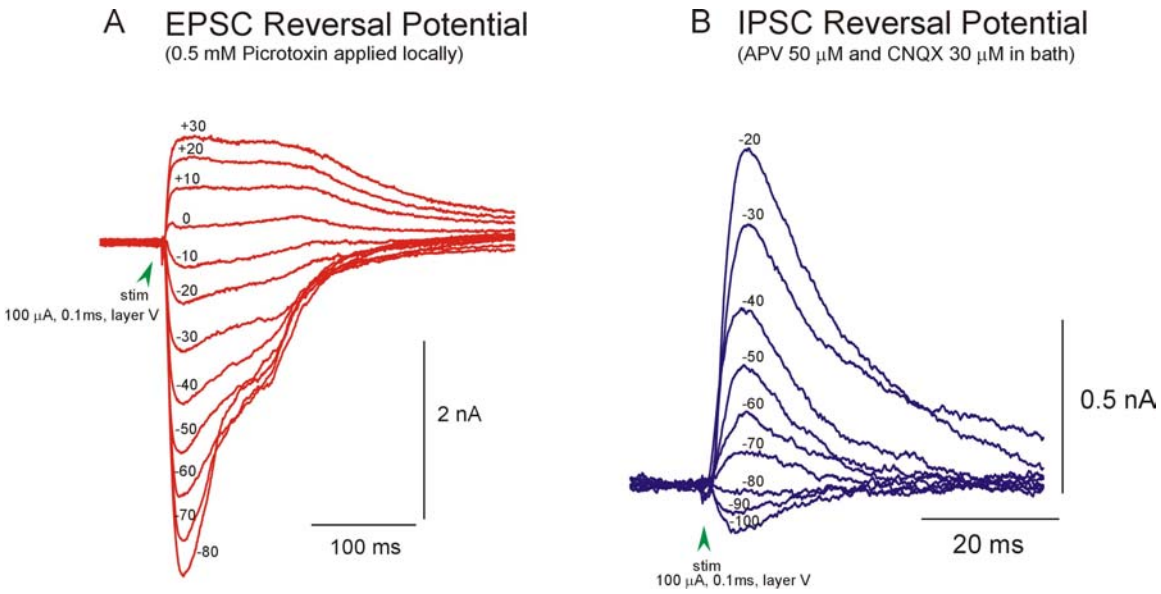
Supplementary Material:

Shu, Y.S., Hasenstaub, A., and McCormick, D.A. (2003) Turning on and off recurrent balanced cortical activity. Nature.

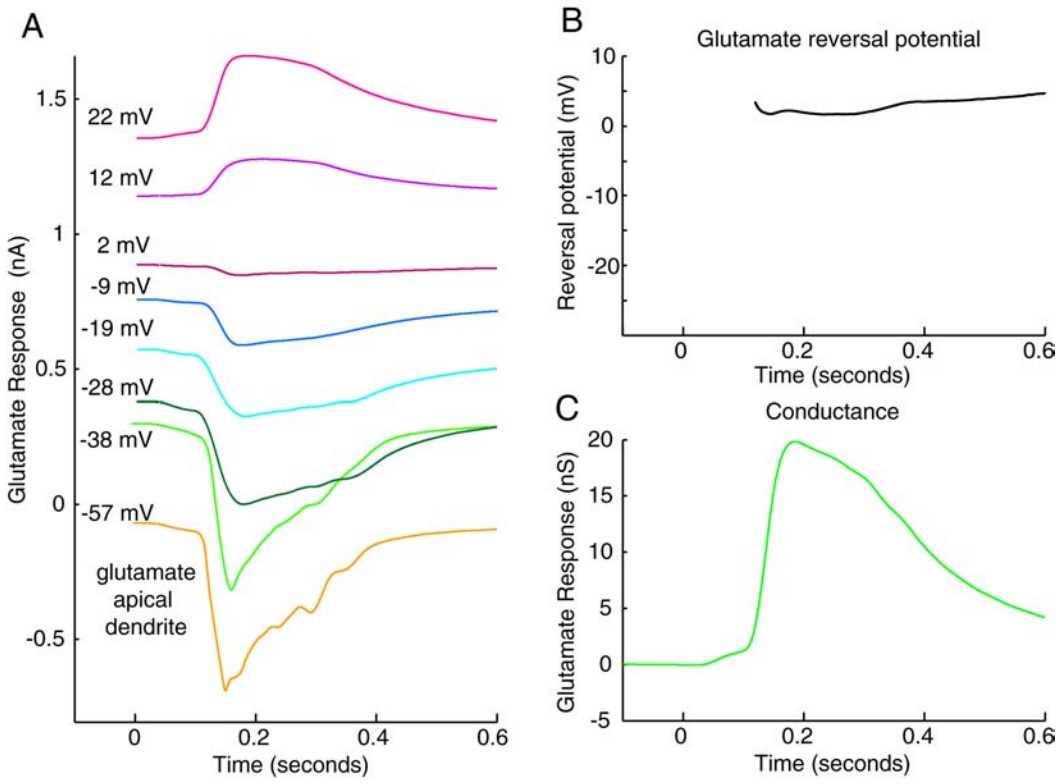
Movies

Movies of simultaneous extracellular multiple unit and intracellular recordings of periodic persistent (UP and DOWN) activities in the prefrontal cortex in vitro. In each recording the top trace is the extracellular multiple unit activity, while an intracellular recording from a nearby layer V pyramidal cell is shown below. The recording of postsynaptic potentials (PSPs) was obtained by hyperpolarizing the cell with the intracellular injection of current.

