Assessment of hypervigilance to understand the neurobiological mechanisms of anxiety symptoms

Supervisory team:
Main supervisor: Dr Emma N Cahill (University of Bristol)
Second supervisor: Dr Tom J Barry (University of Bath)
Prof Matt Jones (University of Bristol), Dr Piotr Słowiński (University of Exeter)

Host institution: University of Bristol

Project description:
Hypervigilance is a diagnostic symptom in anxiety disorders characterised by overactive attention towards perceived signals of danger. Hypervigilance leads to disproportionate reactions to potential threat cues even under conditions of safety. The neurobiological basis for hypervigilance remains understudied.

Associative (pavlovian) conditioning protocols are often used to model aversive learning and memory in both rodents and Human participants. In rodents, changes in behaviour and the production of ultrasonic vocalisation alarm calls are measured as threat reactions. We have piloted a new attentional task to screen for hypervigilance in rats, that the student would optimise. This task tests for individual differences in the thresholds of reactivity to threat cues by modifying the cue properties. The student would investigate the recruitment and necessity of specific brain networks for hypervigilant responding in rats using viral-based techniques and pharmacology. The student would also develop an analogous task to back-translate how thresholds of hypervigilance relate to anxiety symptoms in people.

Exposure therapy, a behavioural treatment for anxiety disorders and other related disorders (e.g., post-traumatic stress disorder), can be modelled by 'extinction' training in animals. A threat cue is presented in the absence of any negative consequence, and so new learning inhibits (extinguishes) responses to the threat cue. Our hypothesis is that individual differences in hypervigilance should predict the overactive responses that are resistant to extinction, and enhancing extinction should help damped hypervigilance.

In the supervisory team, Dr Cahill (Bristol) has expertise in behavioural and pharmacological manipulations to enhance extinction in rodents (for review, Cahill and Milton, 2019). Dr Barry (Bath) has expertise in extinction testing in Humans, and the role of generalisation of fear in symptomology of anxiety disorders (for example, Barry et al., 2015, 2016, 2024). Dr Słowiński (Exeter) develops mathematical models and data analysis pipelines that connect brain circuitry with behaviour (for example, Słowiński et al. 2020, 2021; Jokura et al. 2023). Together this project will address: how can neurobiological mechanisms underlying extinction be leveraged to enhance the inhibition of hypervigilant responses?

Overarching Objectives:
1. Develop a new hypervigilance screen task to identify brain networks recruited by hypervigilant behaviour in rats, and back translate an analogous task for humans.
2. Investigate pharmacological approaches to enhance extinction using partial extinction protocols and assess the capacity to reduce hypervigilant responding.

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.