

Informative cue on stimulus frequency determines criterion in near-threshold somatosensory detection

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Introduction

Stimulus expectations have been shown to influence what we see by changing the decision criterion [1], whether this holds true in the somatosensory domain has not been investigated yet [2, 3]

The phase of the cardiac cycle determines perception of weak somatosensory stimuli [4, 5]

Research questions:

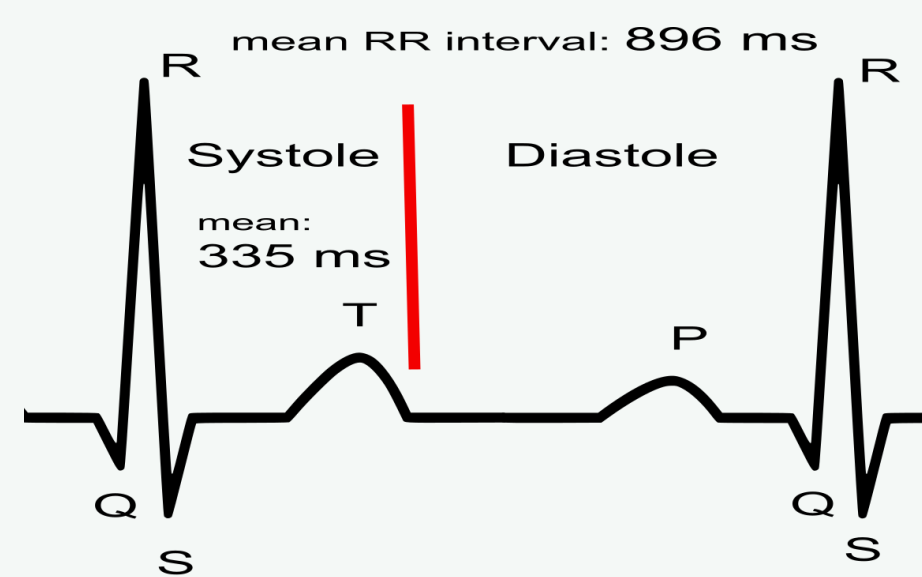
Do participants adapt their **decision criterion** in a **somatosensory near-threshold detection** task based on stimulus expectations?

Does **confidence** depend on the stimulus expectation condition?

Is there an **interaction between stimulus expectations and the cardiac cycle effect** on somatosensory perception?

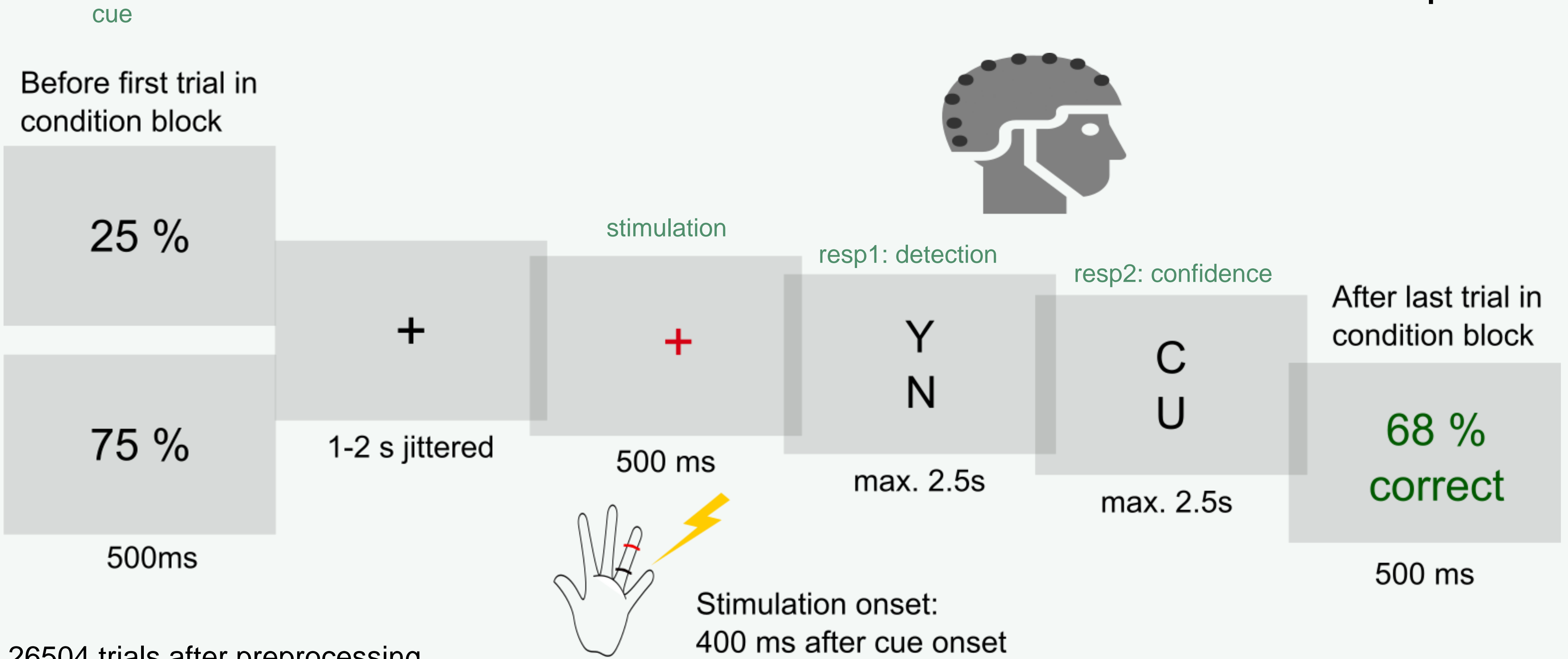
cardiac cycle effect in perception:

