# Depth from Motion Alters Radial & Rotational Motion-Defined Temporal Order Judgments

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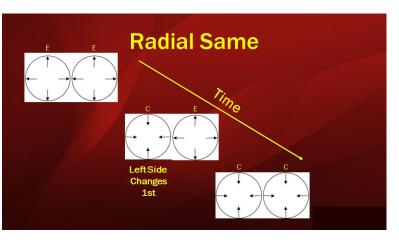


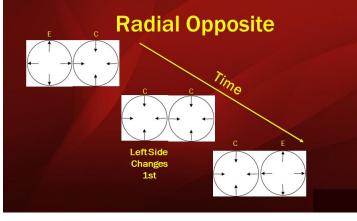
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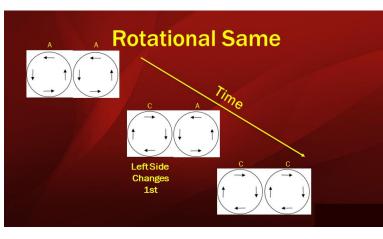
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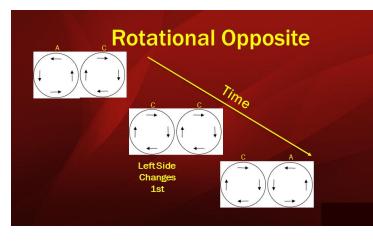
#### Introduction

> Temporal Order Judgments (TOJs) reflect the visual system's timing sensitivity.

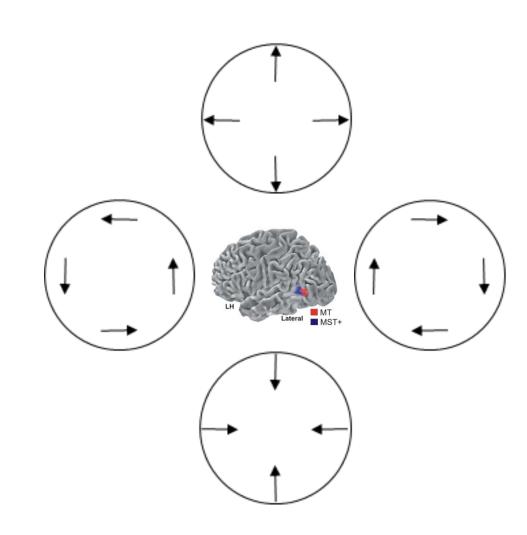








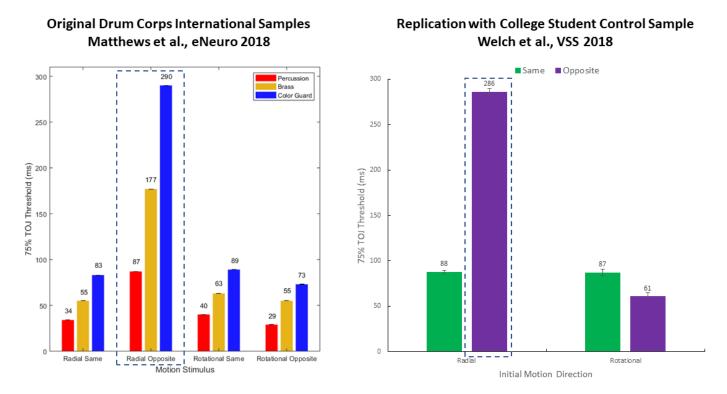
In principle, TOJs for radial and rotational motion could depend on how precisely the visual system registers local linear motion cues [1,2].



## **Hypotheses & Predictions**

> Contrary to the local linear motion cue hypothesis, prior experiments reveal ~3-fold TOJ threshold variations that depends on motion type (radial vs rotational) and direction (same vs opposite) [2,3].

