



Effects of inter-stimulus interval duration and predictability on sensorimotor beta

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Background

- Oscillatory changes are observed in the beta band (13-30 Hz) over sensorimotor regions during movement.¹
- During movement preparation and execution, sensorimotor beta power decreases and then increases (or “rebounds”) following movement termination.²
- Before movement, there is heighten beta suppression when the direction of movement is more certain.³
- Parkinson’s Disease (PD) is characterized by slowed movement and is associated with 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

- 12 subjects were instructed to respond to a left or right triangle (go-cue), with the corresponding arrow key, before the go-cue disappeared. This occurred with concurrent scalp-EEG. There were *two manipulations at the block level*:

- Movement certainty** was manipulated by having trials with a fixed (more predictable) or a varied (less predictable) movement fore period.
- Movement speed** was manipulated by varying the length of the response periods. A shorter response period would require a faster movement.

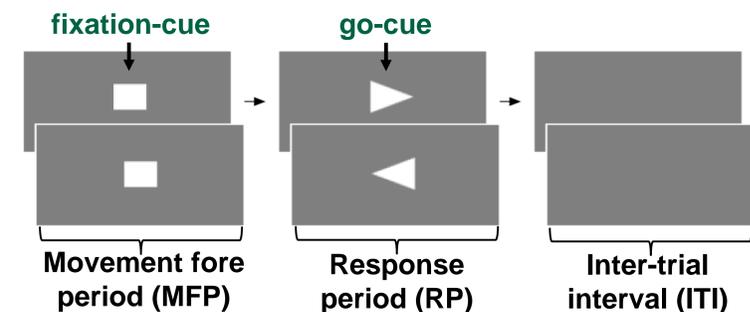


Fig 1. The MFP was **500ms (fixed block)** or varied from **300-700ms** per trial (**varied block**). The go-cue was presented for a **shorter or longer RP for fast or slow blocks**, respectively. The ITI was 2500ms across every block.

Results

Four experimental blocks to address two questions

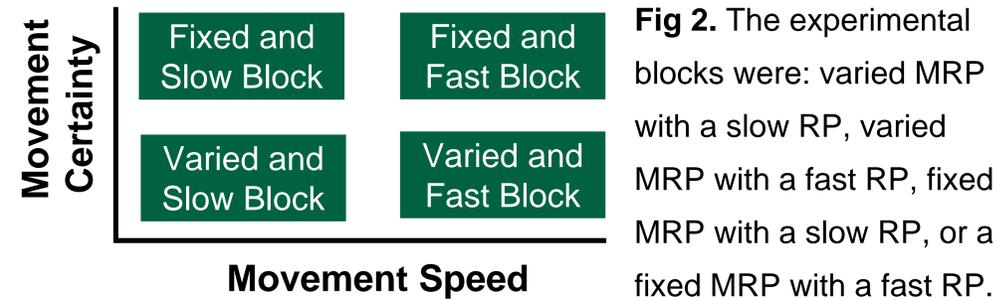
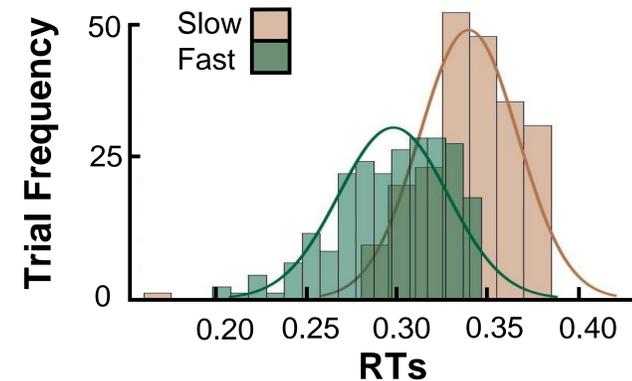


Fig 2. The experimental blocks were: varied MRP with a slow RP, varied MRP with a fast RP, fixed MRP with a slow RP, or a fixed MRP with a fast RP.

Example subject's RTs for slow and fast blocks

Fig 3. An example reaction time distribution from one participant for fast and slow blocks regardless of MFP block type.



