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Neural mechanisms of memory consolidation during sleep

The hippocampus and the amygdala are two structures required for emotional memory. The hippocampus, through place cells, is believed to encode the spatial or contextual part of the memory. During slow-wave sleep, the activity of place cells is replayed in the same order as during the preceding learning epoch. These reactivations specifically occur during local field potential (LFP) short oscillatory events associated with highly synchronous neuronal activity called “ripples”. Our early work shows that the specific suppression of ripples during sleep impairs performance on a spatial task, underlying their crucial role in memory consolidation. On the other hand, the amygdala processes the emotional valence of an event. How do the amygdala and the hippocampus interact to consolidate an emotional event? Are hippocampal ripples involved in the association between a specific context and an aversive event? Using large scale simultaneous neuronal ensemble recordings in the hippocampus and amygdala, we found ripple-related coordinated reactivations between the two structures during sleep following training on an aversive spatial task. Hippocampal ripples during sleep thus emerge as a crucial time windows for intra-hippocampus and cross-structure reactivations sustaining the consolidation of spatial and emotional memories.