Accuracy and Precision in Velocity Estimation during Visual Self-Motion

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Background & Objective

(1) Retinal motion elicited by an object is ambiguous and can be due to:

    (1) Object-Motion

    (2) Self-Motion

    (3) Both

Do humans discount visually experienced self-motion successfully from object motion? Does this come at a price?

Hypotheses: Congruent self-motion and object motion lead to an underestimation of target velocity and vice-versa. Self-Motion generally leads to noisier judgments.

Methods

The tasks

- Which of two presented motions is faster?

The stimuli

- Two intervals of left or rightwards motion presented at eye-height in 3D virtual environment

- One big target (moving at 6.6 m/s or 8 m/s), one ball cloud (velocity adjusted according to subject's performance)

- Subject is moved visually in the same or opposite direction as the target, or could remain static during observation of the big target

Dependent variables

- Mean (= accuracy) and slope (= precision) of psychometric function

## What is a psychometric function?
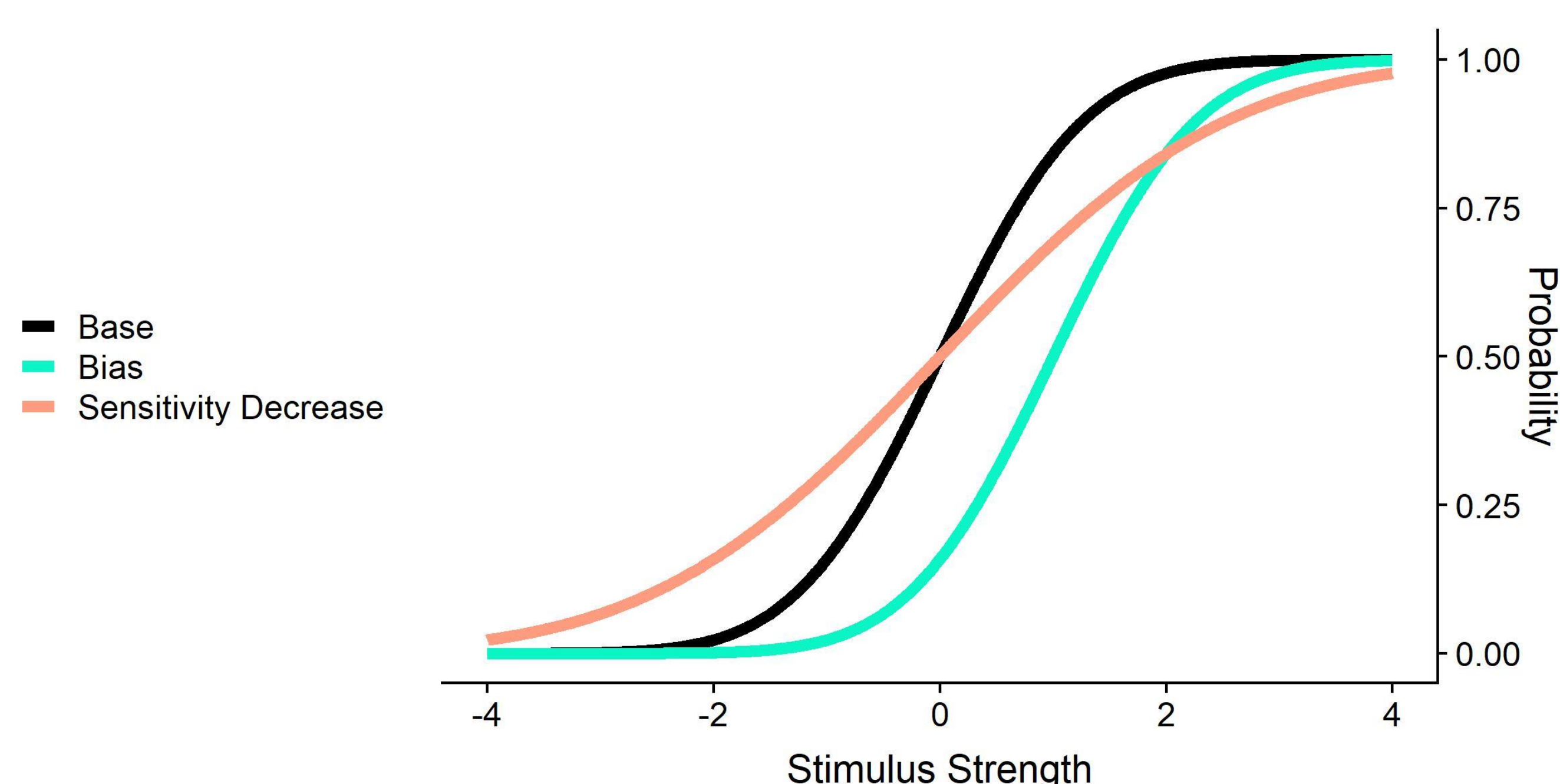
Mean of Cummulative Gaussian indicates **biases**: does the target look faster in one condition than in another?