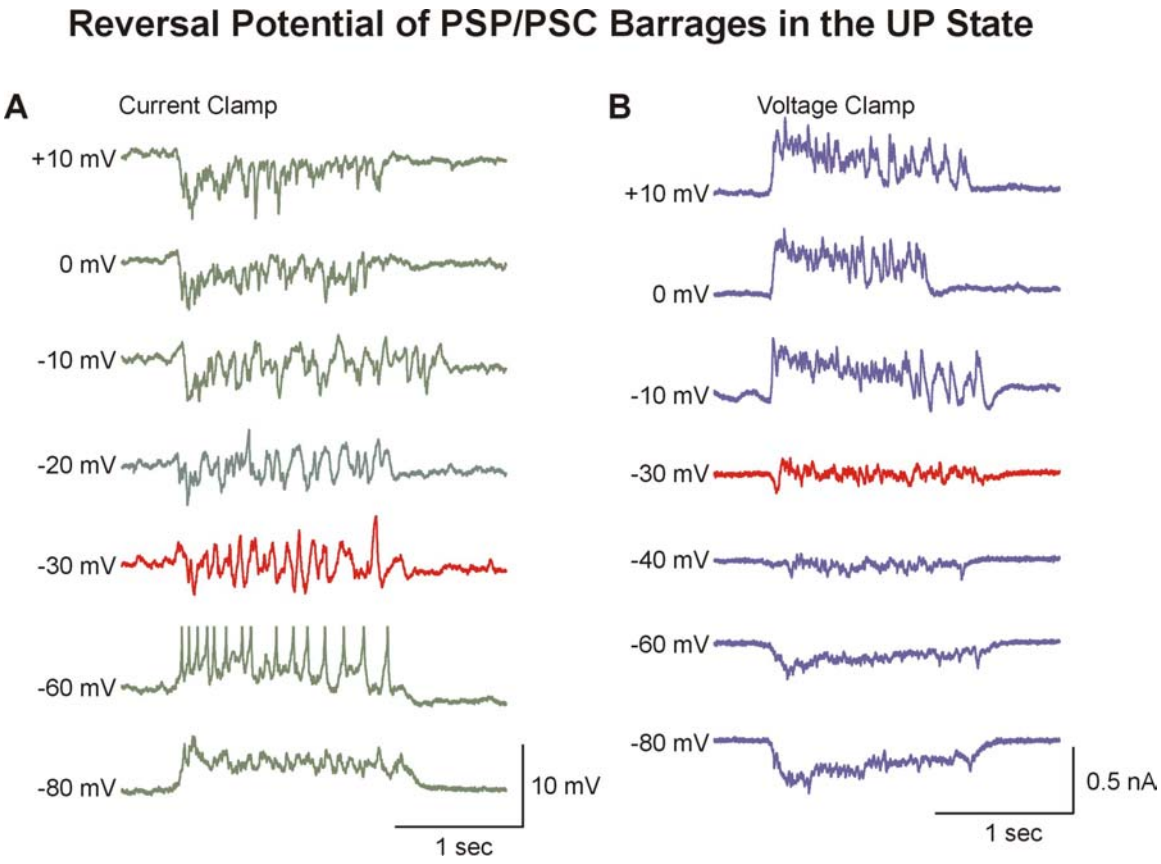
Figures



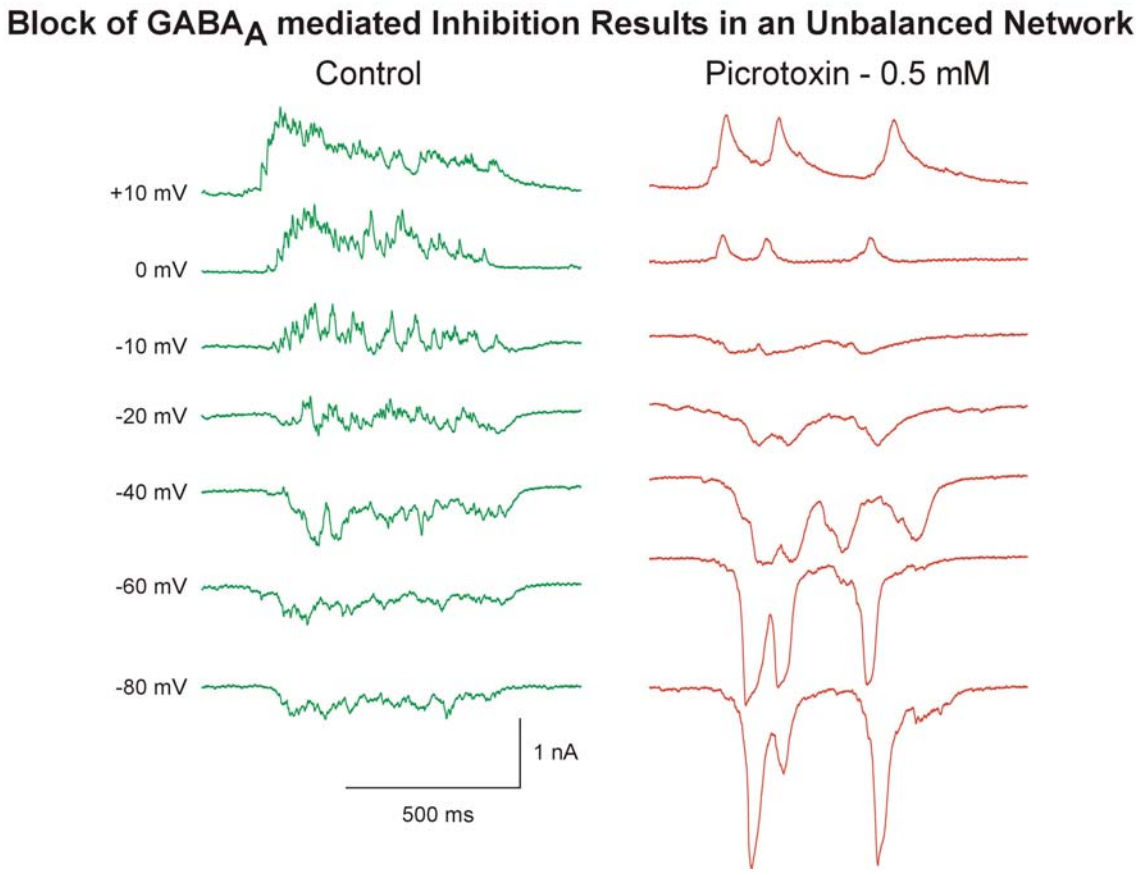
Supplementary Figure 1. Reversal potential of evoked excitatory and inhibitory compound postsynaptic currents in a layer V pyramidal cell illustrating the quality of the voltage clamp technique used. A. Excitatory postsynaptic currents evoked with local electrical stimulation following the block of $GABA_A$ receptor mediated IPSPs with the local application of picrotoxin (0.5 mM in micropipette). Note that the remaining excitatory postsynaptic currents reverse at around –5 mV at all time points, even though there are large changes in current amplitude (i.e. large changes in membrane conductance). These EPSCs are generated by strong recurrent activity in the cortical network. B. Reversal potential of $GABA_A$ mediated inhibitory postsynaptic currents evoked by local electrical stimulation following the block of glutamatergic EPSPs with bath application of 50 μM dl-APV and 30 μM CNQX. Microelectrode contained 2 M CsAc and 50 mM QX-314.



Supplementary Figure 2. Ionic currents and calculated reversal potential and conductance for a response to the application of glutamate in the distal dendrites (layer 2/3) of a layer V pyramidal neuron. A. Ionic currents recorded at different membrane potentials in response to local application of glutamate (1 mM in micropipette). Picodrop application was used to keep the sphere of influence of glutamate limited to < approximately 20-30 μm; movement of the drug application pipette more superficially within the tissue would abolish this response). Baseline holding current is not subtracted in these traces. B. Calculation