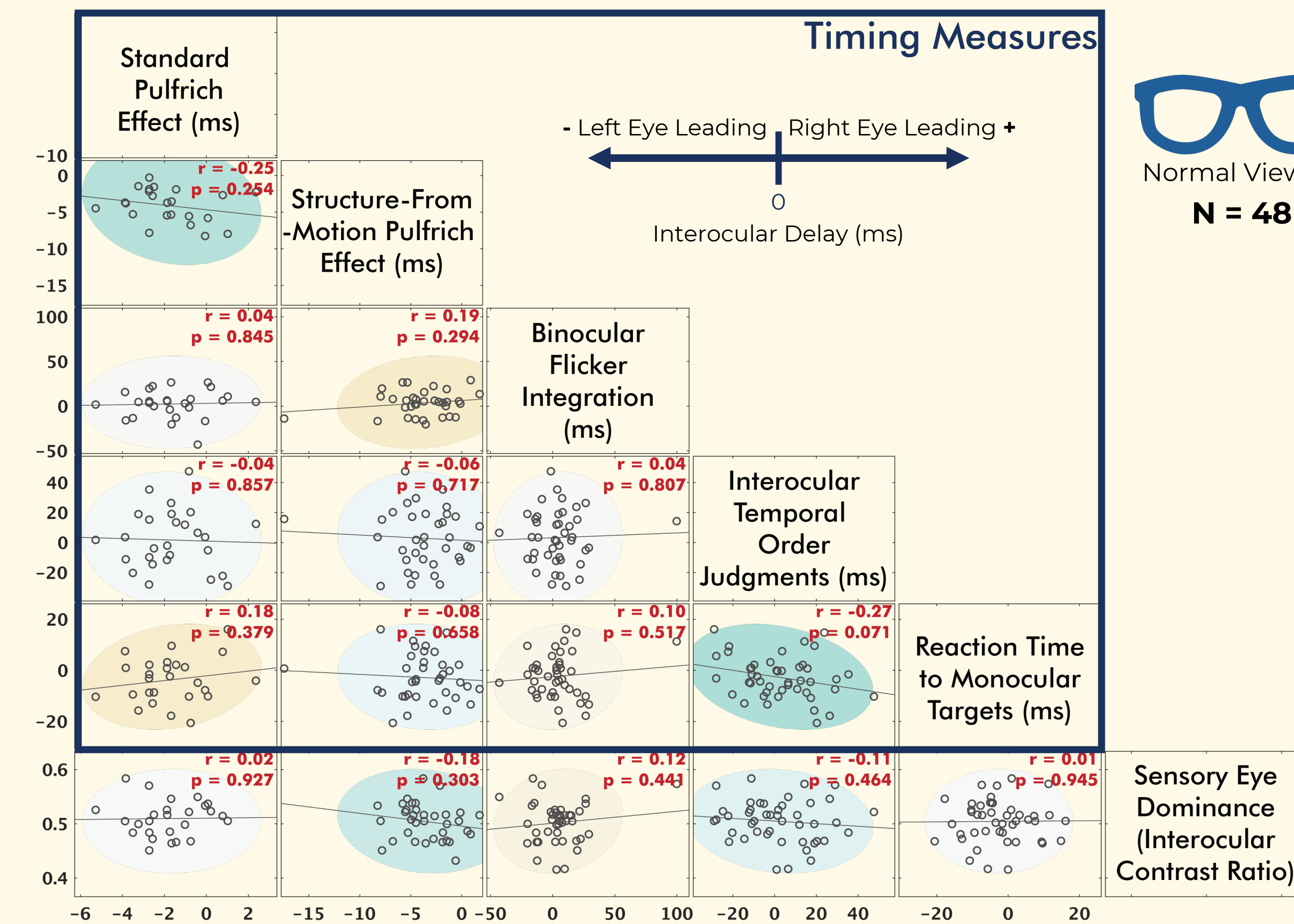
Normally sighted participants completed six tasks in a randomized order, wearing polarized 3D glasses