higher sensitivity in diastole



Methods

42 young, healthy participants
62-channel EEG & 1-lead ECG & respiration



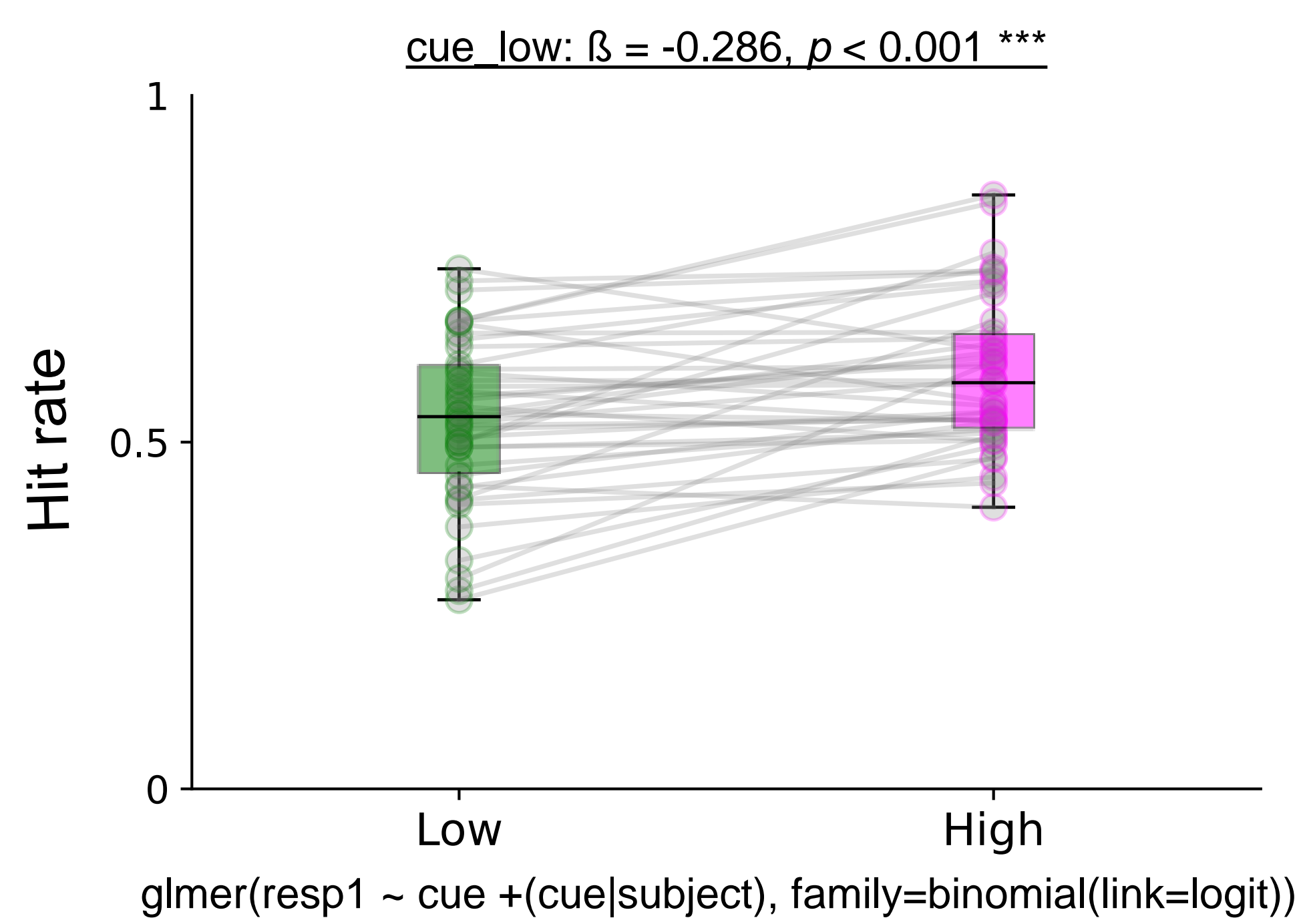
26504 trials after preprocessing

Independent variable: cue (low/high expectations), stimulation (signal/noise), cardiac cycle phase (four 200 ms time bins post R peak), congruency (cue == low & resp1 == no | cue == high & resp1 == yes)

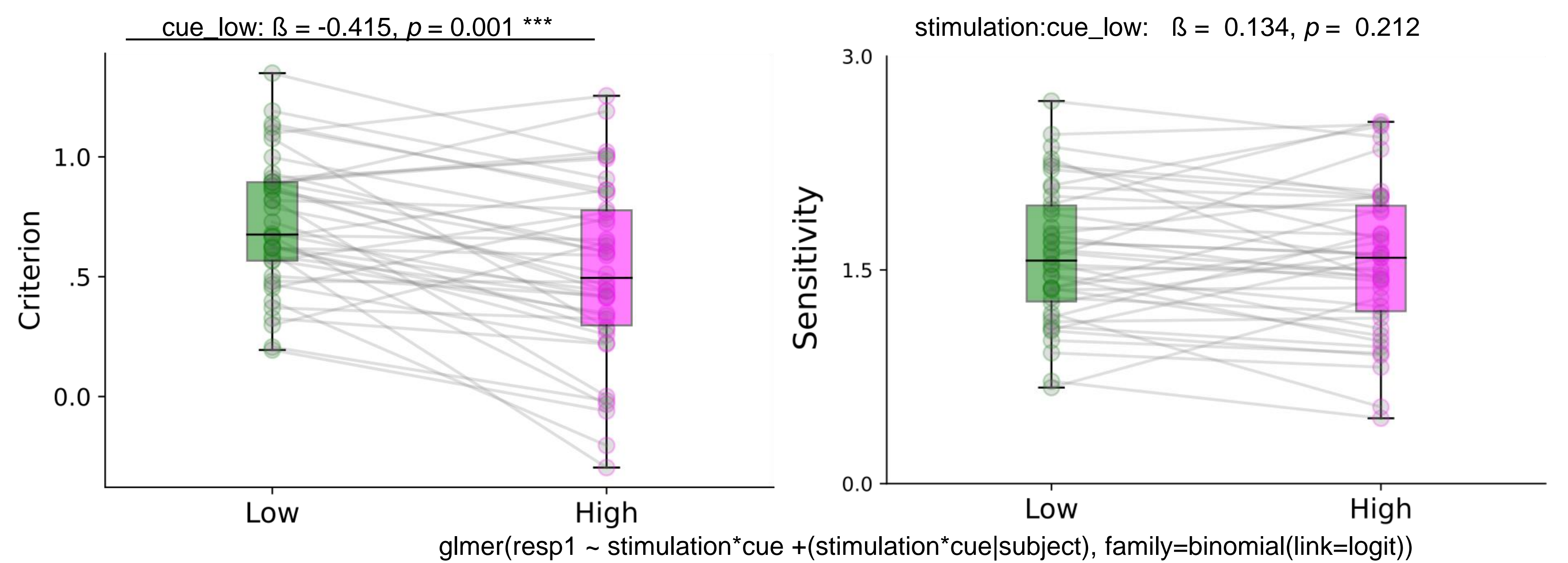
Dependent variable: detection (yes/no), confidence (confident/unconfident), reaction times

