Determining the pathways and synaptic mechanisms of the prefrontal cortex in recognition memory

Supervisory team:
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Project description:

How do we recognise our house, our car, our street? Such memories are clearly essential for everyday living. Recognition memory involves multiple processes operating across a network of interconnected brain regions including medial temporal lobe, prefrontal cortex and thalamus.

Previous work has established the importance of different brain regions involved in associative recognition memory but not how or when information is transferred between them: this study will apply new technologies to now reveal the essential neurones, the pathways and synaptic mechanisms of associative recognition memory.

The aims of this project are to determine: (i) which different output pathways from medial prefrontal cortex (PFC) encode novel versus familiar information, (ii) the synaptic basis of how novel and familiar information is encoded at the different output pathways from PFC.

We will use a combination of optogenetics and behavioural analysis to address aim (i) and in vitro electrophysiology and optogenetics to address aim (ii).

In this project you will work jointly within the Bashir and Warburton labs and interact closely with the 10 postdocs/Phd students within this group. In the Bashir lab you will utilise slice electrophysiology and optogenetic methods to enable stimulation of selected inputs and record from appropriate individual neurones in target regions. Thus you will determine how the physiology of specific synapses allows the PFC circuitry to process and appropriately transfer novel and familiar information. In the Warburton lab you will use optogenetic methods to selectively switch off PFC output pathways to different regions during encoding, consolidation and retrieval of recognition memory.

Combining these different approaches will allow advances in understanding the synaptic and circuit mechanisms by which PFC contributes to recognition memory. Ultimately this will allow us to understand how dysfunction of these circuits contributes to dementias and Alzheimer's disease