Used a high frame rate projector:
240 hz per eye



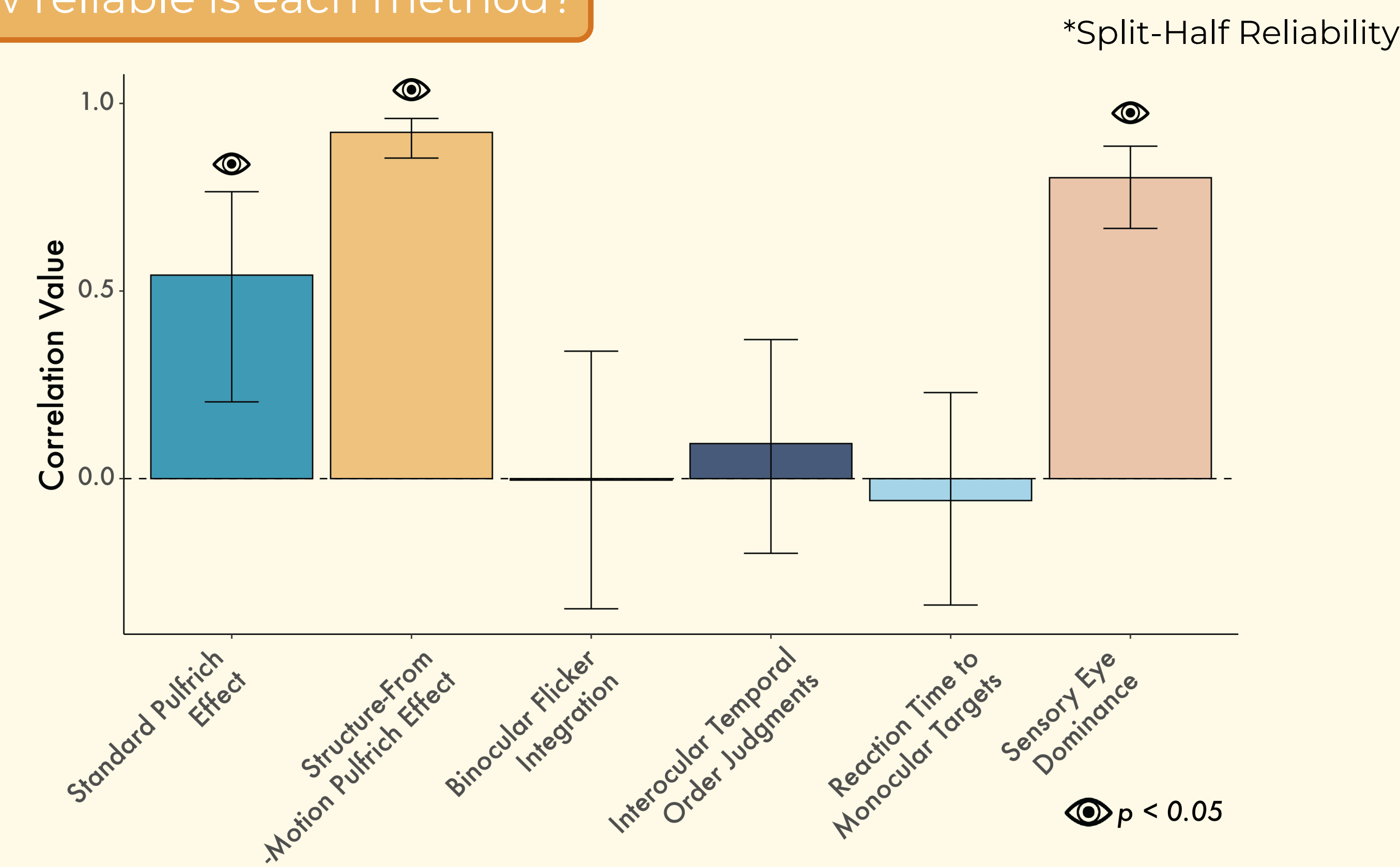
Exp 1: Individual Differences

How much agreement is there across methods?



Method agreement: Variation in normally sighted participants is not large enough to show any significant correlations across tasks

How reliable is each method?



