neurons in response to sugars and sweeteners.

Next, the authors sought to investigate the contribution of neuropod cells to sugar preference behaviour. Using a flexible fibre optic that enabled delivery of light to the gut lumen without damaging the intestinal wall, they could optogenetically manipulate the activity of neuropod cells in mice as the animals chose between sucrose and sucralse. In mice in which a stable sugar preference had been previously established, inhibiting the activity of the neuropod cells markedly reduced this preference, with the mice consuming less sucrose and more sucralse than controls.

Blocking glutamate receptor activity locally in the gut lumen similarly abolished the sucrose preference, indicating that glutamatergic signalling by neuropod cells is required to distinguish between sugar and sweetener.

This study provides evidence that neuropod cells rapidly transmit sensory information about the nutritive content of consumed food to the brain to guide the circuits that govern food choices.

Katherine Whalley

The authors showed that inhibiting genetic activation of mSTNCRH neurons during REM-sleep episodes when the animal was exposed to TMT prolonged the sleep episode compared with nonactivated controls that were also exposed to TMT during REM sleep. Thus, mSTNCRH neurons regulate arousal in response to predator cues during REM sleep.

Tseng et al. used a model of prolonged predator stress in which a rat (which can predate on mice) is housed behind a plexiglass barrier in the mouse’s cage for 12 days, and introduced into the mouse’s chamber for 10 minutes on most days. This model led to increases in total freezing time. Furthermore, optogenetic activation of mSTNCRH neurons during REM-sleep episodes when the animal was exposed to TMT prolonged the sleep episode compared with nonactivated controls that were also exposed to TMT during REM sleep. Thus, mSTNCRH neurons regulate arousal in response to predator cues during REM sleep.

The authors showed that inhibiting projections of mSTNCRH neurons to the lateral global pallidus (LGP), but not those to other target regions, reduced the ability of TMT to wake mice from REM sleep. Furthermore, activating LGP-projecting mSTNCRH neurons during wake promoted escape from looming stimuli. Notably, injection of a CRH receptor antagonist into the LGP blunted both of these effects. However, the antagonist did not stop the activation of LGP-projecting neurons from increasing REM sleep. Thus, CRH signalling in the LGP may regulate arousal and defensive behaviours, but not sleep adaptation.

Together, these results characterize a basal ganglia circuit that promotes arousal and defensive behaviours in response to threat, and that enables sleep adaptations in the face of prolonged predatory stress.

Natasha Bray

IN BRIEF

SPATIAL PROCESSING

The shape of activity

Grid cells in the medial entorhinal cortex fire in a hexagonal pattern of locations, allowing mapping of an individual’s position in an environment. Recurrently connected continuous attractor networks (CANs) may underlie this pattern, but to date, it has not been clear whether grid-cell networks exhibit continuous attractor dynamics. Gardner et al. recorded from a large number of grid cells in freely moving rats and found that the population activity from a single grid-cell module resided on a toroidal manifold, as predicted by a 2D CAN model, with positions on the torus relating to locations in the environment.

NEUROLOGICAL DISORDERS

Epstein–Barr virus and multiple sclerosis

The cause of multiple sclerosis (MS) is not known, but one hypothesis is that it is triggered by infection with Epstein–Barr virus (EBV). This has been difficult to study, not least because most adults will be infected by EBV at some point in their lives. Here, the authors assessed this hypothesis in a large cohort of young adults serving in the US military. The authors identified 955 individuals who developed MS during their service period. Through the collection of multiple serum samples across time for individuals in this cohort, they found that EBV infection was associated with a 32-fold increase in risk of developing MS.

MODEL SYSTEMS

Sheep electrophysiology

Sheep harbour potential advantages over some other species as a model in which to study mammalian brain function in vivo but, to date, single-neuron recordings have not been conducted in freely moving sheep. Here, the authors successfully conducted such recordings in the cortex and hippocampus of unrestrained sheep while they performed two-choice discrimination tasks or in different states of vigilance. Thus, this study provides a proof of principle that sheep can be used as a large-brained mammalian model species in large scale and/or longitudinal recordings.

NAVIGATION

Encoding reward locations

Hippocampal place cells fire when animals are at specific environmental locations. Here, the authors examined the role of place cells in dorsal CA1 (dCA1) and intermediate CA1 (iCA1) hippocampal regions in reward-directed navigation. They monitored CA1 calcium activity in mice using head-mounted microscopes as the animals learned different reward locations. The population activity of iCA1 place cells rose with anticipation of a reward. However, with changes in reward location, changes were observed in the population of active dCA1 place cells. By contrast, in iCA1, the same place cells were activated during reward anticipation for multiple reward locations. Thus, these CA1 place cell populations both predict reward location but through different means.