Public Abstract

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Title:PLASTICITY IN LATERAL AMYGDALA AFTER PAVLOVIAN FEAR CONDITIONING
" A Computational Study

One of the main contributions of the dissertation is an explanation of how and why certain neurons are recruited into a memory trace. For this, we developed a biophysical model of the rodent lateral amygdala (LA) and then examined how particular LA neurons are assigned to the fear memory trace, i.e., how fear memory is formed in a rodent brain, after Pavlovian fear conditioning. The model revealed that neurons with high intrinsic excitability are more likely to be integrated into the memory trace but that competitive synaptic interactions also play a critical role. We also examined the relative contributions of plasticity in auditory afferent (thalamic, cortical) neurons vs. within LA. This revealed that plasticity in afferent pathways to LA is required for fear memory formation, but that once formed, the plasticity in afferent pathways was not needed. The model then provided insights into how ‘competition’ was implemented at the single cell level, including the role of excitatory connections among neurons, of disynaptic inhibition, and of neuromodulation. These principles should also apply to other forms of memory in brains. We then investigated another related concept of specificity of memory, i.e., how can memory of one music prevented from interfering with that of another. Analysis showed that formation of memory involves plasticity in the connections within LAd and this plasticity also ensures specificity for that memory.
Neuronal network models presently use simplified single cells models with either one or two compartments. This is largely due to the fact that computational overhead become prohibitive with more detailed models. We report a procedure to develop a reduced order model matching passive properties, current injection traces, and preserving some synaptic integration features. Comparisons are made at both single cell and with a 100-cell network model. Analysis showed that a model with three compartments provides a good compromise between biological realism and ease of computation.