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MODELS OF LEARNING WITHOUT DETECTABLE SYNAPTIC PLASTICITY IN THE LEECH. S.R. Lockery and T.J. Sejnowski. Salk Institute, La Jolla, CA 92037.

Studies of neural mechanisms of learning have focussed on large changes at identified synapses. However, learning in even simple reflexes may be distributed over many synapses. We used a model network of the local bending reflex in the leech to investigate the distribution of synaptic plasticity underlying habituation in a parallel processing system. The model comprised 4 sensory, 20 inter-, and 8 motor neurons. Synaptic connections were trained by the recurrent backpropagation algorithm until the model reproduced the amplitude and timecourse of synaptic potentials recorded intracellularly from motor neurons in response to sensory cell stimulation in non-habituated preparations. This "naive" network was then "habituated" by retraining it until the amplitude of each synaptic potential was 40% of the non-habituated level. The training algorithm was allowed either to increase or decrease the strength of a connection. Final connection strengths in the model network were inferred from the heights of simulated synaptic potentials when the presynaptic neuron was stimulated with a standard current pulse. Comparison of connection strengths in naive and habituated networks revealed that habituation was distributed across all connections in the model, with the largest changes in the connections between sensory and interneurons. However, even these changes were small--on average, less than 1 mV. This result raises the possibility that substantial changes in behavior can occur in the absence of easily detectable changes in synaptic strength.