of the reversal potential during the glutamate response. C. Calculation of the change in conductance during the glutamate response according to the change in slope of the current-voltage plot formed by the values in A for each time point. Note that despite large changes in membrane conductance, which are larger than those associated with the UP state, the reversal potential of the distal glutamate response stays within a 2-3 mV. Applications of glutamate to basal (layer 5) or apical (layers 2/3 or 4) dendritic fields yielded similar results. Microelectrode contained 2 M CsAc and 50 mM QX-314. The bath contained 50 μM APV and 100 μM picrotoxin to block NMDA and $GABA_A$ receptors.



Supplementary Figure 3. Illustration of the reversal potential of PSPs barrages recorded in current clamp with 2 M KAcetate filled microelectrodes versus those recorded with single electrode voltage clamp with electrodes containing 2 M CsAc and 50 mM QX-314 to reduce K^+ and Na^+ currents respectively. Note that in both cases (different cells in different slices), the postsynaptic potential activity reverses at around –20 to –30 mV throughout the UP state.



Supplementary Figure 4. Comparison of postsynaptic currents in a balanced and unbalanced network. A. Postsynaptic currents at different membrane potentials in this layer V pyramidal cell during normal periods of persistent activity. B. Following the block of $GABA_A$ receptors with the local application of picrotoxin (0.5 mM in micropipette), the network starts generating uncontrolled regenerative events (paroxysmal discharges) that reverse at around –5 mV. Microelectrode contained 2 M CsAc and 50 mM QX-314.