Nature Reviews Neuroscience | Published online 24 Mar 2016; doi:10.1038/nrn.2016.35

SPATIAL CODING

Stay where you are

> They identified a set of cells in the CA2 that fired at higher rates when the animals' movement slowed or stopped

Hippocampal place cells fire as an animal passes through particular locations in its environment, providing a neural code for spatial position. In addition, place cell firing during periods of immobility has been shown to encode past or possible future experiences; however, the mechanisms by which an animal's current position is represented during immobility are unknown. Kay *et al.* have now identified a subset of hippocampal neurons that may perform this function.

The authors recorded from neurons in hippocampal CA1, CA2, CA3 and dentate gyrus (DG) subregions as rats performed a spatial memory task in which they learned to find a food reward in one of three locations (wells) in a maze. They identified a set of cells in the CA2 that fired at higher rates when the animals' movement slowed or stopped. The firing of these cells, which the authors termed 'N units', was spatially specific: individual N units fired when the animals stopped at only one of the three reward wells. In agreement, examination of the size of the spatial firing fields of the N units revealed that they were smaller than those of typical place cells in CA1 and CA3.

Place cell firing is modulated by patterns of synchronized hippocampal activity, including sharp wave–ripples and theta rhythms. The authors found that N unit firing during immobility was not evidently coupled to these canonical network patterns, but was instead associated with a distinct transient local field potential (LFP) pattern that the authors termed the 'N wave'. Subsets of cells within CA1, CA3 and DG were also coupled to the N wave, and in CA1 and CA3 these cells also encoded spatial position during immobility, pointing to the engagement of a hippocampus-wide network.

Previous studies have shown that an animal's nesting position during sleep is encoded by the firing of a subset of CA1 cells during periods of desynchronized low-amplitude LFPs known as small-irregular activity (SIA). The authors examined N unit activity during sleep between training sessions and showed that, like the CA1 place cells that encoded nesting position, N unit firing during SIA periods encodes the animal's location.

This study suggests that a distinct hippocampal network encodes an animal's position when it is immobile or asleep and may thus be important for the formation of location-specific memories and other cognitive functions.

Katherine Whalley

ORIGINAL ARTICLE Kay, K. *et al.* A hippocampal network for spatial coding during immobility and sleep. *Nature* **531**, 185–190 (2016)