Persistent Increases in Beta Frequency Oscillatory Activity in the Dentate Gyrus of the Hippocampus During Object-Context Association Intervals


Previous studies have shown large increases in beta frequency (15-30Hz) power during learning in the hippocampus. These studies suggest that this rhythm may be key for coordination of activity between sensory systems and the hippocampus during early learning, as large beta bursts appear during intervals when sensory cues must be associated with a rule or reward value. While beta appears to persist in some regions of the hippocampus such as the dentate gyrus (DG), it appears to decrease over learning in other subregions of the hippocampus. The beta rhythm may be a persistent organizing principle of sensory and context (or rule) associations in DG. To test this hypothesis, we recorded in vivo single cell and local field potential activity in the DG and CA1 of the hippocampus as rats performed a context-dependent olfactory discrimination task. After successful acquisition of the task, we found large increases in beta frequency power in the DG during odor sampling intervals in which rats correctly discriminated and chose the correct odor of a pair. This beta frequency power increase was preceded by a phase reset in beta frequency range at the start of odor sampling. Lastly, single cell phase relationships to the beta rhythm in DG and CA1 were examined during specific odor sampling conditions to examine whether single cell entrainment to the beta rhythm varied across structures and according to the contexts in which odors were presented. Together, these results indicate an important role for the beta frequency rhythm in temporally coordinating activity in the dentate gyrus during object-context associations.