Results: behavioral

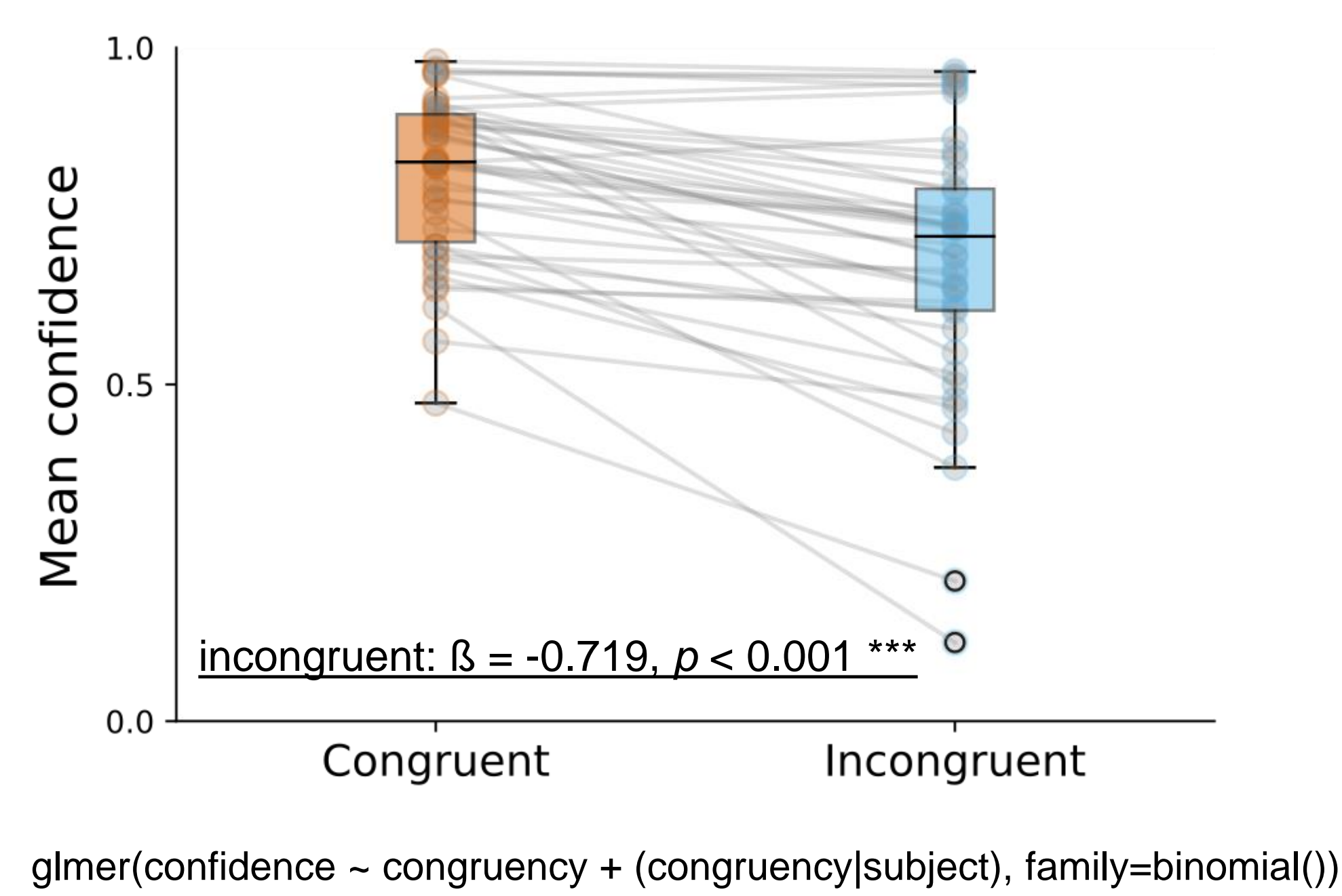
1 Higher hitrate in high expectation condition



