Contribution ID: **31** Type: **Poster**

Modulation of Brain Resilience with Transcranial Magnetic Stimulation: a TMS-EEG Study

Tuesday 10 September 2024 18:15 (45 minutes)

Background. Resilience reflects the ability of a complex system to sustain damage while still maintaining a proficient level of functioning. At the neural level, the brain's resilience to focal lesions or diffuse pathological processes develops as a function of favorable genetic predispositions and exposure to enriched environments.

Objective/Hypothesis. We tested if targeted, personalized exposure to other forms of stimulation, i.e. noninvasive brain stimulation, could momentarily alter one's level of brain resilience, as tested through simulation of the induced effect of a random or targeted lesion on the brain connectome.

Methods. 23 subjects underwent a single-pulse transcranial magnetic stimulation (TMS) protocol during concurrent EEG recording targeting two regions belonging to two negatively correlated brain functional networks: the Dorsal Attention (DAN) and Default Mode (DMN) networks. We tested for induced changes in network topology using graph theory analysis, followed by the exploration of resilience through an in silico lesioning procedure, investigating the ability of the network to resist the progressive removal of its nodes and edges.

Results. For both networks tested, the delivery of a TMS pulse changed some resilience indexes accompanied by an immediate significant reduction in modularity. TMS targeting the DMN was also accompanied by a transient increase in clustering coefficient and local efficiency. Interestingly, all such TMS-induced changes in topology were significantly correlated with the increased resilience of the brain network in silico to the targeted removal of its edges.

Conclusion(s). Although exploratory, to our knowledge no previous studies have investigated the short-term impact of TMS pulses on one's level of brain connectivity and resilience, as tested through simulation of the induced effect of a random or targeted lesion. In particular, the observed decrease in modularity following stimulation of both the DAN and the DMN suggests an overall strengthening of connectivity across the network's nodes, resulting in a momentary increase between-modules connections with respect to those within. This appears in line with recent evidence highlighting the tendency of the induced TMS effect to spread across several different networks rather than remaining limited to the stimulated area. In line with such an increase in the processing capacities between the network's nodes, we also observed a transient increase in the resilience of the brain network to the targeted removal of its edges. Indeed, more resilient systems benefit from distributed processing, as it allows the information transfer to be more equally distributed instead of relying on a few strong connections, which would cause a significant disruption in the system's capacity if lesioned.

Primary authors: ROMANELLA, Sara M. (Precision Neuroscience and Neuromodulation Program, Gordon Center for Medical Imaging, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA & Department of Neuroscience & Padova Neuroscience Center, University of Padova, Padova, Italy); MENARDI, Arianna (Precision Neuroscience and Neuromodulation Program, Gordon Center for Medical Imaging, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA & Department of Neuroscience & Padova Neuroscience Center, University of Padova, Padova, Italy)

Co-authors: TATTI, Elisa (Department of Molecular, Cellular & Biomedical Sciences, CUNY, School of Medicine, New York, NY, US); TURRINI, Sonia (Precision Neuroscience and Neuromodulation Program, Gordon Center for

Medical Imaging, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA & Psychology Department, Alma Mater Studiorum Università di Bologna, Campus di Cesena, Cesena, Italy); OZDEMIR, Recep (Berenson-Allen Center for Noninvasive Brain Stimulation, Department of Neurology, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, USA); ROSSI, Simone (Siena Brain Investigation & Neuromodulation Lab (Si-BIN Lab), Unit of Neurology and Clinical Neurophysiology, Department of Medicine, Surgery and Neuroscience, University of Siena, Italy); PASCUAL-LEONE, Alvaro (Hinda and Arthur Marcus Institute for Aging Research and Deanna and Sidney Wolk Center for Memory Health, Hebrew SeniorLife, Boston, MA, USA); SHAFI, Mouhsin (Berenson-Allen Center for Noninvasive Brain Stimulation, Department of Neurology, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, USA); SANTARNECCHI, Emiliano (Precision Neuroscience and Neuromodulation Program, Gordon Center for Medical Imaging, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA)

Presenter: MENARDI, Arianna (Precision Neuroscience and Neuromodulation Program, Gordon Center for Medical Imaging, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA & Department of Neuroscience & Padova Neuroscience Center, University of Padova, Padova, Italy)

Session Classification: Poster Session