



Electrical brain waves modulate with movement speed and uncertainty

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Introduction: brain waves and movement

- brain waves in the "beta band" fluctuate at 13-30 cycles per second (Hz) over the sensorimotor cortex throughout movement¹
 - during movement preparation, sensorimotor beta power decreases²
- when participants are *less certain* which direction they will be asked to move, beta activity is heighten during motor preparation.³
- Parkinson's Disease is associated with *slowed movement* and elevated beta band synchrony in the thalamo-cortical-basal ganglia loop.⁴

Question: How is beta power prior to movement modulated by movement certainty and speed in healthy participants?

Hypothesis: Increased beta power will be observed in *slower* and *less certain* movements.

Methods: operationalizing speed and uncertainty

Behavioral Task: (I) square appears = get ready to move (II) arrow appears = press arrow key (III) Short break and repeat

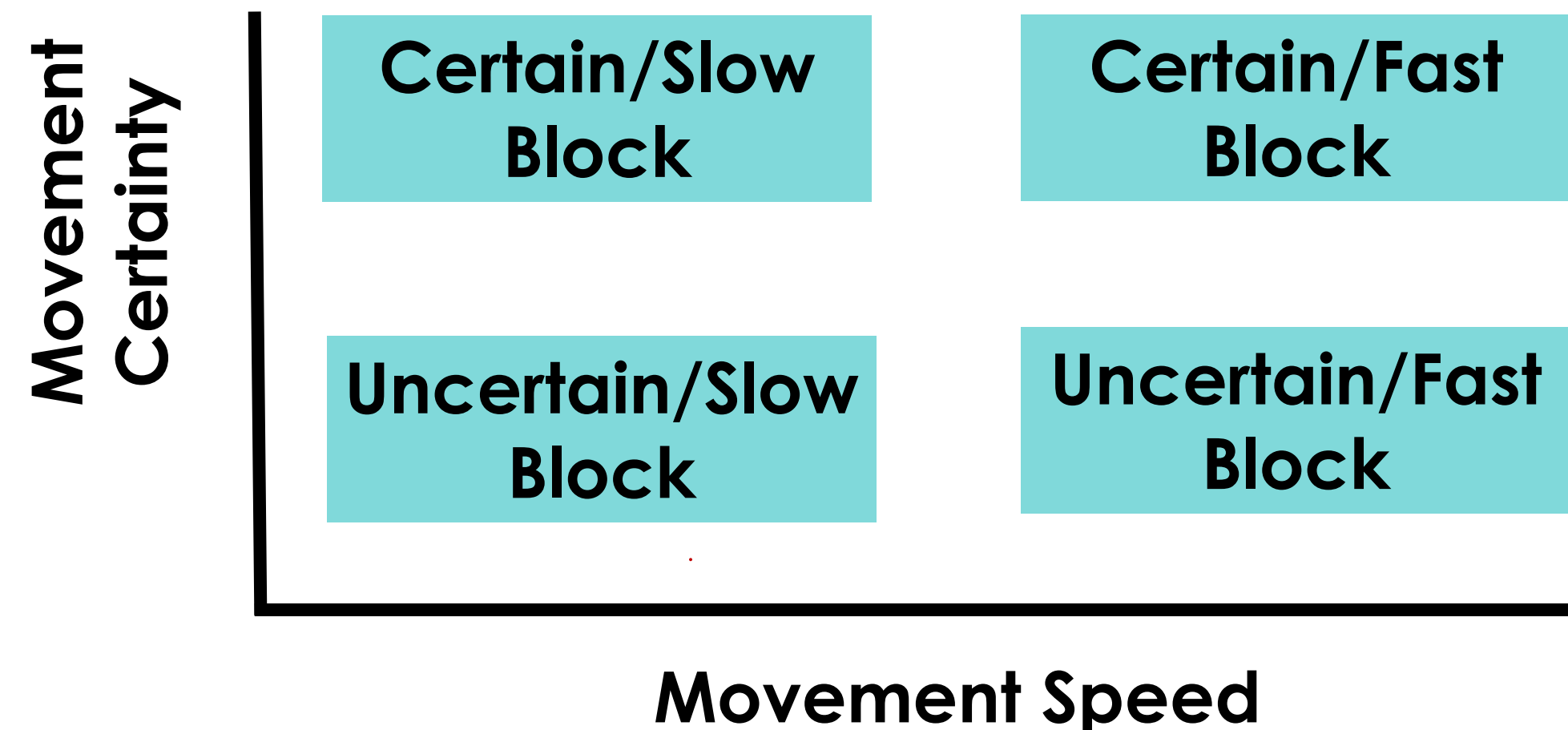


Movement fore period (MFP): time elapsed between square and arrow

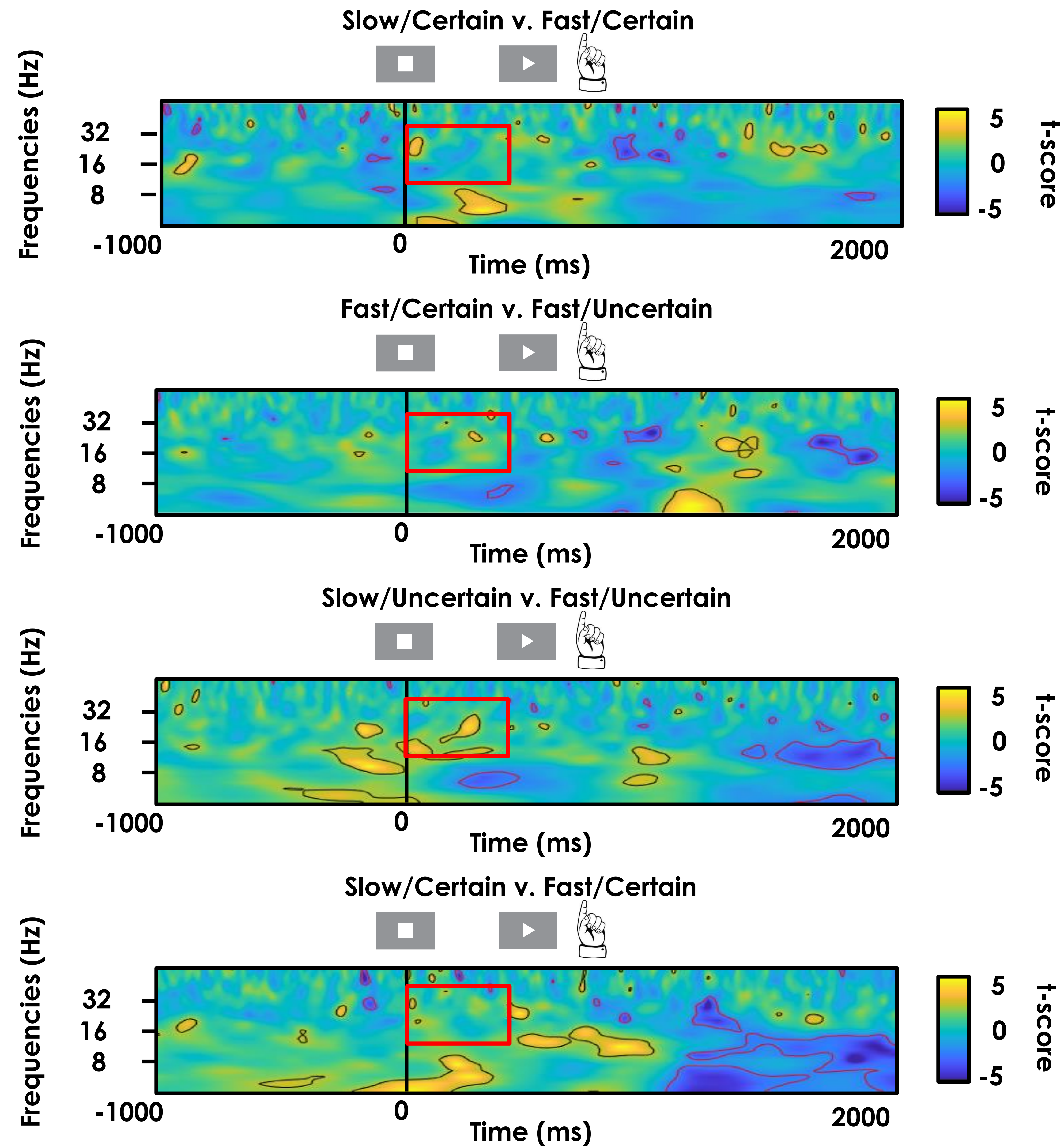
Response Period (RP): time window to press arrow

- respond before the go-cue disappears, so the RP should influence reaction time (i.e. movement speed)
- change the MFP and you change the certainty of the upcoming movement
- pairing uncertain/certain MFPs with slow/fast RPs to create four experimental blocks

