Simultaneous (r)TMS and EEG reveals multiple functional roles for alpha-band oscillations

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Transcranial magnetic stimulation (TMS) offers a means to test causal hypotheses about functions supported by frequency band-specific dynamics in the EEG. One previous study, for example, has provided confirmatory evidence for an inhibitory role for alpha-band oscillations in posterior visual circuits, with repetitive (r)TMS-induced changes in alpha-band power negatively related to rTMS-related changes in visuospatial short-term memory (STM) performance. Here, we will present more recent work highlighting "task-positive" functions of alpha-band oscillations. In one study, individual differences in delay-period alpha-band power were positively related to the strength of the TMS-evoked response in prefrontal cortex, when TMS was delivered to superior parietal lobule during the delay period of a spatial STM task. Because this effect was largely attenuated during the ITI, this provides evidence that alpha-band oscillations underlie behaviorally specific patterns of effective connectivity in the dorsal control network. In a second study we used delay-period rTMS to effect a causal test of a hypothesized role for alpha-band oscillations in binding individuated object identities to specific locations. During a variant of the change-detection task – STM for the color-in-location of squares within an array – we delivered rTMS at 10Hz to the inferior IPS. Our results revealed a positive association between rTMS-related change in delay-period alpha-band power and rTMS-related change in STM capacity. They thus provide causal evidence for a role of for posterior alpha-band oscillations in supporting visual STM performance, perhaps by maintaining the bindings between stimulus dimensions in STM.