Visual-spatial processing within the retrosplenial cortex

Supervisory team:
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Project description:

Learning about our spatial environments and how to navigate within these environments is critical for all species. It is a long-standing goal of neuroscience to understand how our brains support these processes. This goal is becoming ever more important as it has become apparent that spatial processing is particularly sensitive to both normal ageing and pathological ageing, such as Alzheimer's disease. The retrosplenial cortex appears to be particularly important for processing information about our environments.

We recently used an in vivo imaging technique (two-photon imaging) to identify patterns of neuronal activity that developed as animals learnt a spatial memory task; the more stable representations at the end of training were related to how well the animals performed the task. We also found cells in the retrosplenial cortex that responded to visual stimuli and the movement of the animal. Combining visual-spatial and movement information at a neuronal level could be critical for the retrosplenial cortex's role in navigation.

This project will build on these previous findings to try and understand at a network level how these spatial representations within the retrosplenial cortex are formed. An important question is how connections with other brain regions such as the hippocampus and visual cortex help these representations to develop and how the interaction across these brain structures changes from when an environment Is new to when it has become familiar and well-learnt. The project will provide an opportunity to learn a number of skills including behavioural testing, in vivo neuronal imaging and in vivo electrophysiology. In addition, chemogenetic and optogenetic approaches enable us to temporarily inactivate or stimulate different pathways within the network to determine which are particularly important for different aspects of spatial learning and memory.

The overall aim of this project is to identify specific neuronal pathways related to the retrosplenial cortex that underpin the acquisition and retention of spatially-related representations.