

Poster: 24

**Neuromodulation of hippocampal synaptic plasticity in waking and REM sleep**  
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Gina R. Poe

University of Michigan

Victoria Booth

University of Michigan

Experimental observations indicate that REM sleep may uniquely facilitate depotentiation of intra-hippocampal synapses which are associated with familiar, cortically-consolidated memories to allow for learning of new information and the integration of novel information with old memories.

In a simulation study, the PIs investigated neural mechanisms underlying the observed experience-dependent theta trough firing during REM sleep. The biophysically accurate neuron model incorporates the differential in the phase of the theta rhythm drive at the two excitatory afferent pathways that target CA1 pyramidal neurons and tests cell responses to inputs at these two paths. The simulation results support the hypothesis that the observed gradual shift to theta trough firing would result from a growing potentiation of synapses in the direct, temporo-ammonic (TA-CA1) pathway while initially-potentiated Schaffer collateral (SC-CA1) synapses are depotentiated.

Current experiments seek to test the role of the two uniquely REM-suppressed neurotransmitters norepinephrine (NE) and serotonin (5-HT) in the processes of theta phase reversal, potentiation of TA-CA1 inputs, depotentiation of SC-CA1 synapses and hippocampus-dependent learning and memory. Specifically, we are investigating the hypothesis that the absence of NE and 5-HT during REM reactivation provides an environment wherein TA-CA1 synapses may be strengthened and SC-CA1 synapses may be weakened, thus indicating a unique role for REM sleep in learning and memory. Results may lead to sleep-specific treatments for learning disabled persons and the elderly.

## **Publications**

1. Booth V and Poe GR. Input source and strength influences overall firing phase of model hippocampal CA1 pyramidal cells during theta: Relevance to REM sleep reactivation and memory consolidation. *Hippocampus* **16**(2):161-173, 2006.