

Electroencephalography Correlates of Movement-Induced Enhancements of Beat Timing



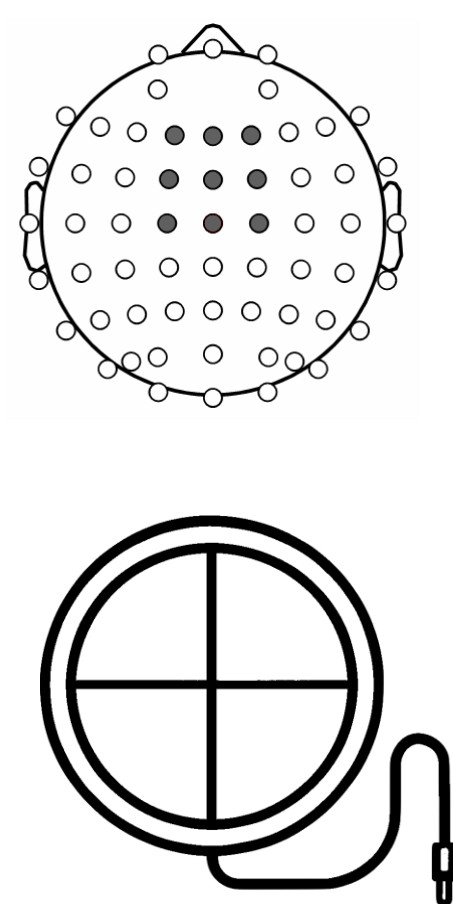
Background

- Motor systems and rhythmic auditory processing are linked¹.
- Inducing movement in a subject can lead to enhancement of auditory timing abilities².
- The neural correlates of this effect are unknown.
- We here investigated how rhythmic movements induce perceptual improvement in timing abilities.

