Nature Reviews Neuroscience | AOP, published online 1 April 2015

IN BRIEF

LEARNING AND MEMORY

Remembering your place

Place cells in the hippocampus become active at specific locations in the environment and are thought to be involved in spatial memory; reactivation of these neurons during sleep is thought to consolidate spatial memories. de Lavilléon *et al.* devised an experiment to create an artificial place–reward association (similar to the conditioned place preference paradigm) in sleeping mice: place cell spikes that were above a certain threshold triggered stimulation of the median forebrain bundle, the activation of which is thought to be rewarding. This protocol led to a marked place preference for the place field associated with the place cell that had been stimulated, thus directly illustrating that place cell reactivation during sleep is important for spatial memory and navigation.

ORIGINAL RESEARCH PAPER de Lavilléon, G. *et al.* Explicit memory creation during sleep demonstrates a causal role of place cells in navigation. *Nature Neurosci.* http://dx.doi.org/10.1038/nn.3970 (2015)

PAIN

Pinpointing the pain producer

Pain is a multifactorial response, and it is therefore difficult to identify pain-specific brain areas. To identify a brain area involved in all aspects of the pain response, Segerdahl *et al.* monitored changes in cerebral blood flow that paralleled the response to heat-induced pain mediated by capsaicin application to the lower right leg. They showed that, in humans, the dorsal posterior insula is vital for experiencing pain during the course of the pain response, including during onset, habituation and pain relief.

ORIGINAL RESEARCH PAPER Segerdahl, A. R. *et al.* The dorsal posterior insula subserves a fundamental role in human pain. *Nature Neurosci.* http://dx.doi.org/10.1038/nn.3969 (2015)

TECHNIQUES

Nanoscale neuronal activation

The use of light to stimulate neurons using techniques such as optogenetics has been tremendously useful but also has certain limitations. Two recent papers report on the use of nanoparticles to artificially stimulate neurons. Carvalho-de-Souza *et al.* report a technique that uses gold nanoparticles conjugated to neuronal membrane proteins. Light pulses are transduced by these conjugated nanoparticles into heat, which results in neuronal depolarization. Importantly, these ligand-conjugated nanoparticles enabled neuronal stimulation with smaller increases in temperature than other similar techniques. In a separate study, magnetosensitive nanoparticles, which release heat when exposed to a magnetic field, were used to activate the heat- and capsaicin-sensitive transient receptor potential cation channel TRPV1. Chen *et al.* showed that exposure of cultured primary hippocampal neurons expressing TRPV1 to a magnetic field could induce magnetothermal depolarization. Lentiviral delivery of TRPV1 into the ventral tegmental area of mice followed by magnetic nanoparticle administration to the same area enabled wireless magnetothermal stimulation to trigger neuronal firing in targeted neurons and in downstream brain areas. Both of these techniques offer advantages over other techniques and expand the repertoire of techniques available to neuroscientists for selective neuronal activation.

ORIGINAL RESEARCH PAPERS Carvalho-de-Souza, J. L. *et al.* Photosensitivity of neurons enabled by cell-targeted gold nanoparticles. *Neuron* http://dx.doi.org/10.1016/j.neuron.2015.02.033 (2015) | Chen, R. *et al.* Wireless magnetothermal deep brain stimulation. *Science* http://dx.doi.org/10.1126/science.1261821 (2015)