Slope of Cummulative Gaussian indicates **sensitivity**: how well do subjects do at discriminating different velocities?

References

[1] Dokka, K., MacNeilage, P. R., DeAngelis, G. C., & Angelaki, D. E. (2015). Multisensory self-motion compensation during object trajectory judgments. *Cerebral Cortex*, 25(3), 619–630. https://doi.org/10.1093/cercor/bht247
[2] Dupin, L., & Wexler, M. (2013). Motion perception by a moving observer in a threedimensional environment. *Journal of Vision*, 13(2), 1–14. https://doi.org/10.1167/13.2.15

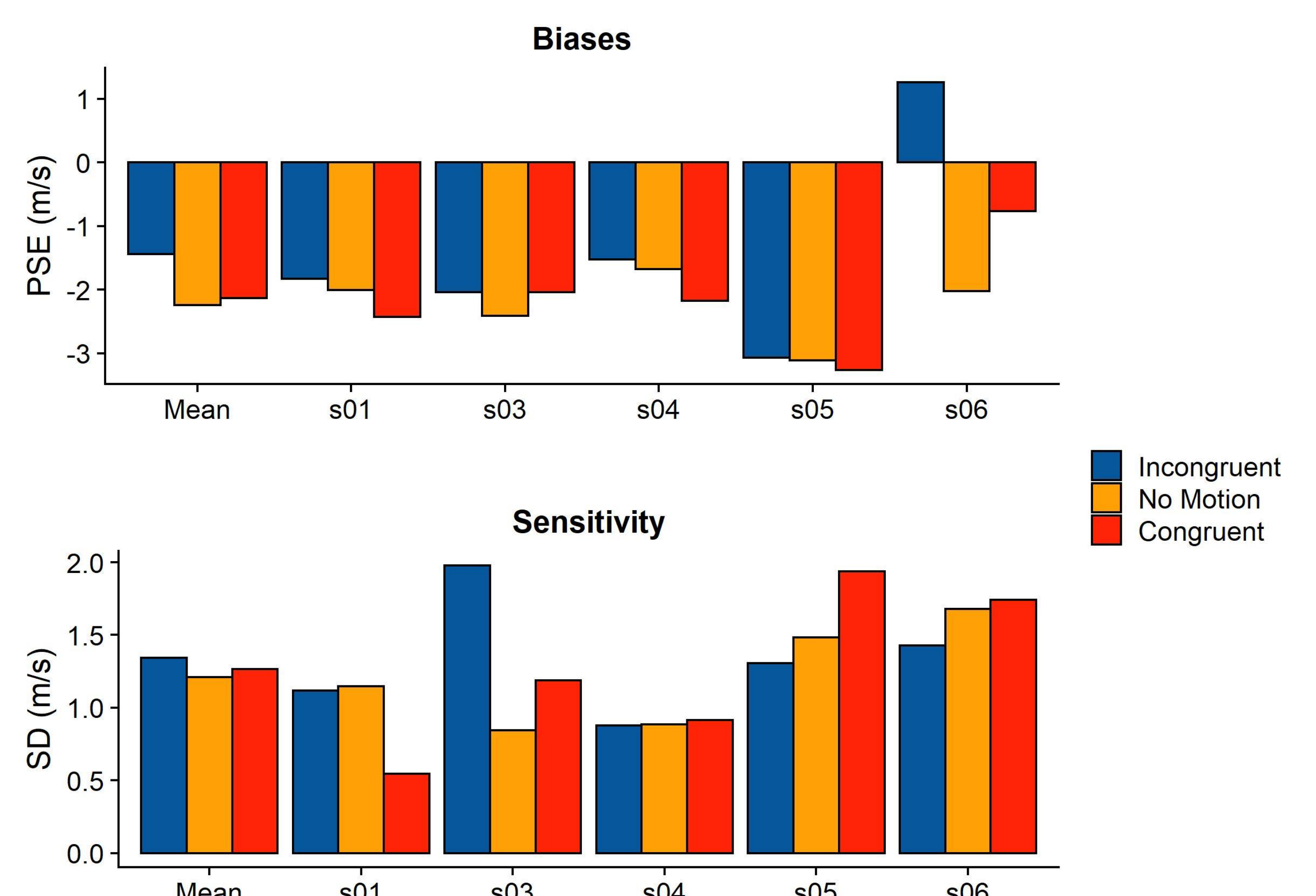## Results
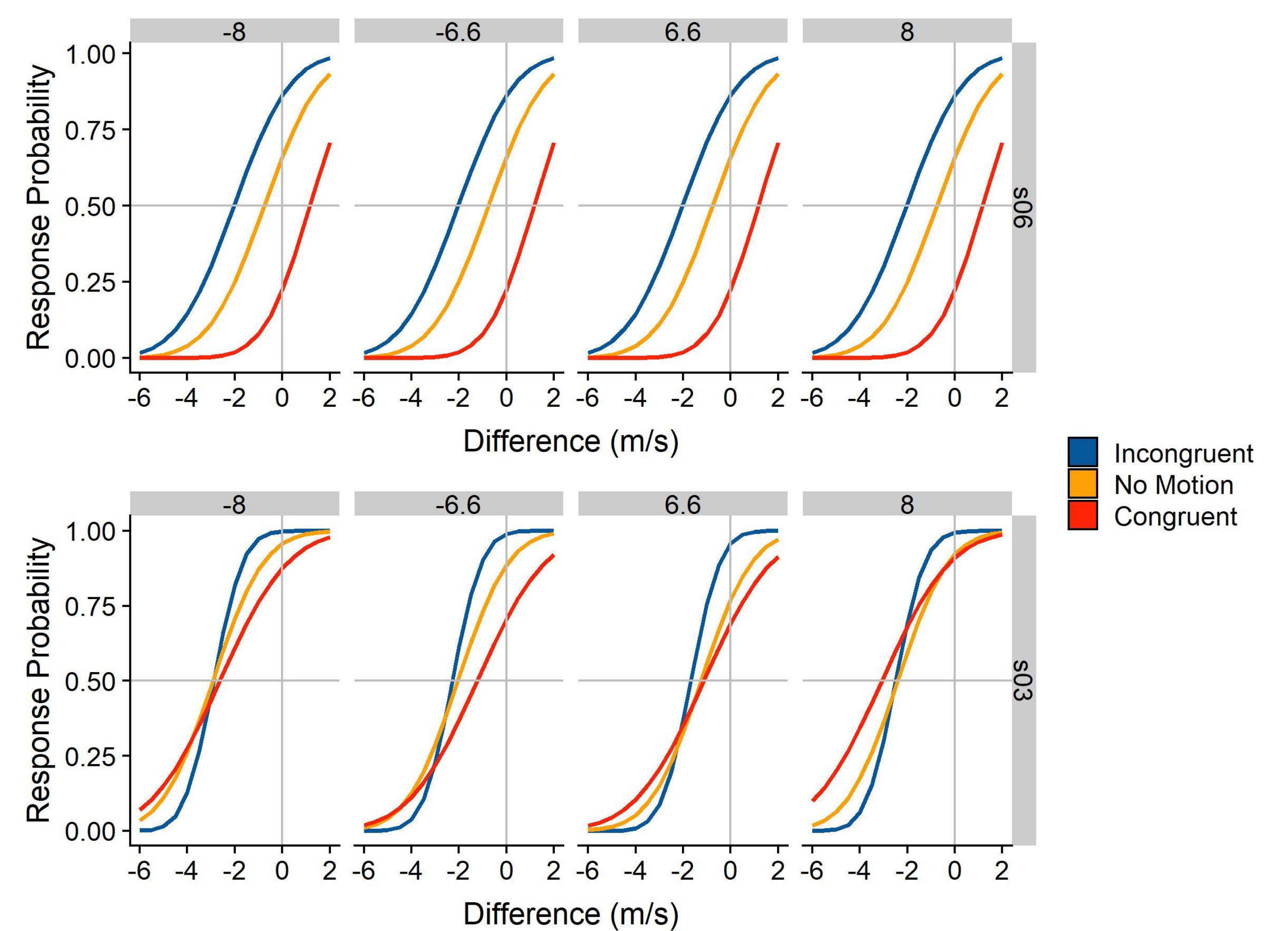
Participant 06: Bias to perceive incongruent motion as faster than congruent motion

Participant 03: Sensitivity higher without Self-Motion

All Participants

- On average, incongruent motion is judged as too fast; no big difference between no motion and congruent motion

- On average, subjects judge speed somewhat less precisely when self-motion is simulated

Conclusions

- Everything is (still) a huge mess
- Hypotheses are partially confirmed:
  - Incongruent motion is perceived as faster than congruent motion/no motion
  - Both congruent and incongruent self-motion elicit lower sensitivity

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