Experimental Method

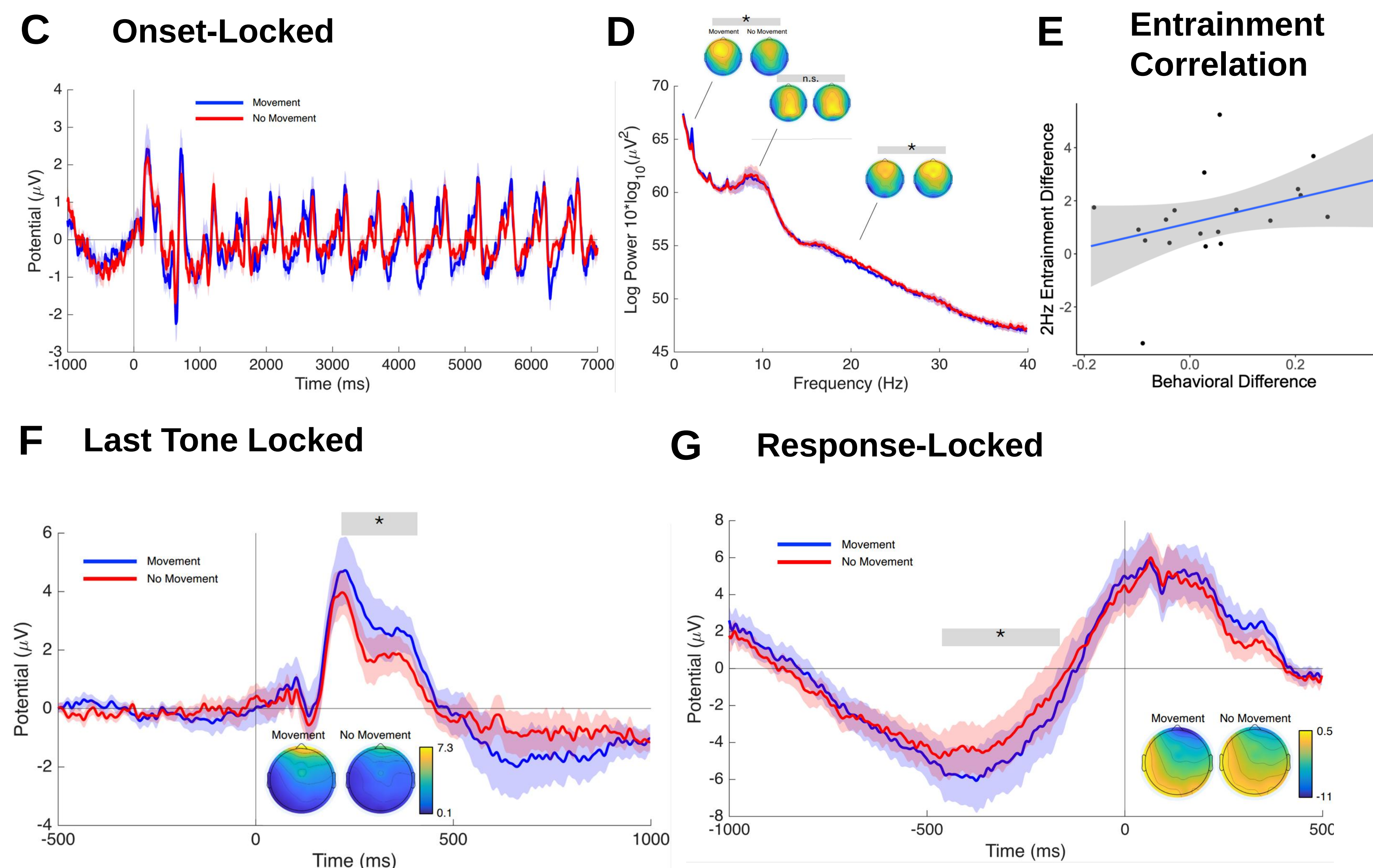
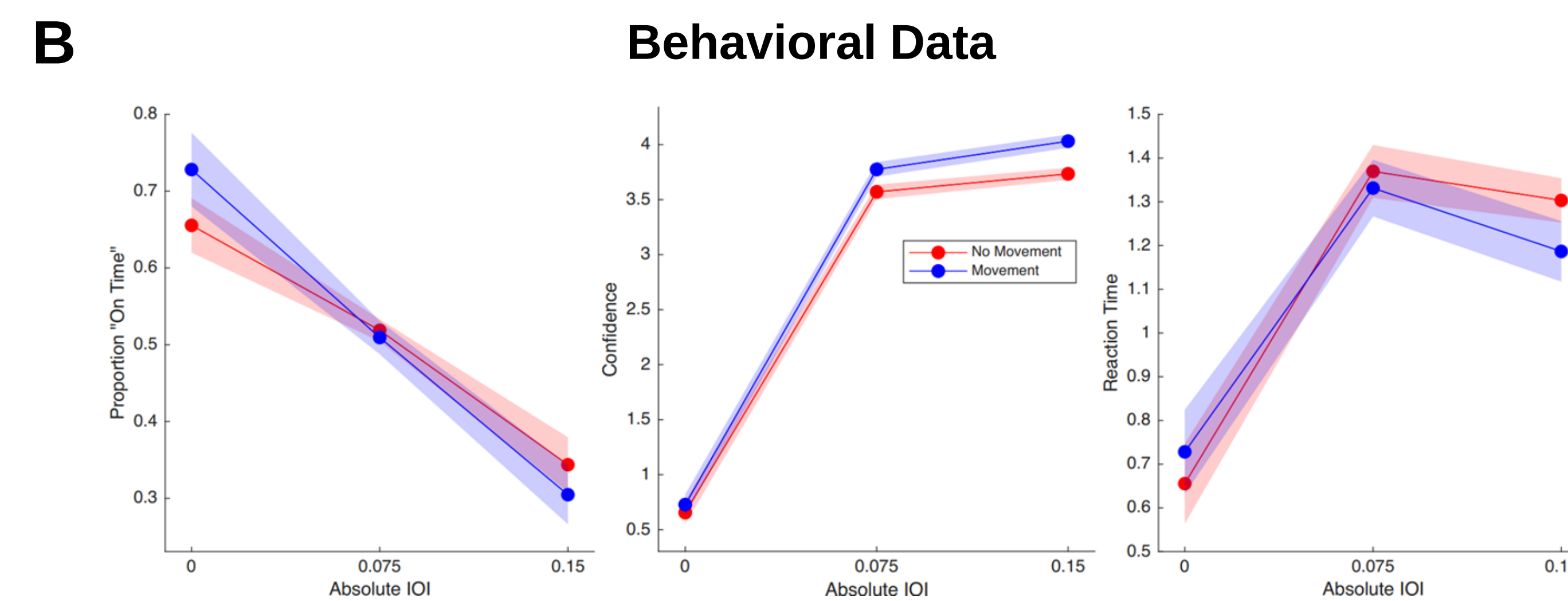
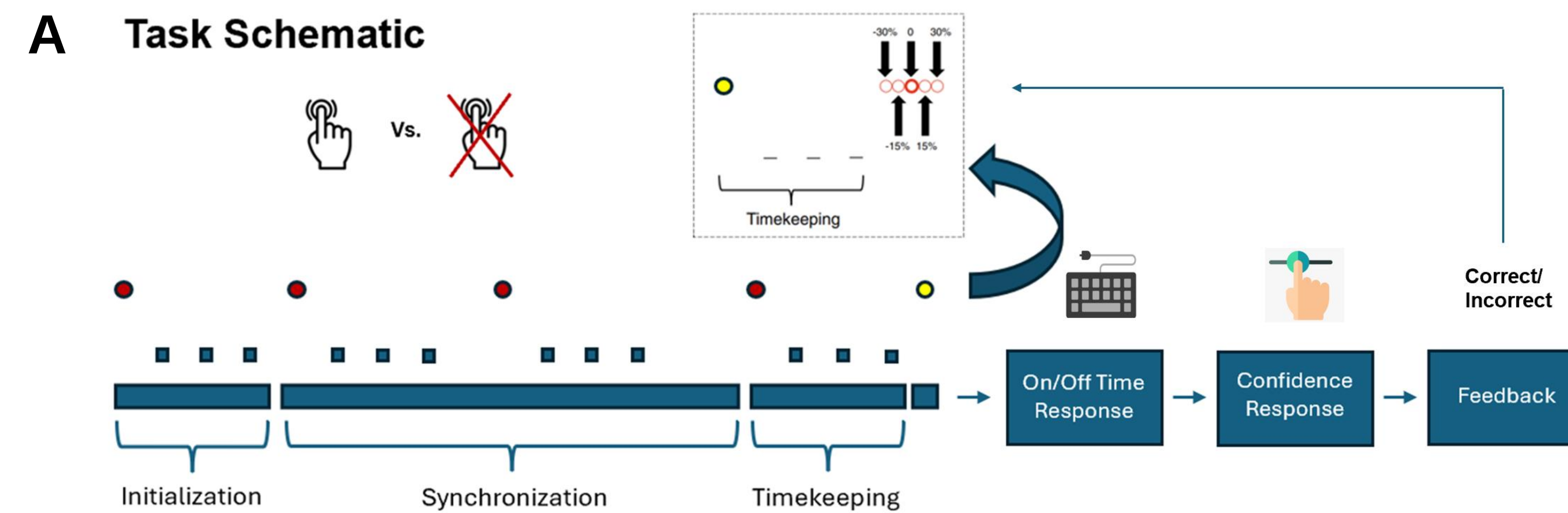
- Subjects tapped along or passively listened to isochronous woodblock sequences.
- Detection of a final tone (probe tone) is on time with the sequence or out of time.
- Probe tone was consistent or inconsistent with sequence. Inconsistent probe tones were subdivided into four IOIs.
- We hypothesized that a movement condition enhancement would be associated with differences in brain activity recorded by EEG.