➤ scalp-electrodes (electroencephalography or EEG) recorded electrical brain waves while subjects responded to the task

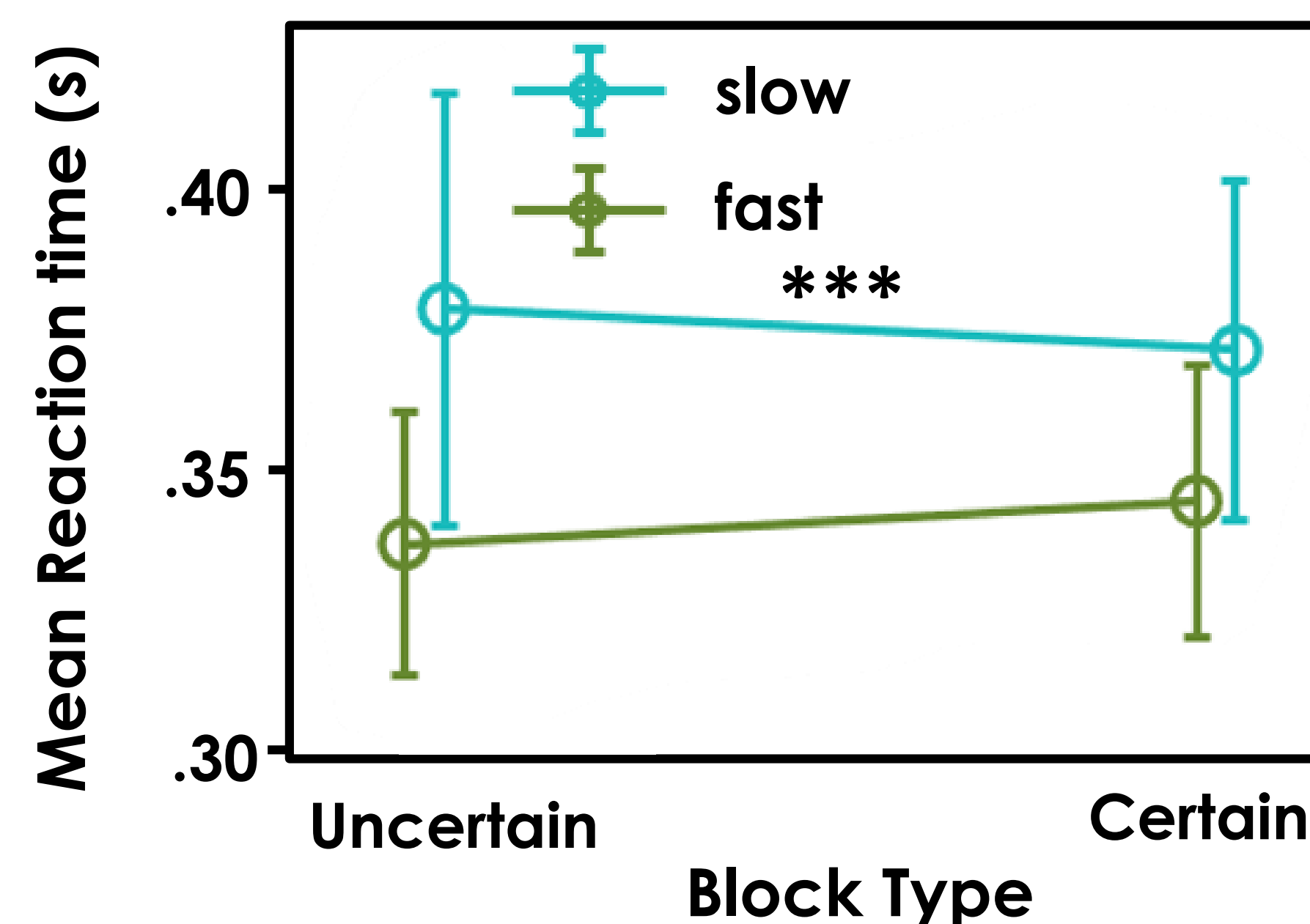


Results: sensorimotor activity throughout task



During the MFP—the time between the square and arrow—beta power was elevated only in the Slow/Uncertain block versus the Fast/Uncertain block.