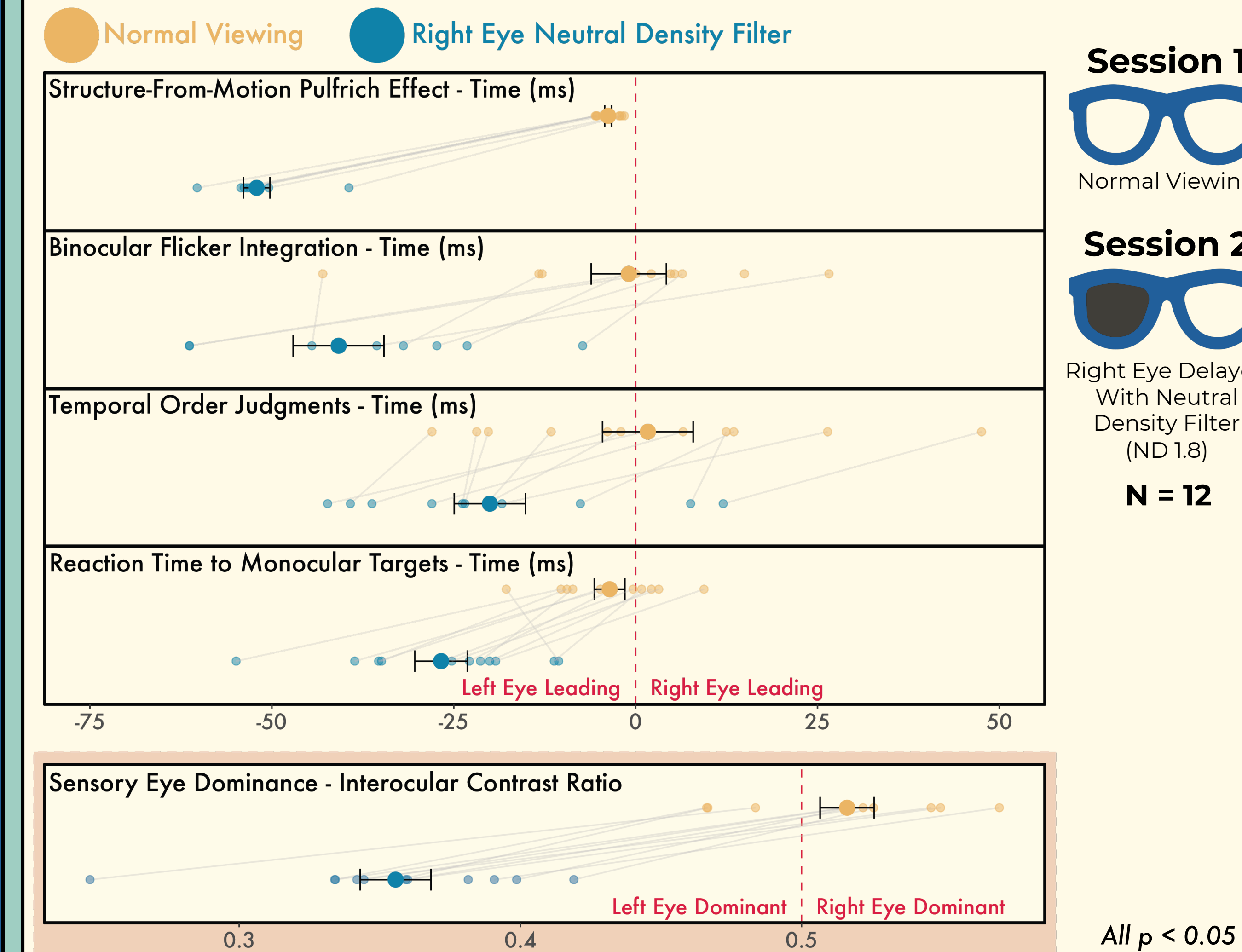
Method Reliability: Some tasks show better split-half reliability than others, but estimates are limited by the narrow range of the data

Conclusion: Exp 1

Even with good split-half reliability for some measures, there is not enough variation in interocular delays in normally sighted participants to show a correlation between tasks.