2 Signal detection theory: more conservative criterion in low expectation condition

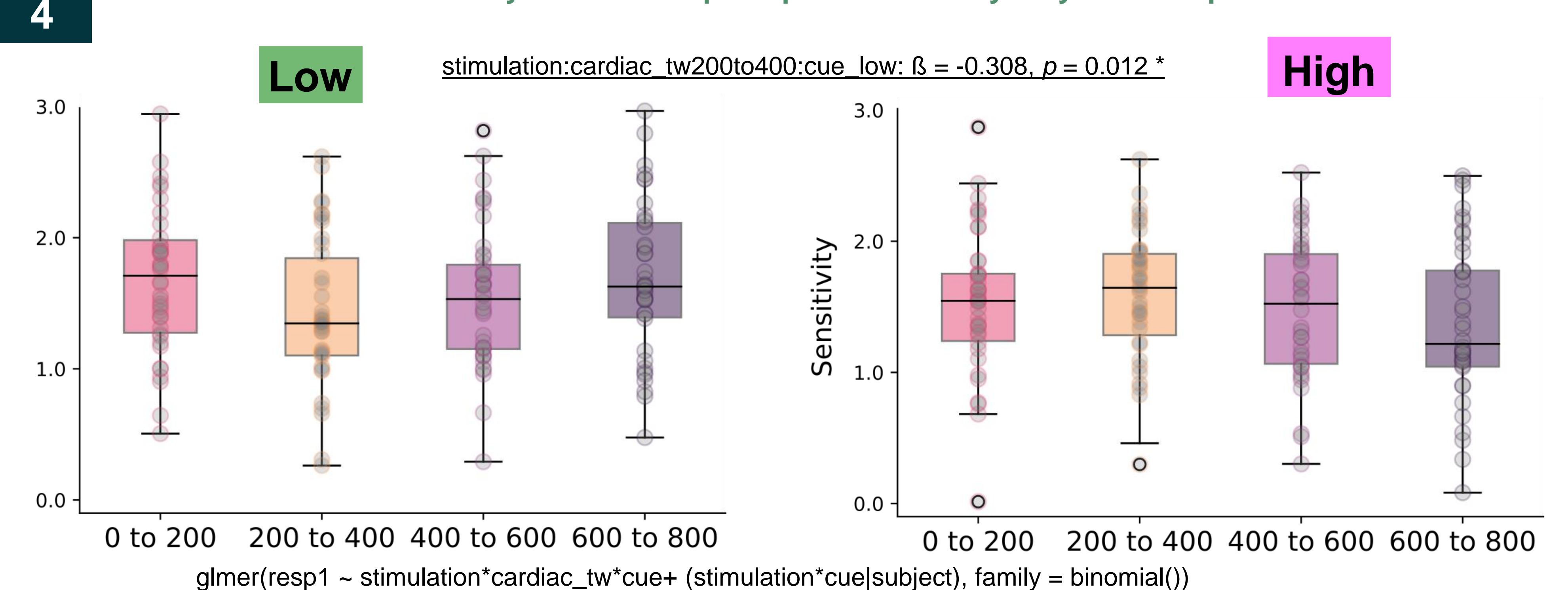


3 Higher mean confidence in congruent trials



cardiac cycle

Interaction between cardiac cycle and expectation condition:
Cardiac cycle effect on perceptual sensitivity only in low expectation condition



Discussion

Summary:

- Participants use information about stimulus probabilities for somatosensory perception

=> reflected in changes in decision criterion and confidence

- Expectations shift the attentional focus from internal to external and interact with unconscious predictive coding

=> interaction effect of expectation condition and the timing of stimulus onset within cardiac cycle on perceptual sensitivity

Open questions:

- Neural correlates of a change in decision criterion
- Differences in the heartbeat evoked potential between expectation conditions?



References:

- Sherman, M. T., Seth, A. K., Barrett, A. B., & Kanai, R. (2015). Prior expectations facilitate metacognition for perceptual decision. *Consciousness and Cognition*, 35, 53–65.
- Kloosterman, N. A., de Gee, J. W., Werkle-Bergner, M., Lindenberger, U., Garrett, D. D., & Fahrenfort, J. J. (2019). Humans strategically shift decision bias by flexibly adjusting sensory evidence accumulation. *eLife*, 8, e37321.
- Zhou, Y. J., Iemi, L., Schoffelen, J.-M., de Lange, F. P., & Haegens, S. (2021). Alpha Oscillations Shape Sensory Representation and Perceptual Sensitivity. *Journal of Neuroscience*, 41(46), 9581–9592.
- Al, E., Iliopoulos, F., Forschack, N., Nierhaus, T., Grund, M., Motyka, P., Gaebler, M., Nikulin, V. V., & Villringer, A. (2020). Heart-brain interactions shape somatosensory perception and evoked potentials. *Proceedings of the National Academy of Sciences*, 117(19), 10575–10584.
- Grund, M., Al, E., Pabst, M., Dabbagh, A., Stephani, T., Nierhaus, T., ... & Villringer, A. (2022). Respiration, heartbeat, and conscious tactile perception. *Journal of Neuroscience*, 42(4), 643-656.