ASSESSING THE INFLUENCE OF LOCAL NEURAL ACTIVITY ON GLOBAL CONNECTIVITY FLUCTUATIONS: APPLICATION TO HUMAN INTRACRANIAL EEG DURING A COGNITIVE TASK

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Background: Cognitive-relevant information is processed by different brain areas that cooperate to eventually produce a response. The relationship between local activity and global brain states during such processes, however, remains for the most part unexplored.

Aims: We aim to investigate how local activity and global brain states relate to each other when performing cognitive processes.

Method: We designed a simple face-recognition task performed in drug-resistant epileptic patients with intracranial EEG. Based on our observations, we developed a novel analytical framework (named “local-global” framework) to statistically correlate the brain activity in every recorded gray-matter region with the widespread connectivity functions as proxy to assess the level of influence of local neural activations into the brain’s global state during cognition.

Results: The application of our analysis to the data from two subjects was able to detect the local activity in task-relevant brain areas including the primary visual and motor cortices. Despite substantial differences in the recorded regions of each subject, the connectivity functions consistently showed a significant global desynchronization occurring a few hundred milliseconds after the stimulus onset. In this context, the local-global framework revealed that the reported desynchronization was better explained by the local activity of brain areas involved in face information processing.

Conclusions: Overall, our work provides evidence that the global measures might be a novel signature of functional brain activity reorganization taking place when a stimulus is processed in a task context.

Keywords: Intracranial EEG, Local neural activity, Spectral estimation, Global brain connectivity, Cognitive task.

Publications:

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