



Minischool and Workshop on Multiple Time Scale in the  
Dynamics of the Nervous System  
16 to 29 June 2008, ICTP, Trieste, Italy

**NOTES FOR TALK ON**

**"LEARNING RULES IN THE HIPPOCAMPUS AND CEREBELLUM"**

**by Prof. Samuel WANG**

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**Timing and contributions of pre-synaptic and post-synaptic parameter changes  
during unitary plasticity events at CA3-CA1 synapses.**

**O'Connor DH, Wittenberg GM, Wang SS.**

Synapse. 2007 Aug;61(8):664-78.

At individual synapses, post-synaptic responses include a mixture of "successes" and "failures" in which transmitter is released or not released, respectively. Previously we measured synaptic strength at CA3-CA1 synapses averaged over all trials, including both successes and failures, using an induction protocol that allowed us to observe potentiation and depression events as step-like changes. Here we report quantal properties of 15 of the earlier experiments, including 14 potentiation events and eight depression events. In five experiments both potentiation events and depression events were evoked at the same synapse. During potentiation, success rate increased from  $0.56 \pm 0.14$  (mean  $\pm$  SD) to  $0.69 \pm 0.12$ , and during depression, success rate decreased from  $0.70 \pm 0.09$  to  $0.51 \pm 0.10$ . During potentiation potency increased from  $10 \pm 5$  to  $19 \pm 9$  pA, and during depression, potency decreased from  $18 \pm 12$  to  $12 \pm 7$  pA. On average, changes in potency accounted for 76% of the change in response size in potentiation events and 60% of the change in depression events. A reduced-assumption spectral analysis method showed evidence for multiple quantal peaks in distributions of post-synaptic current amplitudes. Consistent with the observed changes in potency, estimated quantal size (Q) increased with potentiation and decreased with depression. A change in potency, which is thought to reflect post-synaptic expression mechanisms, was followed within seconds to minutes by a change in success rate, which is thought to reflect pre-synaptic expression mechanisms. Synaptic plasticity events may therefore consist of changes that occur on both sides of a synapse in a temporally coordinated fashion.