Exploring the Mechanism of “Forgetting” with Electrophysiology

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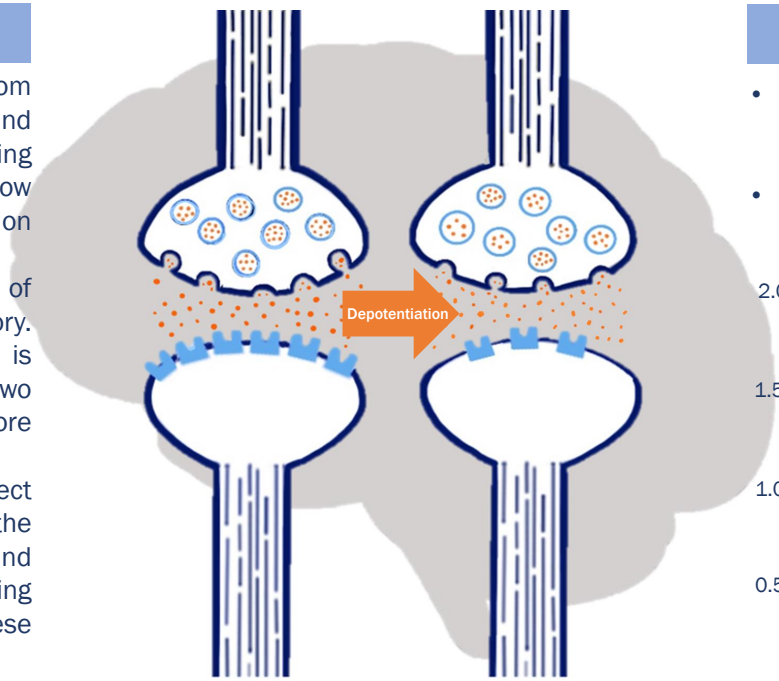
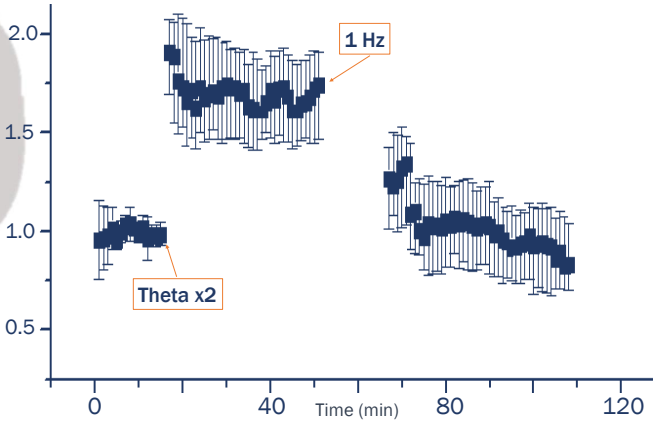
Background

- An estimated six million Americans suffer from neurological disorders such as Alzheimer's and Dementia (Alzheimer's Association, 2021). Studying the brain in the context of synaptic plasticity, or how the brain changes and adapts, can shed new light on the effects of aging and these forgetting disorders.
- Long-term potentiation is the strengthening of synapses and is correlated with learning and memory. Depotentiation is the weakening of synapses and is correlated with “forgetting." Understanding these two opposing processes may be helpful in learning more about the inner workings of the brain.
- There are several factors that may affect depotentiation, including the age of the brain, the types of neuronal membrane receptors involved, and the duration of LTP prior to depotentiation. Using electrophysiology, we are investigating the role these factors play in "forgetting.”

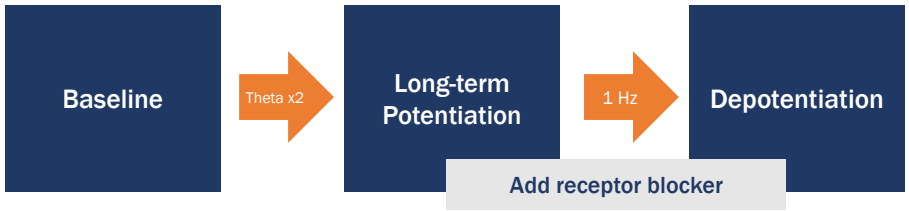


Results

- The graph below compares averaged slope values representing the synaptic activity of our baseline, LTP, and DP.
- While our LTP slopes are far above our baseline, the averaged DP slopes trend lower than baseline.



Methods



- Electrophysiology: For each experiment, brain slices from mice of varying ages were stimulated with electrodes. We recorded the voltage changes in hippocampal synapses. After measuring a 15-minute baseline of synaptic activity, a high frequency stimulus (Theta x2) was used to induce Long-term Potentiation. After short or long durations of long-term potentiation, a low frequency stimulus (1 Hz) was applied to induce depotentiation.
- Neuropharmacology: To investigate the role of membrane receptors in depotentiation we added antagonists in vitro for either mGLUR or NMDA receptors.

Discussion

- Preliminary control data with young brains and short-duration long-term potentiation suggests that a 1 Hz low frequency stimulus induces depotentiation at a 40% success rate.
- Preliminary experiments have also shown that when an mGluR antagonist is present, we do not observe depotentiation, indicating that mGluR plays a crucial role in the "forgetting" mechanism.
- Further research will lend new insights into the weakening of synapses. This will shape future understanding of the effects of aging, Alzheimer's, and Dementia.

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