Stimulation-Based Control of Working Memory Computations

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Presentation Abstract Summary The ability to modulate brain activity using targeted neurostimulation is increasingly being employed as a means of enhancing working memory performance. While working memory is typically operationalized as increasing load, numerous computationally complex processes underlie even simple working memory operations like alphabetization. Understanding these computations is essential to understanding how and why brain stimulations protocols succeed. Furthermore, these processes rely on distributed networks performing discrete but interrelated functions. Here we use the network science concept of controllability, which refers to the ability of a single region to shift a global network into a novel brain state. We found that the controllability of the stimulation site predicted the benefit of subsequent online transcranial magnetic stimulation (TMS) during an alphabetization-based working memory task. Second, we found other cortical regions showing increases in activity with increasing computational complexity (number of sorting operations on letter array, distance between letters). Left PFC and right superior parietal cortex also showed increasing functional connectivity with increasing computational complexity, suggesting that increasing computational complexity in the behavioral domain manifests as a more distributed cortical network. Such a model-based approach helps to provide a rational basis for selecting reliable targets in TMS protocols for research and therapy.

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