Online Paired-Pulse Transcranial Magnetic Stimulation (TMS) and Motion Perception in an Individually-Titrated Motion Discrimination Task

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Background
The capacity for transcranial magnetic stimulation (TMS) to modulate visual perception provides a well-characterized avenue for studying state dependency in the brain, defined here as the impact of ongoing brain activation during cortical stimulation[1]. TMS effects arising from stimulation of motion sensitive visual cortex, however, have led to diverse findings, in part due to variability in the strength of motion perception produced by visual stimuli, and in part from differing methods to target visual cortex[2]. The present study reflects a controlled attempt to better understand how these elements impact TMS effects.

Methods
Online TMS was applied to motion-sensitive cortex at 120% of resting motor threshold to test whether paired-pulse, long-interval cortical inhibition (LICI) stimulation impacted performance on a motion direction discrimination task as compared to sham TMS, and whether these effects are modulated by both task difficulty and targeting approaches. Participants (N=15) determined on each trial if a cluster of dots in the right periphery was moving coherently to the left or right. Difficulty was manipulated by altering dot coherence through a staircase procedure on day one. Three individualized coherence levels were selected to achieve desired performance levels of 60, 75, and 90% accuracy. On day two, participants performed the task while receiving TMS targeted to motion-sensitive visual cortex in two different ways. Target stimulation was defined either by scalp measurements (3 cm dorsal, 5 cm lateral to inion) or as the peak activation in the NeuroSynth meta-analytic database, and was applied 50 ms prior to motion onset.

Results
Analyses showed no significant active-versus-sham effect of TMS when LICI was delivered to the Neurosynth-defined target ($p=0.15$) nor at the scalp coordinates ($p=0.17$), which were separated by 58 mm on average. Additionally, there was no significant effect observed for the interaction between TMS at the Neurosynth-defined target or the 3-5 scalp measurement and task difficulty level ($p=0.12$ and $p=0.33$, respectively).

Conclusions
These findings do not support the hypothesis that LICI affects sensitivity to motion direction when applied to motion-sensitive cortex. While this type of paired-pulse TMS has led to cortical inhibition as a result of increased GABA receptor-mediated inhibition in *motor cortex*[3], applying similar TMS parameters to motion-sensitive cortex did not impact online motion perception using either targeting approach. Future studies can build upon these findings to further explore how the relative timing of stimulation and stimulus presentation influence motion perception.

References
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