Neural Correlations of Sleep Behavior and Olfactory Learning in Apis mellifera

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Animals can engage in lifelong learning because they can form, consolidate, and recall memories. Because sleep plays a vital role in consolidating newly acquired information and aiding recall, studying learning requires an understanding of sleep. Analyzing changes in neuronal activity patterns can provide insights into active learning and memory formation. Ultimately, this research aims to identify neural patterns that signify learning success. In this project, 24-hour extracellular neural recordings are conducted on honey bees subjected to olfactory learning tasks and placed under various sleep conditions. This phase aims to characterize the neurological activity of bees with intact sleep. By establishing this baseline, we can compare future disturbed-sleep results and attribute changes in learning to sleep quality. My focus is on spike sorting raw neural data to cluster neural spikes with similar waveform characteristics into putative neuron groups. This allows us to distinguish responsive from non-responsive neural signals, enhancing downstream analysis accuracy. The processed data delineates intact sleep events as drops in antennal movement coinciding with reductions in neural activity, with few neuron units remaining active even during sleep. To evaluate the best approach, both single and multichannel tetrode recordings were performed and compared. The results show that our current methodology is viable and single-channel recordings are preferred for simpler sorting and interpretation. In the future, these efforts may assist software engineers in developing artificial neural networks to replicate biological memory consolidation and address catastrophic forgetfulness – a significant challenge in machine learning.

Awards Won: