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Computational modeling of heterosynaptic plasticity in the hippocampus

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Hippocampal long-term potentiation (LTP) and long-term depression (LTD) are central synaptic mechanisms of learning and memory. Here we use compartmental models of hippocampal granule cells to better understand LTP and heterosynaptic LTD which have been reported in the dentate gyrus of awake rats [1]. Our simulations indicate that LTP and heterosynaptic LTD can be explained by a spike-timing-dependent plasticity (STDP) rule combined with a fast Bienenstock-Cooper-Munro (BCM)-like metaplasticity rule [2-5]. We study the interaction between these plasticity rules and ongoing pre- and postsynaptic activity. Our models are able to account for the experimentally observed degree of LTP and heterosynaptic LTD induced by various plasticity-inducing protocols.

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References

1. Bowden JB, Abraham WC, Harris KM: **Differential effects of strain, circadian cycle, and stimulation pattern on LTP and concurrent LTD in the dentate gyrus of freely moving rats.** *Hippocampus* 2012, **22(6)**:1363-1370.
2. Abraham WC: **Metaplasticity: tuning synapses and networks for plasticity.** *Nat Rev Neurosci* 2008, **9(5)**:387.
3. Benuskova L, Abraham WC: **STDP rule endowed with the BCM sliding threshold accounts for hippocampal heterosynaptic plasticity.** *J Comp Neurosci* 2007, **22(2)**:129-133.
4. Abraham WC, Logan B, Wolff A, Benuskova L: **"Heterosynaptic" LTD in the dentate gyrus of anesthetized rat requires homosynaptic activity.** *J Neurophysiol* 2007, **98(2)**:1048-1051.
5. Benuskova L, Jedlicka P: **Computational modeling of long-term depression of synaptic weights: insights from STDP, metaplasticity and spontaneous activity.** *Neural Network World* 2012, **22(2)**:161-180.

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