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TMS-induced EEG perturbation as a marker of psychological resilience to deleterious mental health effects during the COVID-19 pandemic

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Abstract

Background: Social, economic and psychological hardships associated with the COVID-19 pandemic are expected to result in a global burden on mental health outcomes. However, while some individuals suffer from increasing distress and reduced quality of life, others will show no negative effects. A better understanding of brain mechanisms subtending resilience would be helpful in informing future recommendations to individuals and societies facing the present pandemic and future similar events. Here, we compared neurophysiological brain markers between individuals who exhibited resilience or vulnerability to pandemic associated psychological stress.

Method: 23 participants from the longitudinal study cohort of the Barcelona Brain Health Initiative (Cattaneo et al., Front. Aging Neurosci. 2018;10:321) who underwent concurrent transcranial magnetic stimulation with electroencephalography (TMS-EEG), were classified as either resilient (n=16) or non-resilient (n=7), based on their scoring in the PHQ-4 questionnaire (Kroenke et al., Psychosomatics 2009;50(6):613–21) along four timepoints; one before COVID-19 outbreak and three spanning 2.5 months during the pandemic. Individuals maintaining a score below 3 across all timepoints were deemed resilient, while those scoring below 3 before pandemic but higher than 2 at any pandemic timepoint were considered non-resilient. TMS-EEG data was collected by delivering 120 single TMS pulses to the dorsolateral prefrontal cortex (DLPFC) and inferior parietal lobule (IPL). TMS evoked global mean field amplitude and local response at the stimulation site were computed.

Result: Figure 1 depicts time-series for DLPFC and IPL responses for both groups of subjects. Overall, non-resilient individuals exhibited a larger global response to TMS perturbation during DLPFC stimulation, as well as larger local current density estimates during IPL stimulation.

Conclusion: These preliminary results revealed that non-resilient individuals were more susceptible to TMS perturbation, shown by global DLPFC and local IPL reactivity. Notably, these targets are nodes of the default mode and cognitive control networks

affected by stress (van Oort et al., Neurosci. Biobehav. Rev. 2017;83:281–97), and the left frontal cortex has been proposed as a cognitive resilience hub (Franzmeier et al., J. Alzheimer's Dis. 2017;59(4):1381–92.). Future studies should investigate and confirm the possibility that these nodes constitute a shared neurophysiological substrate for psychological and cognitive resilience.

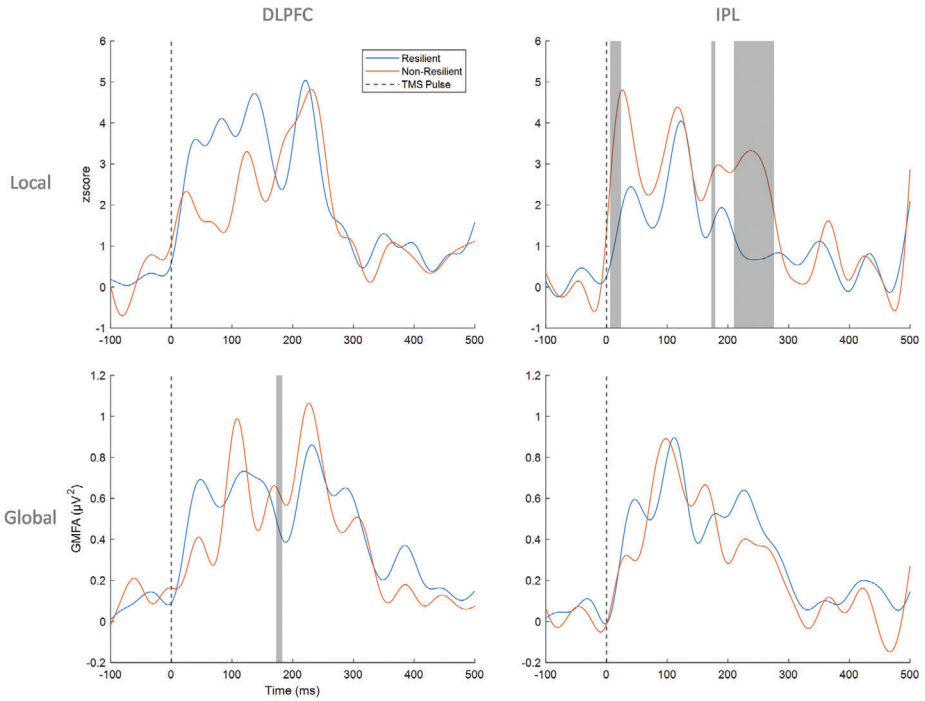

Figure 1. First row: z-transformed local current density time-series estimated from source space at the target sites of DLPFC and IPL stimulation. Second row: global mean field amplitude time-series extracted from sensor space in response to DLPFC and IPL stimulation. Grey areas highlight significantly different points between groups, revealed by non-parametric permutation testing and corrected for multiple comparisons by maximum z-value distribution thresholding.

FIGURE 1