This Week in The Journal

● Cellular/Molecular

Blocking One Channel Can Increase Conductance of Another

Joseph L. Ransdell, Satish S. Nair, and David J. Schulz

(see pages 9649–9658)

Activity in neural circuits depends not only on synaptic connections, but also on the intrinsic electrical properties of individual neurons. Characteristics such as excitability, spike shape, and firing mode are determined by the type, density, and localization of ion channels each neuron expresses. Changes in the relative levels of different channels can alter a neuron's electrical properties and thus its behavior in the circuit. Coregulating the expression and conductance of various channels, therefore, can help stabilize activity. Such coregulation occurs in crabs: although levels of mRNAs encoding various channels in identified cardiac neurons vary across animals, the ratio of one to another is maintained. Ransdell et al. report that compensatory changes in two large, transient K^+ conductances, I_A and I_{KCa}, can also occur posttranslationally. Pharmacologically blocking either channel induced a rapid increase in the other conductance, resulting in a return to baseline excitability and bursting, both of individual neurons and of the network.

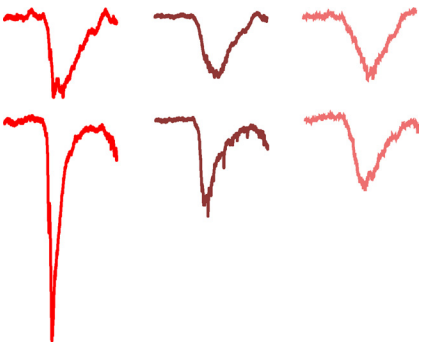
▲ Development/Plasticity/Repair

Whisker Stimulation Potentiates Cortical Responses In Vivo

Shuming An, Jenq-Wei Yang, Haiyan Sun, Werner Kilb, and Heiko J. Luhmann

(see pages 9511–9516)

Many developing circuits are shaped by long-term potentiation (LTP). In rodent thalamocortical slices, pairing afferent stimulation with depolarization of layer IV barrel cortex neurons induces LTP, but only if slices are taken at postnatal days 3 (P3)–P7, when the barrel map is forming.



Field potential responses recorded in the activated barrel (left), in the surrounding septum (middle), and in an adjacent barrel before (top) and after (bottom) whisker stimulation. See the article by An et al. for details.

This suggests that LTP contributes to activity-dependent barrel refinement. An et al. bolster this hypothesis by showing that whisker stimulation potentiates cortical responses in young mice *in vivo*. Stimulating a single whisker increased the slope of the field potential recorded in its associated barrel and, to a lesser extent, the surrounding septa. No potentiation was detected in adjacent barrels. Potentiation could be induced in cortical layers II/III and IV at P3–P5, but not after P7. At P0–P1, before barrels had formed, whisker stimulation induced potentiation in the cortical plate and deep cortical layers. Thus, activity-dependent LTP occurred in the whisker pathway throughout the period of barrel formation *in vivo*.

■ Behavioral/Systems/Cognitive

mGluRs Trigger Cannabinoid Production under Stress

Laura C. Gregg, Kwang-Mook Jung, Jessica M. Spradley, Rita Nyilas, Richard L. Suplita II, et al.

(see pages 9457–9468)

In stressful situations, animals become less sensitive to pain, which likely helps them to face impending threats when injured. A crucial brain area for stress-induced analgesia (SIA) is the periaqueductal gray (PAG), which receives inputs from cortical and limbic structures and influences nociceptive transmission in the dorsal horn of the spinal cord. The analgesic effects of both opioids and cannabinoids are mediated partly by relieving inhibition of PAG projection neurons. Gregg et al. have further explored the neurochemical underpinnings of SIA, finding that the antinociceptive effects of repetitive foot shock in mice required activation of type-5 metabotropic glutamate receptors ($mGluR_5$) and downstream activation of diacylglycerol lipase-α (DGL-α) in the PAG. DGL-α, which colocalized with $mGluR_5$ in PAG dendrites, cleaves diacylglycerol to form an endocannabinoid, 2-arachidonoyl-*sn*-glycerol (2-AG). The latter most likely diffuses retrogradely to act on CB_1 cannabinoid receptors, which were expressed on presynaptic terminals.

◆ Neurobiology of Disease

IgG Complex Depolarizes Sensory Neurons by Activating TRPC3

Lintao Qu, Yumei Li, Xinghua Pan, Pu Zhang, Robert H. LaMotte, et al.

(see pages 9554–9562)

IgG binds to specific antigens, forming an immune complex (IC) that is recognized by Fcγ receptors (FcγRs) on various immune cells. Binding of IgG-ICs to FcγRI leads to activation of tyrosine kinases, elevation of intracellular calcium, and release of inflammatory mediators. Sensory neurons of the rat dorsal root ganglion (DRG) also express FcγRI, and IgG-IC treatment increases calcium levels in these neurons, leading to neurotransmitter release. Such activation might contribute both to allergic itch and to pain associated with autoimmune disorders. Qu et al. show that IgG-IC activates an inward cation current that is carried primarily by Na^+, but depends on intracellular Ca^{2+}. This current was mediated mainly by type-3 transient receptor potential canonical (TRPC3) channels. FcγRI-mediated activation of TRPC3 current required many of the same signaling molecules that underlie FcγRI signaling in immune cells, including Syk tyrosine kinase, phospholipase C, and IP_3 receptors, which release calcium from internal stores.