Results: reaction times across blocks



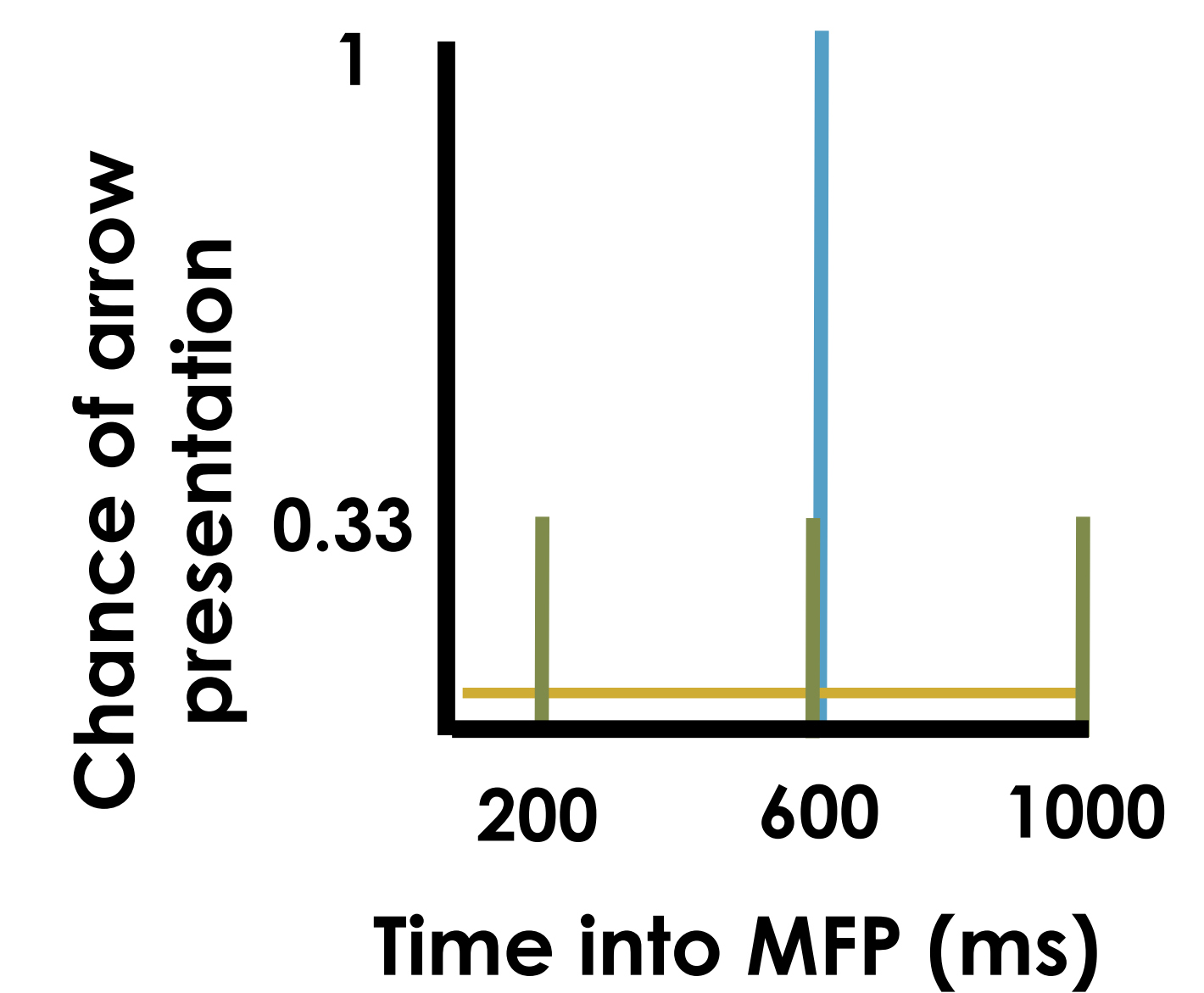
- slow blocks had longer mean reaction times than fast blocks
- MFP uncertainty had no significant effect on reaction time

Discussion: brain waves in light of behavioral results

- Why were there no reaction time differences across MFP uncertainty conditions?
- combination of movement speed and uncertainty showed difference in beta activity
- need to correct for multiple-comparisons problem before drawing conclusions
- explore during movement/after movement epochs
- explore movement speed and uncertainty in separate experiments

Follow-up Experiment

- more drastic differences in MFP certainty across blocks



References and Acknowledgements

1. Pfurtscheller et. al., Electroencephalogr. Clin. Neurophysiol. (1981).
2. Kilavik, et. al., Exp. Neurol (2013).
3. Tzagarakis, et. al., J. Neurosci., (2010).
4. Hammond, et. al., Trends Neurosci., (2007)

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