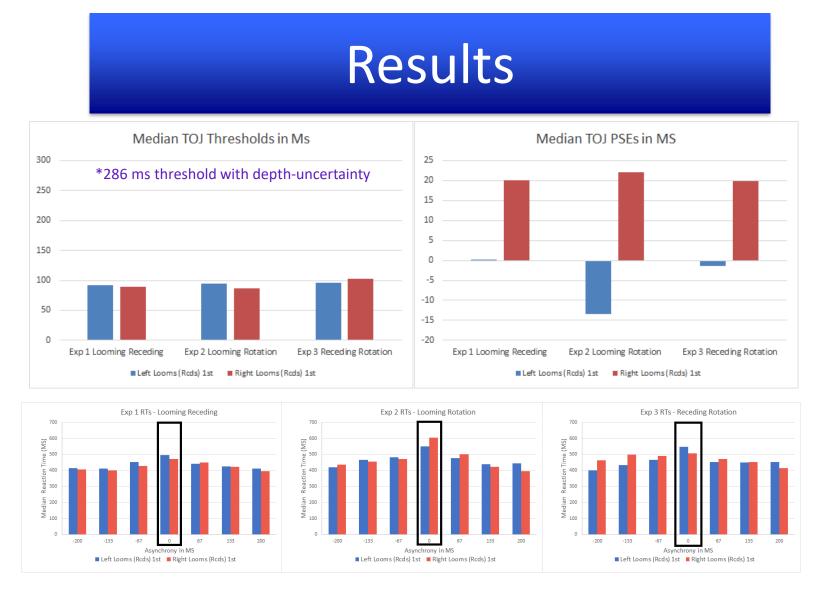
**TOJ Thresholds Elevated for Initially Opposite Radial Directions** 



- > Here we tested three additional hypotheses.
- The Attentional Prior Entry (APE) hypothesis predicts elevated TOJ thresholds, large (>100 ms) TOJ psychometric-function biases (PSE shifts), and peak-reaction-times (peak-RTs) skewed toward initially looming stimuli [4].
- > The **Perceptual Grouping (PG)** hypothesis predicts elevated TOJ thresholds when motion stimuli fail to provide common-fate motion cues.
- > The **Depth Uncertainty (DU)** hypothesis predicts reductions in TOJ thresholds after reducing depth-from-motion uncertainty.

## Participants, Stimuli & Task

- > 76 college students completed 21,280 TOJ trials.
- > Stimuli: Bilaterally presented plaids rotated or radiated before changing direction.
- > Task: Which side changed direction first (L or R)?
- $\triangleright$  Exp 1 (n=26), one stimulus initially loomed while the other initially receded.
- > Exp 2 (n=22), one stimulus initially loomed then receded; the other stimulus rotated.
- > Exp 3 (n=28), one stimulus initially receded then loomed; the other stimulus rotated.
- > All experiments had looming stimuli to test APE, eliminated common-fate motion cues to test PG, and eliminated depth-cue uncertainty to test **DU**.



## Discussion

- Contrary to the APE and PG hypotheses, TOJ thresholds decreased ~2.5-fold (more than 150 ms) relative to prior experiments conducted with similar (but differently paired and blocked) stimuli and the same population.
- Contrary to the APE hypothesis, psychometricfunction biases (PSE shifts) never exceeded 25 ms, and peak-RTs exhibited no skew [5].
- The data match the **DU** hypothesis' predictions.
- > Conclusions Depth from motion can generate dissociations between radially and rotationally defined TOJs. The finding also provide evidence for a global-to-local (course-to-fine) spatial **sequence** in visual **timing sensitivity**. This follows from the fact that manipulating the certainty of global motion configurations generated ~2.5- to 3-fold TOJ threshold variations while local linear motion cues remained constant.

### References

- Pitzalis et al., (2013). PLoS One
- 2. Matthews, Welch & Festa (2018). eNeuro.
- 3. Welch, Matthews, Festa & Schafer (2018). VSS Poster.
- Franconeri & Simons (2003). Perception & Psychophysics.
- 5. Matthews, Welch, Achtman, Fenton & FitzGerald (2016). PLoS One.

Stimuli & data available on the Open Science Framework: https://osf.io/knvxj/

Poster: http://personal.denison.edu/~matthewsn/vss2019matthewsetal.html