**Double Dissociation in Radial & Rotational Motion-Defined**

**Temporal Order Judgments**

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**Introduction:** Rotational and radial motion register in the Medial Superior Temporal (MST) region of the primate visual system, according to prior neurophysiological research (Smith et al., 2006; Strong et al., 2017). Here we psychophysically probed the independence between these two MST-mediated motion types.

**Method:** We bilaterally presented plaids that either radiated or rotated before changing direction. College students reported whether the direction changed first on the left or right –a temporal order judgment (TOJ). In Exp 1 (n=31; 17,360 trials), the two plaids either initially moved in the same or opposite direction. In Exp 2 (n=30; 16,800 trials), all plaids initially moved in the same direction and contained either no phase noise (as in Exp 1), or phase noise from a 0-to-45 degree phase range. To promote reproducibility, the Open Science Framework (https://osf.io/knvxj/) contains the complete data set and all software necessary for replicating the study.

 **Results:** Exps 1 & 2 each generated statistically significant 2x2 interactions, but with distinct patterns. In Exp 1, changing from same to opposite initial directions impaired TOJs on radially defined asynchronies but improved TOJs on rotationally defined asynchronies ( F(1,30) = 67.324, p < 0.001, partial eta^2=0.692 ). Dissimilarly, in Exp 2 adding phase noise impaired TOJs significantly more on rotationally than on radially defined asynchronies ( F(1,29) = 6.213, p = 0.019, partial eta^2=0.176 ). Specifically, Exp 1’s direction manipulation increased radial TOJ thresholds 225% (from 88 to 286 ms), but decreased rotational TOJ thresholds 30% (from 87 to 61 ms). By contrast, Exp 2’s phase manipulation increased radial TOJ thresholds 30% (from 69 to 90 ms), and increased rotational TOJ thresholds 70% (from 86 to 146 ms).

**Conclusion:** The findings suggest a double dissociation between the neural events that track the temporal order of asynchronies defined by two types of MST-mediated motion.

**Word Count:** 300