- N=20
- 64-Channel EEG
- Frontocentral Cluster ROI (centered on FCz)
- Linked Mastoid reference
- Tapping responses recorded via USB drum pad



Key References

- 1. Fujioka, T., Trainor, L. J., Large, E. W., & Ross, B. (2012). Internalized timing of isochronous sounds is represented in neuromagnetic beta oscillations. *Journal of Neuroscience*, 32(5), 1791-1802.
- 2. Manning, F., & Schutz, M. (2013). "Moving to the beat" improves timing perception. *Psychonomic bulletin & review*, 20(6), 1133-1139.
- 3. Ross, J. M., Comstock, D. C., Iversen, J. R., Makeig, S., & Balasubramaniam, R. (2022). Cortical mu rhythms during action and passive music listening. *Journal of neurophysiology*, 127(1), 213-224.



Results

Behavioral

- Greater improvement in accuracy when moving to a beat.
- Participants are significantly more confident in the movement condition.
- No significant difference in reaction time between conditions

EEG Activity

- Significantly stronger entrainment at 2Hz in movement condition. Reduced 20Hz activity also observed.
- Significant correlation between 2Hz entrainment and the behavioral effect of on-time improvement
- Within the last IOI (probe tone)-locked data the movement condition elicits a larger P3 response in comparison to the no movement condition.
- Significant difference in the response-locked data where the movement condition shows a larger readiness potential.

Conclusions

- Findings suggest motor-related improvements in timing are due to stronger entrainment of auditory signals, which in turn lead to better detection thresholds and higher confidence.
- Future studies can explore the impact of musicianship and musical expertise in relation to these findings.

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