Understanding how interneurons in medial prefrontal cortex control associative recognition memory

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Project description:
The medial prefrontal cortex (mPFC) is the centre of a brain circuit essential for associative recognition memory. Other regions of the circuit such as the hippocampus (HPC), nucleus reuniens (NR) and medial dorsal thalamus (MD) have extensive projections to mPFC. We have good evidence for how these different regions contribute to different phases of memory but there is little understanding of the roles of mPFC interneurons in associative memory. The student will work within a collaborative grouping of postdocs, PhD students and technicians. This project will bring together a variety of different techniques including behavior, imaging, synaptic physiology, and opto/chemogenetics to understand how interneuron activity controls associative recognition memory.

This project will begin by investigating roles of PV interneurons in encoding and retrieval of associative memory. This component of the project will use viral targeting of inhibitory DREADDs to selectively inhibit mPFC interneurons in PV-cre mice during associative recognition memory. If necessary, other major classes (SOM and VIP) of interneurons will be examined.

The next experiments will determine whether inputs from different nodes of the memory circuit converge onto PV interneurons. This will be achieved by high resolution imaging to co-localise PV interneurons with separate anterograde markers injected into 2 different regions of the memory circuit. These data will provide detailed understanding of how inputs from different nodes of the memory circuit terminate onto the key inhibitory interneurons in mPFC.

The student will next use optogenetic activation of the inputs from different regions of the circuit to examine transmission and plasticity at the synapses onto PV-interneurons. Viral delivery of ChR2 will be performed in the input brain regions and then whole cell electrophysiological recordings will be carried out from interneurons in mPFC slice preparations from PV-td-tomato mice. These experiments will determine how specific inputs to mPFC control interneuron and circuit activity.

Together, the data from this project will drive understanding of how mPFC interneurons control associative recognition memory.