INTERPLAY OF LOCAL NEURAL ACTIVITY AND GLOBAL CONNECTIVITY FLUCTUATIONS IN HUMAN INTRACRANIAL ELECTROENCEPHALOGRAPHY DURING A COGNITIVE TASK

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Invasive electroencephalography (iEEG) is a standard diagnostic procedure used to localize the epileptogenic zone in drug-resistant epilepsy. During this procedure, the intracranial activity of up to 200 electrode contacts in varied neocortical and deep regions is simultaneously recorded, which provides a unique opportunity to directly measure neural activity at different spatial scales associated with a variety of cognitive functions. These functions typically involve different brain areas that cooperate to eventually produce a response. The relationship between local activity at specific areas and global brain connectivity fluctuations during such processes, however, remains for the most part unexplored. To address this question, we designed a simple face-recognition task performed in patients with drug-resistant epilepsy and monitored with iEEG. 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 fluctuations as proxy to identify concurrent local activations and global brain phenomena that may plausibly reflect a common functional network during cognition. The application of the local–global framework to data acquired from three subjects showed that similar connectivity fluctuations found across patients were mainly coupled to the local activity of brain areas involved in face information processing. In particular, our findings provide preliminary evidence that the reported global measures might be a novel signature of functional brain activity reorganization when a stimulus is processed in a task context regardless of the specific recorded areas. As part of our ongoing work, we will also discuss the application of this framework to a decision-making task where the participant is asked to make rapid perceptual choices in a situation where there is a conflict between sensory and value-based information.