This Week in The Journal

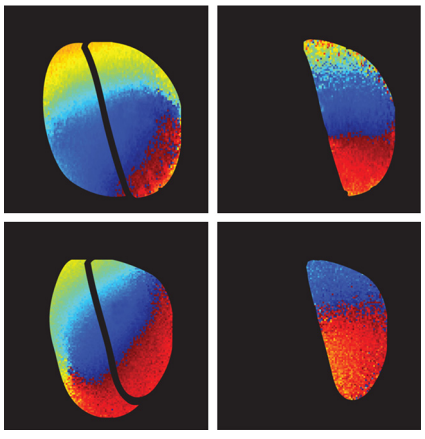
Development/Plasticity/Repair

STAT1 Regulates Ocular Dominance Plasticity

Ikue Nagakura, Audra Van Wart, Jeremy Petravicz, Daniela Tropea, and Mriganka Sur

(see pages 10256–10263)

Monocular deprivation (MD) experiments have proven invaluable for investigating the cellular and molecular underpinnings of experience-dependent plasticity. MD during the critical period first reduces V1 responsiveness to inputs from the deprived eye (after 3–4 d MD in mice), then increases responses to the non-deprived eye (after 5–7 d). The first phase is thought to depend on a Hebbian process involving NMDA receptors and internalization of AMPA receptors (AMPARs), whereas the second phase is thought to be a homeostatic process involving tumor necrosis factor α (TNFα). Nagakura et al. now provide evidence that insertion of AMPARs contributes to the homeostatic phase of ocular dominant plasticity. Additionally, they show that the transcription factor STAT1, which inhibits TNFα-mediated signaling, influences the timing of this phase. Knocking out STAT1 caused V1 responses to the non-deprived eye to increase after only 4 d MD. This was accompanied by a higher surface expression of AMPARs and a greater amplitude and frequency of EPSCs compared to wild-type mice exposed to 4 d MD.



Retinotopic maps recorded optically in mouse V1 in response to stimulation of the contralateral (left) and ipsilateral (right) eyes of wild-type (top) and STAT1-null (bottom) mice. See the article by Nagakura et al. for details.

Systems/Circuits

Training Alters Odor Representations in Piriform Cortex

Amin MD. Shakhawat, Carolyn W. Harley, and Qi Yuan

(see pages 10206–10210)

Ensembles of neurons in association cortex are thought to represent perceived objects. For example, ensembles in the anterior piriform cortex are thought to represent odor "objects." To examine the representation of different odors and whether these representations change with experience, Shakhawat et al. used the catFISH technique, which allows researchers to determine which neurons were activated by each of two stimuli by examining the distribution of the immediate early gene *Arc* within the neurons. Sequential presentation of the same odor activated partially overlapping (~25%) neuronal ensembles, and the overlap increased after rats learned to associate the odor with reward, suggesting learning sharpened the representation. Presentation of two different odors also activated partially overlapping (~18%) ensembles, and associating a mixture of the odors with reward increased the overlap to ~24%, suggesting representations of the two odors merged. Finally, training rats to distinguish between two closely related odors reduced the overlap in their representations, suggesting that discrimination training causes odor representations to diverge.

Behavioral/Cognitive

Methylation of Glucocorticoid Receptor Gene Affects Memory

Vanja Vukojevic, Iris-T. Kolassa, Matthias Fastenrath, Leo Gschwind, Klara Spalek, et al.

(see pages 10274–10284)

Emotionally arousing events are long remembered partly because glucocorticoids released during the events enhance memory formation. Although enhanced memory is generally considered a good thing, it can be problematic: intrusive memories of traumatic events are a hallmark of posttraumatic stress disorder (PTSD), for example. One factor underlying individual differences in PTSD susceptibility is the sensitivity and expression level of glucocorticoid receptors in the brain. Vukojevic et al. report that methylation of a site in the promoter of the glucocorticoid receptor gene *NR3C1* reduced receptor levels and was associated with a reduced severity of intrusive memories and a lower risk of PTSD in male survivors of the Rwandan genocide. Methylation differences likely preceded the traumatic events because a similar pattern of *NR3C1* methylation was found across Europeans who had not experienced trauma. Moreover, *NR3C1* methylation levels were inversely correlated with picture recognition memory in the European men. Interestingly, *NR3C1* methylation was not correlated with either PTSD risk or memory in women.

Neurobiology of Disease

BNST Contributes to CO_2-Induced Fear

Rebecca J. Taugher, Yuan Lu, Yimo Wang, Collin J. Kreple, Ali Ghobbeh, et al.

(see pages 10247–10255)

Inhaling CO_2 typically causes fear and sometimes panic. Several studies have suggested that amygdala neurons expressing acid-sensing ion channels (ASICs) are activated by the acidosis that accompanies hypercapnia and that these neurons drive fear responses. But a recent study found that people who rarely experienced fear and did not respond to aversive conditioning as a result of amygdalar lesions did feel fear and panicked when they inhaled CO_2. Taugher et al. therefore hypothesized that the bed nucleus of the stria terminalis (BNST)—which also expresses ASICs and has roles in unconditioned fear responses in mice—helps drive CO_2 responses. Indeed, BNST lesions in mice significantly reduced fear responses to CO_2 inhalation and reduced CO_2-conditioned place aversion. Moreover, CO_2 inhalation lowered the pH in the BNST, and acidifying the BNST activated neurons and evoked fear responses. Finally, knocking out ASIC1A selectively in the BNST reduced CO_2-evoked fear responses, while restoring ASIC1A selectively in the BNST of ASIC1A-null mice increased these responses.