Abstract View

LOCALIZED CONNECTIVITY CHANGES ALTER PAN-NETWORK ACTIVITY PATTERNS: IMPLICATIONS TO EARLY POST-TRAUMATIC EPILEPSY AND NEURODEGENERATION

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This study examines the effects of changes in a network's structure on its activity. Previously, using recurrent connectionist models, we have shown that localized changes in network connectivity are sufficient to cause fundamental changes in network dynamics and may account for early post-traumatic epilepsy. In order to test the universality of this principle, we examined whether these effects would hold in more detailed models. To this end, we used neural network models composed of up to 10,000 map-based units individually capable of exhibiting spiking behavior. Simulations in these spiking models showed that changes in network structure following localized removal of cells were sufficient to account for the initiation and propagation of hyper-excited oscillatory activity. In effect, boundary units whose activity would otherwise be dampened by their interactions with neighbors were now more likely to fire. The network level propensity for hyper-excitability showed sensitivity to both the size of the lesion as well as the spatio-temporal properties of initial activity and noise. The models suggest that changes in network structure may account for early post-traumatic epilepsy even in the absence of changes to intrinsic cellular properties. Preliminary observations indicate that connectivity changes due to diffuse cell deletion can also lead to changes in dynamics. The changes in oscillations and propagation patterns seen following the diffuse removal of cells thus highlight the importance of examining the contribution of chronic changes in network structure to brain dynamics following neurodegeneration in Alzheimer's, Parkinson's and Transmissible Spongiform Encephalopathies.
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