Summer Internship Projects

MRC Cognition and Brain Sciences Unit
Undergraduate Summer Internship Scheme 2022

Monday 4 July – Friday 12 August 2022

Project A. Mapping the Interaction between Semantic Representation and Control Systems: Controlled Semantic Cognition

Supervisor: Lorna Garcia-Penton

People, places and things have "meaning" that we use to know who/what they are and what we can do with them. Our ability to use that knowledge –our "semantic cognition"– determines how well we can interact with the world. This vital ability seems to depend on two separate brain systems, one "representing" what we know and the other "controlling" our ability to use that information. However, how these two semantic systems interact remains unclear. This interaction is crucial and more evident in situations where it is difficult to recover, for example, ambiguous, impoverished, unexpected meanings, demanding different semantic control. A fuller understanding of semantic cognition depends on us uncovering this relationship. Accordingly, to model the semantic systems this project aims to study healthy participants and patients in whom one or the other system is damaged. Patient and healthy-control groups are evaluated using an in-depth neuropsychological assessment combined with different neuroimaging techniques (DWMRI, fMRI and T1MRI). We will model the causal dynamical interactions between the semantic subnetworks, understanding how and under what circumstances they recruit each other. Our results will reveal how the brain manipulates information that gives rise to semantic behaviours, advancing knowledge about a critical part of the human experience. Also, we will advance the implementation of methods for multimodal neuroimaging integration in the study of brain dynamics and plasticity in highly distributed and heterogeneous cognitive systems, such as controlled semantic cognition.

The students will work with a pre-processed dataset to gain data analysis experience using brain networks and data-driven approaches to explore the brain-behaviour relationships and will be involved in the preparation of methods and results sections of a scientific paper.

Project B. Learning to Learn: How do our perceptual systems improve themselves?

Supervisors: Lizzie Michael and Alexandra Woolgar

Experience with difficult perceptual tasks can result in improved performance (perceptual learning), not only on the trained task but also, sometimes, on other challenging perceptual tasks. This generalisation can in some cases be extended to a new class of visual stimulus, suggesting that something beyond improved visual representations has occurred in the learning process. This type of mechanism is particularly interesting because it may give us some clues for designing interventions to help people with impaired perceptual function (e.g. hearing loss in healthy aging). Explanations for non-sensory transfer (NST) of learning currently rely on the invocation of high level learning processes (e.g. "learning-to-learn") but little is understood about the properties and efficacies of this level of learning. The aim of this project is to answer two questions: 1) is the extent of NST dependent on the length of initial task experience? 2) does NST decay over time, suggesting a memory-like process? We will answer these questions using a modified existing behavioural paradigm with naïve human participants, with an interactive online protocol. In the course of this internship, we would expect an intern to gain experience with: implementing a behavioural experiment, interacting with participants and analysis of behavioural data.

Project C. How is the Third Thumb represented?

Supervisors: Tamar Makin, Lucy Dowdall, and Maria Molina

In recent years, there has been increased interest in augmentative technologies that enhance the physical and cognitive abilities of the human body. Incredibly, these technologies are no longer science fiction – engineers are designing robotic fingers and even entire arms to augment our own. However, these innovative devices introduce various theoretical and practical challenges. What resources can the brain employ to control a body part that has never been there before? In this project, we work with supernumerary robotic fingers, designed to allow the user to single-handedly perform typically bimanual tasks. We will train participants to use the robotic finger for a week. We will then investigate the neural correlates of hand augmentation using a series of behavioural and fMRI pre- and post-training measures.

This is an ambitious project, and we are therefore looking for hard-working and motivated students with a keen interest in sensorimotor neuroscience. The main role of the student/s during the internship will be training participants to use the robotic finger over a week, as well as helping us run the fMRI tasks. Excellent organisation and people skills are vital, and previous data collection experience is desirable. Basic programming skills are also desirable. Interns will learn about how to run a longitudinal study requiring substantial technological setup, and gain experience running a variety of different behavioural and fMRI measures. They will receive excellent experience interacting with participants, as well as a unique insight into the upcoming field of augmentation technology. As a member of the highly collaborative Plasticity Lab, interns will also attend weekly journal clubs and seminars hosted by the lab.

Project D. Does fear extinction spontaneously engage retrieval stopping? Assessing the retrieval stopping hypothesis of fear extinction via qualitative experiences

Supervisors: Molly Rowlands and Michael Anderson

The novel retrieval stopping hypothesis of fear extinction posits that, during Pavlovian fear extinction, individuals spontaneously recruit retrieval stopping processes in order to regulate negative affect (Anderson & Floresco, 2021). That is, in response to a cue that no longer predicts a fearful outcome, individuals consciously regulate their fear response by stopping the episodic retrieval of prior fear conditioning tasks. The hypothesis aims to reconceptualise fear extinction in order to better understand exposure-based clinical treatments. However, key predictions of this hypothesis have yet to be explored.

The aim of this project is the assessment of two key predictions of the retrieval stopping hypothesis: 1) Building on meta-analytic fMRI evidence that extinction processes engage key regions of the retrieval stopping network, this study will be a behavioural pilot for a future fMRI study directly assessing activation overlap in both extinction and retrieval stopping tasks at a within-subject level, and; 2) By exploring the qualitative experience of participants during a canonical fear extinction task, we will test the hypothesis' prediction that individuals spontaneously engage retrieval stopping techniques in order to control negative affect during extinction tasks.

Project E. Using eye behaviour to study the encoding of memories for naturalistic events

Supervisors: Kevin Campion and Andrea Greve

The study of eye behaviours, including eye movements and pupillary responses, is an important route to understanding episodic memory processes. The eye movements underlying visual exploration determine the information which is available for encoding, and fixation patterns within items have been shown to predict subsequent memory strength. Encoding processes are also thought to be reflected in pupil dilation. However, prior studies of eye behaviour and memory have focused on discretised, simple stimuli as "events", which do not reflect the experiences we encounter in the real-world. Real-life events feature multiple elements which unfold over time in a spatial context. The use of naturalistic stimuli, which more closely reflect the spatiotemporal dynamics of our experience, allows us to ask new and important questions about how encoding processes operate in real life.

This project will involve running an eye-tracking experiment in healthy volunteers featuring novel naturalistic stimuli created using the Sims 4 video game. Through this project, you will gain experience organizing testing sessions and collecting behavioural and eye-tracking /pupillometry data. There may also be an opportunity to work on related behavioural episodic memory experiments involving naturalistic stimuli.