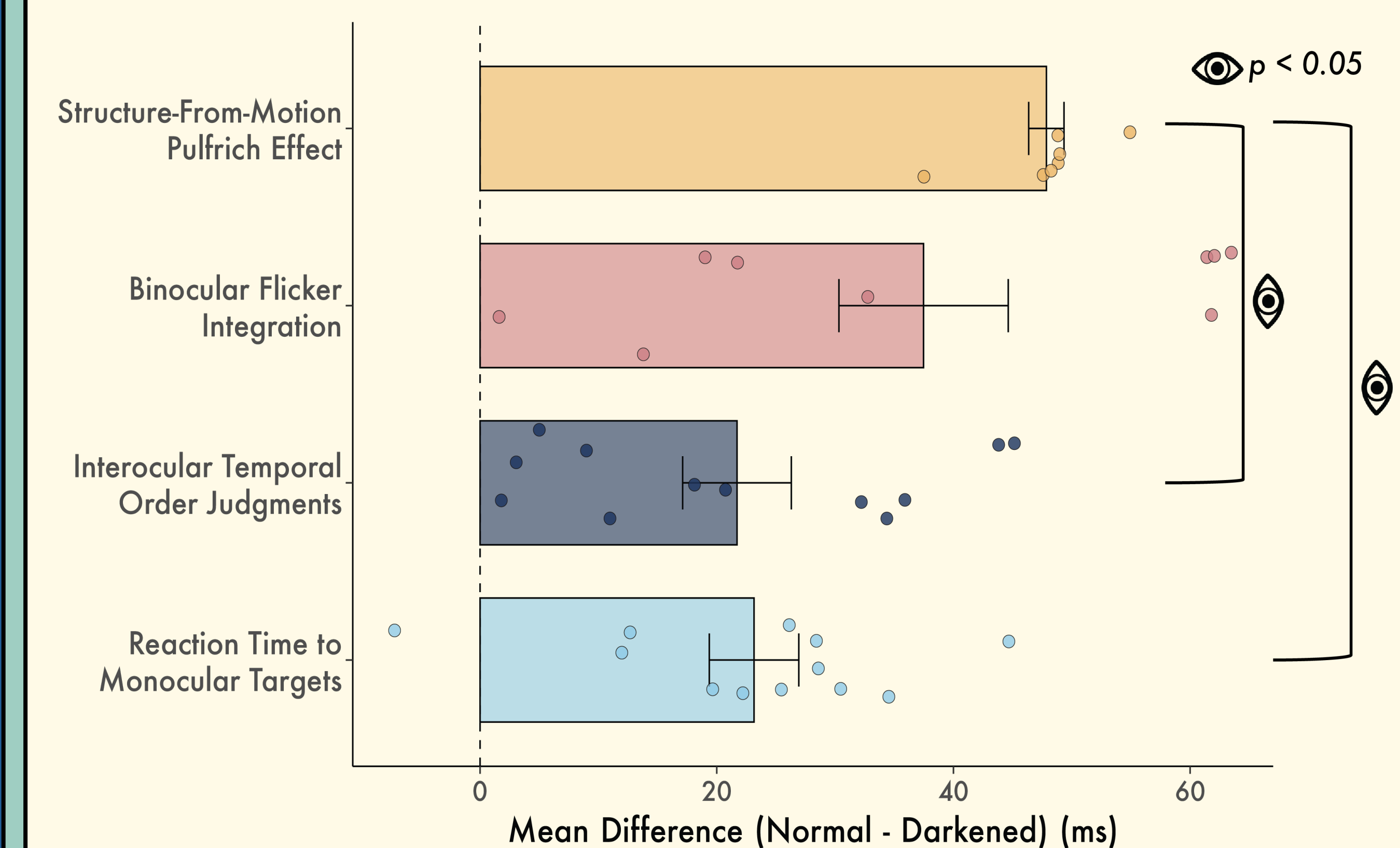
Exp 2: Effect of Neutral Density Filter

Can each method measure timing delays?



Measuring Delays: Applying a neutral density filter on the right eye significantly induced a right-eye delay in each method, but was too large to measure with the Standard Pulfrich effect

