iCase Project / AY 2023 -2024

The role of GABAa and GABAb receptors in visual learning and decision-making

Supervisor: Prof Jeff Dalley (jwd20@cam.ac.uk)

Department/Institute: Psychology

Industrial Partner: Boehringer Ingelheim Pharma GmbH & Co. KG

Research area: Neuroscience, behavioural neuropharmacology

Project outline:

Gamma-aminobutyric acid (GABA) is the main inhibitory neurotransmitter in the brain. GABAergic inhibition is critical for perceptual learning and decision-making. However, the cellular and molecular mechanisms of inhibitory control are not yet fully established.

Two types of GABA receptors exist: 'fast' ionotropic GABAa and 'slower' G-protein coupled metabotropic GABAb receptors. To date, resolving the functional distinction of these two receptor subtypes has been hampered by methodological constraints. The overarching objective of this PhD is to establish the role of GABAa and GABAb receptors in visual perceptual learning and decision-making, capitalising on novel technologies that enable for the first time direct GABA concentration measurement and calibrated drug-delivery in behaving animals.

The student will use two-photon imaging, miniscopes, and fibre photometry to measure GABA and cellular activity in mice performing visual decision-making tasks. Simultaneous pharmacological manipulation of GABAa or GABAb receptors will reveal the mechanistic effects of receptor types on activity levels in visual cortical neurons, learning and decision-making.

The project is a collaboration with the pharmaceutical partner Boehringer Ingelheim and is aligned with their research on GABA receptor-specific modulators of cognition. The PhD is aligned with a cross-disciplinary international team including experts on two-photon imaging and pharmacology (Dalley, Paulsen and Poort labs, Cambridge), optical GABA sensors (Looger lab: UCSD) and electrophoretic drug delivery (Proctor and Malliaras labs, Cambridge). This creates unique opportunities for an industrial internship with a leading pharmaceutical company, and training in state-of-the-art neurotechnology to drive an innovative programme of research.

BBSRC DTP main strategic theme: Transformative technologies

BBSRC DTP secondary strategic theme: Understanding the rules of life, Bioscience for an integrated understanding of health