Quicker RTs in fast blocks

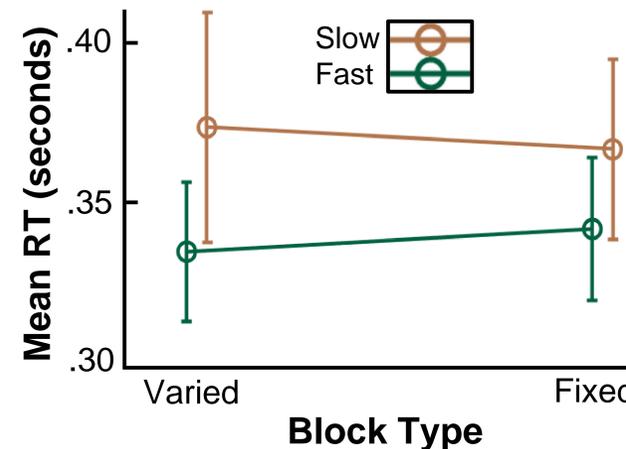


Fig 4. A two-way ANOVA revealed a main effect of block type on mean RT ($p < 0.0001$). Tukey’s post hoc test revealed the mean RT to be longer in slow blocks ($p < 0.0001$).

Interaction of beta power between block types

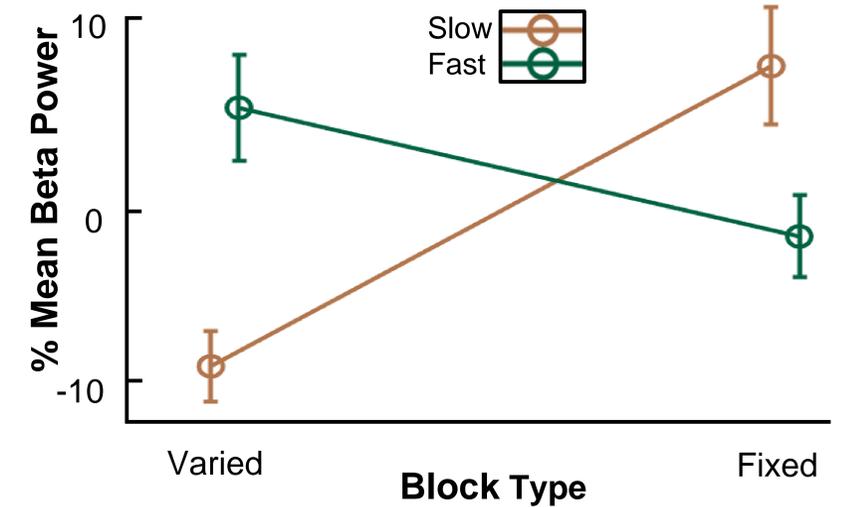


Fig 5. A two-way ANOVA showed an interaction between block types (beta power was normalized per subject to their own mean beta power over the entire experiment ($p = 0.0485$)).

Group go-cue locked spectrogram

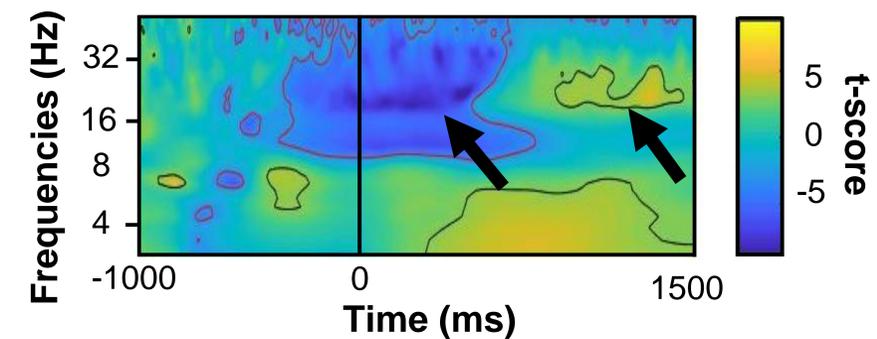


Fig 6. A t-scored group analysis spectrogram locked to the go-cue and relative to baseline (go-cue: $t = 0$, baseline: $t = -1500$ to -1000 ms relative to go-cue) demonstrating the canonical beta decrease peri-movement, and rebound after.²

Discussion/Future Directions

- Next, we plan to repeat this experiment to see if the effect replicates. We will use a wider range of times for the MRP duration to see if this creates a larger effect on movement certainty.
- We will also test a different approach to manipulate movement speed by using a point-based system to incentivize faster movements.

Acknowledgments

- Special thanks to: members of the Swann Lab for their continued support, Summer Program for Undergraduate Research (SPUR) at the University of Oregon, and funding from the National Institute of Health (NIH) and the Renée James Seed Grant to Accelerate Scientific Impact.
- Research reported in this poster was supported by Eunice Kennedy Shriver National Institute of Child Health & Human Development of the National Institutes of Health under award number R25HD0708. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Citations: 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)