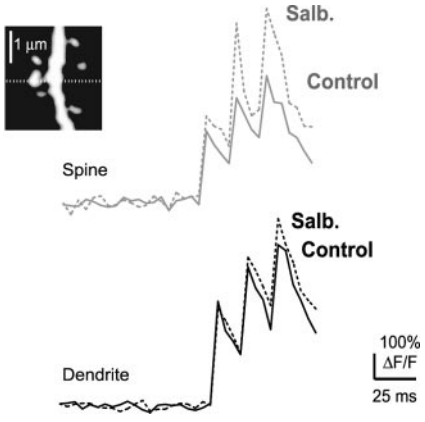
This Week in The Journal

● Cellular/Molecular

L Channels in Dendritic Spines

Tycho M. Hoogland and Peter Saggau
(see pages 8416 – 8427)

Calcium entry into the dendritic spines of excitatory neurons is important for many forms of synaptic plasticity. In this issue, Hoogland and Saggau continue efforts to inventory the calcium channels that function in dendritic spines. They evoked back-propagating action potentials at the soma of CA1 neurons in rat hippocampal slices and recorded calcium transients in basal dendrites and spines using calcium imaging. Voltage-dependent calcium transients in spines were driven primarily by R-type, and perhaps T-type, channels, whereas L-type channels provided a seemingly small contribution under normal conditions. When β_2 adrenergic receptors (β_2-ARs) were activated, however, the L-type channel contribution increased dramatically. This local modulation acted through protein kinase A, as described previously in other cells. The authors propose that under basal conditions, L-type channels act in so-called mode 1 with short openings, but with β_2-AR activation, they move into mode 2 with long open times and a high open probability.



Activation of β_2-ARs by salbutamol (Salb.) results in preferential enhancement of spine Ca^{2+} transients. The image shows the spine and parent dendrites from which Ca^{2+} transients were obtained. The dashed line indicates the position of the line scan. See the article by Hoogland and Saggau for details.

▲ Development/Plasticity/Repair

Repulsion and Attraction with Sema3D

Marc A. Wolman, Yan Liu, Hiroshi Tawarayama, Wataru Shoji, and Mary C. Halloran
(see pages 8428 – 8435)

Axon guidance relies on a complex set of attractive and repulsive forces, including the semaphorin family of guidance molecules as central actors. For example, semaphorin3D (Sema3D) can either repel or guide axons depending on circumstances. This week, Wolman et al. look at axonal guidance affected by Sema3D during embryonic zebrafish development. Using morpholino antisense technology, in which oligos block translation of a selected mRNA, they reduced expression of Sema3D and its neuropilin (Npn)-binding partners, Npn-1A and Npn-2B. Not surprisingly, Sema3D had distinct actions in different pathways. It repelled axons of the nucleus of the medial longitudinal fasciculus (nucMLF), whereas formation of the anterior commissure (AC) depended on Sema3D attraction of telencephalic neurons. Partial knockdown experiments revealed interactions between Sema3D and Npn-1A and Npn-2B, suggesting that these neuropilins may heterodimerize. The push–pull cues from Sema3D appear to depend on expression of different neuropilins: Npn-1A alone in nucMLF and both Npn-1A and Npn-2B in the AC.

■ Behavioral/Systems/Cognitive

Septal GABAergic Neurons and Hippocampal Theta

Zsolt Borhegyi, Viktor Varga, Nóra Szilágyi, Dániel Fabo, and Tamás F. Freund
(see pages 8470 – 8479)

Synchronous theta oscillations are one of the patterns of hippocampal activity thought to contribute to memory formation. The cholinergic and GABAergic neurons of the medial septum help drive these rhythms through reciprocal synaptic interactions with the hippocampus. This week, Borhegyi et al. further characterize parvalbumin (PV)-immunoreactive GABAergic neurons that specifically innervate interneurons in the hippocampus. They coupled *in vivo* hippocampal EEG measurements with single-unit recordings and single-cell labeling. Two distinct groups of PV cells emerged: one that fired bursts at the peak of theta waves and one that fired at the troughs. Cell labeling revealed local collateral projections and symmetrical synapses among septal neurons that likely contribute to synchrony. The authors speculate that septal GABAergic neurons are wired to produce rhythmic hippocampal disinhibition in perisomatic and dendritic inhibitory interneurons at two phases of the theta rhythm.

♦ Neurobiology of Disease

A Shift in Tonic Inhibition with Chronic Seizures

Zechun Peng, Christine S. Huang, Brandon M. Stell, Istvan Mody, and Carolyn R. Houser
(see pages 8629 – 8639)

In this week's *Journal*, we are reminded that the often-neglected receptors in extrasynaptic locations can be important. The test case here is the δ subunit of the $GABA_A$ receptor that is expressed in nonsynaptic sites. These subunits, with their high affinity for transmitter and slow desensitization, are poised to scavenge errant neurotransmitter molecules and thereby provide a tonic form of network inhibition. $GABA_A$ receptors containing δ subunits also are more prone to neurosteroid modulation. Peng et al. explore $GABA_A$ subunit expression in the dentate gyrus in an epilepsy model. They induced status epilepticus in mice with pilocarpine, leading to a condition of chronic spontaneous seizures. In the days after treatment, the characteristic diffuse protein expression of the δ subunit declined. Thus granule cells were resistant to the inhibitory effects of tetrahydrodeoxy-corticosterone, an endogenous neurosteroid. Meanwhile, δ expression in inhibitory interneurons increased. These alterations add up to increased excitability in the network and may contribute to seizure generation.