MAX-PLANCK-INSTITUT
FÜR BIOLOGISCHE KYBERNETIK

Master Thesis Opportunity: Investigating Memory Engrams for Basic Visual Features in sensory areas

The **Brain States for Plasticity group** (PI Dr. Svenja Brodt) invites applications from highly motivated Master students (m/f/d) to join our team at the [Max Planck Institute for Biological Cybernetics](#) in Tübingen, Germany. The master theses are part of **CHROMA**, a project which aims to unravel **memory engrams associated with basic visual features**.

Previous research has shown the rapid formation of neocortical memory engrams. While complex concepts activate large, distributed brain networks, we still lack a complete understanding of how and where engrams for individual aspects of complex visual memories are formed. To address this, we focus on basic visual features known to be processed in early visual cortex. Our primary goal is to understand how we encode and retrieve memories, particularly the individual aspects within complex visual memories. Specifically, we aim to follow the development of memory engrams for basic visual features such as color and motion.

To achieve this, we will collect functional (fMRI) and diffusion-weighted MRI (dwMRI) data while participants perform a memory task involving the learning of colors or motions presented with different objects. Additionally, we will acquire further fMRI and dwMRI data at intervals of 1 hour, 24 hours, and 1 week to investigate long-term changes.

We are currently offering Master theses on this project in two main areas:

Topic 1: Neural Dynamics in basic visual feature consolidation (fMRI)

- **Potential research questions include:** How do neural representations of basic visual features develop over multiple learning repetitions and different delay periods? Which brain regions are involved in the consolidation of basic visual features? What role do sensory areas play in these representations?
- Students will collect and analyze **functional MRI data** to characterize neural changes during memory formation and retrieval. Analyses may include **univariate or multivariate approaches**.

Topic 2: Neural Patterns of Memory Engrams for Specific Colors(fMRI)

- **Potential research questions include**: Are there distinct neural patterns that differentiate memory engrams for specific colors when investigated using multi-voxel pattern analysis methods such as Representational Similarity Analysis (RSA)? How do neural representations of memory engrams for different colors vary across distinct brain regions? What role do sensory areas play in these representations?
- Students will acquire **functional MRI data** and employ **RSA** to analyze the neural patterns associated with memory engrams for specific colors.

Who we are looking for:

- Preferably students studying neuroscience, psychology, cognitive science, or a related field.
- Proficient in German and English.
- Experience with Python and/or MATLAB recommended.
- Interested in state-of-the-art cognitive neuroscience research and motivated to work in a fun and engaging team!

Theses are available **starting from summer/fall 2024**.

If you are interest in writing your thesis in this project, get in touch with project leader
Marius Kreis via marius.kreis@tuebingen.mpg.de