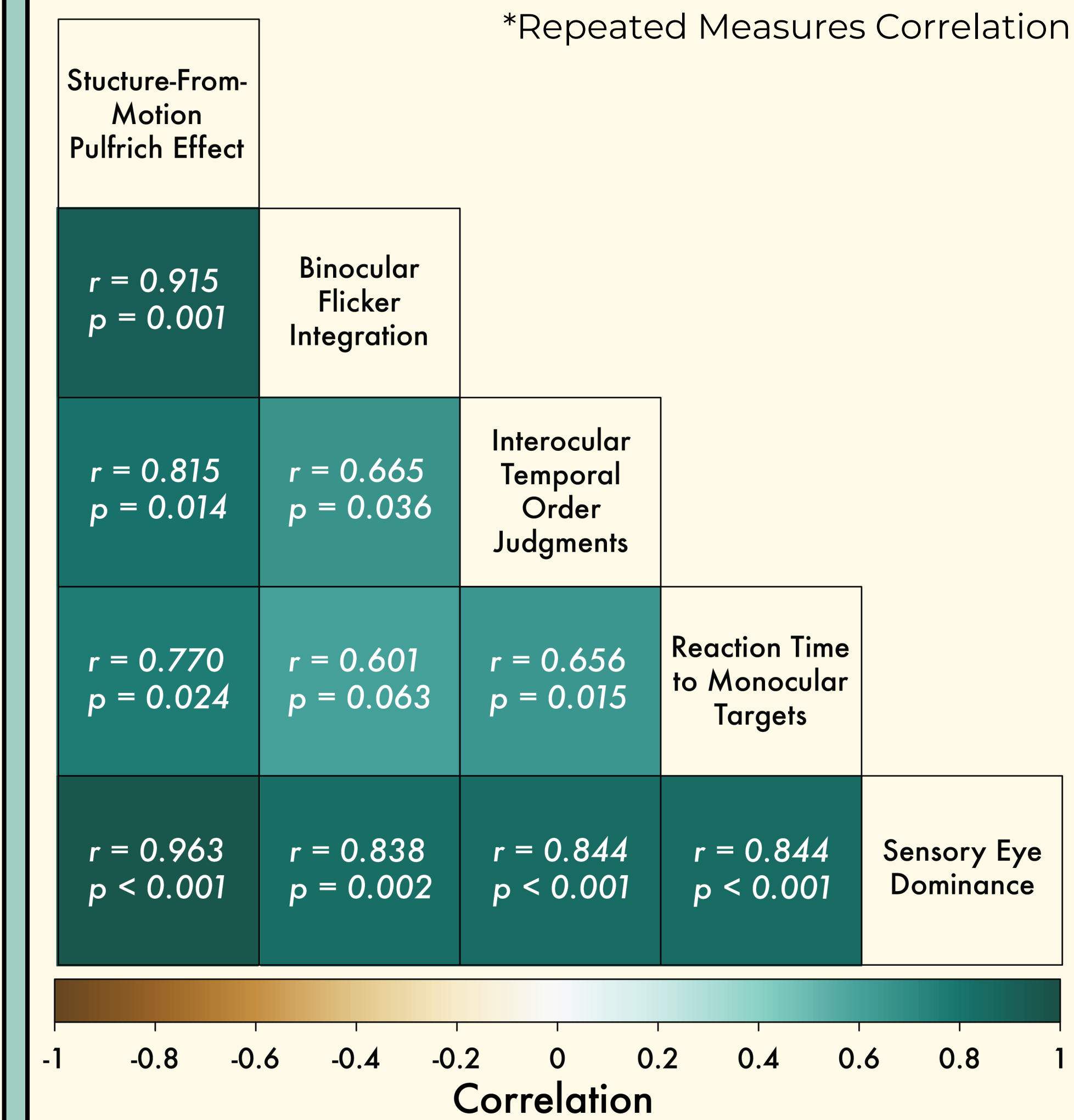
How does the size of the delay vary across methods?



Delay Variation: Across methods, estimates range from 22 to 48 ms

Effect Size: The Structure-from-Motion Pulfrich Effect produced the largest difference between conditions, and the smallest variability between subjects

Do the methods agree with one another?



Method agreement: Nearly all methods are significantly correlated with each other, indicating good agreement in the delay produced by adding a darkening filter on the right eye

Conclusions: Exp 2

- Methods show broad agreement in the effect of a darkening filter on the estimated delay, with some variability across tasks.
- Participants are very sensitive to timing differences between the eyes when they produce changes in depth.
- Other methods may be needed for participants who have limited stereopsis.

Overall Conclusion:

In normally sighted observers, there is not enough spread in the estimated delays to show consistency across methods. However, they each reliably measure a filter-induced delay.

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References: [1] Burge J, Rodriguez-Lopez V, Dorronsoro C., *Curr Biol.* (2019). [2] Min SH, Reynaud A, Hess RF., *Vision* (2020). [3] Shadlen M, Carney T. *Science.* (1986).