Cellular, Synaptic and Network Scale Plasticity Underlying Learning and Memory

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The mammalian brain evolved through natural selection and exhibits plasticity at multiple scales through diverse mechanisms. These natural neural networks encode memories of events across multiple regions depending on the time elapsed since the event. Such an organisation of information spanning multiple regions is thought to imbibe several unique characteristics to retrieval of these memories. Understanding and emulating some of these features using artificial neural networks (ANN's) resulted in the Complimentary Memory System model. However, such a model still falls short when it comes to understanding generalisation (the act of abstracting commonalities across multiple related memories). Core to understanding such an abstraction is being able to identify, characterize and follow molecular, neuronal and network level changes as the animal acquires and consolidates these memories. Students who participate in this project would pursue research to identify and elucidate these mechanisms utilising a multitude of optical, electrophysiological, behavioral, and computational approaches (including ANN's). Specifically, we will be investigating the relationship between the changes in local field potentials as the animals acquire memory following behavioral training across different brain regions. We will be developing novel optical and electrophysiological tools that utilise ANN's to collect, analyse and model the experimental data.