The role of VTA GABA neurons in reward learning

Supervisory team:
Main supervisor: Dr Paul Dodson (University of Bristol)
Second supervisor: Dr Rui Ponte Costa (University of Bristol)

Host institution: University of Bristol

Project description:

Understanding how we learn to make associations between rewarding outcomes and the cues that predict them (e.g. the ice-cream van jingle and a delicious treat) remains a central challenge for neuroscience and is critical for tackling maladaptations like drug addiction. Recent evidence suggests that GABA neurons in the ventral tegmental area (VTA) may shape the way the brain performs the calculations important for learning, but the details of how they do this are not yet clear.

Furthermore, it has recently been found that there are multiple populations of these GABA neurons which are diverse both in terms of their molecular make-up and the anatomical connections they make. This raises the possibility that different populations play different roles in learning, and transmit diverse signals to different brain regions. The focus of this PhD is to define how different populations of VTA GABA neurons encode aspects of reward-learning. To achieve this, we will combine cutting-edge neurophysiological techniques and advanced computational models.

To record from individual dopamine neurons in behaving mice we will take advantage of a new technique we recently developed (Dodson et al. 2015, 2016). This approach not only allows one to identify the precise location and neurochemical identity of each recorded neuron, but also to interrogate which key proteins they express and which brain regions they innervate (and thus subdivide neurons into their different populations). We will then use computational models to probe how the signals we record are related to different parts of the learning process.

During the PhD, the student will have the opportunity to learn, and develop their skills in: in vivo recording, animal behaviour, neuroanatomy and immunohistochemistry, microscopy, data analysis and programming, and computational modelling.