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Oscillations contribute to memory consolidation by changing criticality and stability in the brain JIAXING WU, Applied Physics Program, University of Michigan, QUINTON SKILLING, Biophysics Program, University of Michigan, NICOLETTE OGNJANOVSKI, SARA ATON, Department of Molecular, Cellular, Developmental Biology, University of Michigan, MICHAL ZOCHOWSKI, Biophysics Program, University of Michigan — Oscillations are a universal feature of every level of brain dynamics and have been shown to contribute to many brain functions. To investigate the fundamental mechanism underpinning oscillatory activity, the properties of heterogeneous networks are compared in situations with and without oscillations. Our results show that both network criticality and stability are changed in the presence of oscillations. Criticality describes the network state of neuronal avalanche, a cascade of bursts of action potential firing in neural network. Stability measures how stable the spike timing relationship between neuron pairs is over time. Using a detailed spiking model, we found that the branching parameter σ changes relative to oscillation and structural network properties, corresponding to transmission among different critical states. Also, analysis of functional network structures shows that the oscillation helps to stabilize neuronal representation of memory. Further, quantitatively similar results are observed in biological data recorded in vivo. In summary, we have observed that, by regulating the neuronal firing pattern, oscillations affect both criticality and stability properties of the network, and thus contribute to memory formation.

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