Cellular and network effects of psychedelics on emotional memory processing

Supervisory team:
Main supervisor: Dr Ross Purple (University of Bristol)
Second supervisor: Prof Emma Robinson (University of Bristol)

Collaborators: Dr Christopher Thomas (COMPASS Pathways), Prof Matt Jones (University of Bristol)

Host institution: University of Bristol

Project description:
Psychedelic drugs can have profound effects on consciousness and subjective experience leading to lasting psychological changes. This has led to a resurgence of interest in the therapeutic value of these drugs for treatment of mental health problems including depression, substance abuse, and post-traumatic stress disorder. While several of these disorders involve a dysregulation to emotional processing, how psychedelics alleviate this imbalance remains largely unexplored.

A prominent theory of psychedelic drug action states that top-down signal transmission along the cortical hierarchy of signal processing is reduced, liberating previously inaccessible bottom-up information transfer. Persistent and harmful connectivity patterns within the brain can thus be reconfigured, promoting lasting psychological benefits. While this likely relies on a complex interplay between limbic structures within the brain including the prefrontal cortex, hippocampus and amygdala, currently there is little evidence of how this works mechanistically at a cellular and network level. Furthermore, sleep in known to play an important role in the processing our daily experiences including the consolidation of emotional memories and reduction of emotional tone. Alterations to neural activity during sleep could therefore be a key process in which psychedelics promote lasting change.

Psilocybin is a classical psychedelic with targets including serotonergic 5-HT2A and 5-HT1A receptors, highly expressed throughout limbic regions of the brain. Our recent work has shown that psilocybin leads to a slowing of neural dynamics and an attenuation of their complexity within the prefrontal cortex during wake in healthy, freely behaving rats. This was also extended into sleep with an increase in synchronous activity that may be related to enhanced consolidation and plasticity processes. In collaboration with COMPASS Pathways, we now seek to extend this investigation in the context of an emotionally salient experience, whilst also extending our recordings to other parts of the limbic system including the amygdala and hippocampus. During the PhD you will have the opportunity to work as part of a multidisciplinary team in the labs of Dr Ross Purple and Prof Emma Robinson. You will be trained in a range of bioscience skills including in-vivo electrophysiology, behavioural studies, neural stimulation, immunohistochemistry, microscopy, and numerous computational analyses including the use of machine learning algorithms. Collectively, this work will allow us to investigate how different areas of the brain communicate and integrate emotional information, and what impact psilocybin has on these processes.

Our aim as the SWBio DTP is to support students from a range of backgrounds and circumstances. Where needed, we will work with you to take into consideration reasonable project adaptations (for example to support caring responsibilities, disabilities, other significant personal circumstances) as well as flexible working and part-time study requests, to enable greater access to a PhD. All our supervisors support us with this aim, so please feel comfortable in discussing further with the listed PhD project supervisor to see what is feasible.