Master Thesis Opportunity: Investigating Reactivation-Induced Rapid Memory Consolidation in Wakefulness and Sleep

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. In the REHA project, we aim to examine and compare the nature of memory consolidation during rehearsal and sleep.

Both sleep and rehearsal have been shown to accelerate systems memory consolidation by reactivating mnemonic information. However, little is known about the underlying neural mechanisms involved in rehearsal-induced memory consolidation, and how the stabilizing effects of rehearsal may be modulated by sleep. The REHA project will investigate in which respects rehearsal-consolidated memory representations may resemble or differ from memories that have undergone classical, sleep-dependent memory consolidation. To this end, we will collect functional and diffusion-weighted MRI data while participants perform an image-location learning task. After learning, participants will either experience a night of total sleep deprivation in the lab or will be sent home to sleep wearing a mobile EEG that records polysomnography data. Following a three-day delay, participants will re-enter the MRI scanner to assess potential changes in memory representations of rehearsed and non-rehearsed associations.

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

**Topic 1: Rehearsal-dependent changes in neural activity (fMRI)**

- **Potential research questions include**: Which brain regions are involved in rehearsal-dependent consolidation? How do their contributions change over learning repetitions? How do interactions between brain regions differ for rehearsed vs. non-rehearsed associations?
- **Students will collect and analyze functional MRI data** to characterize neural changes during rehearsal. Analyses may include univariate or multivariate approaches as well as functional connectivity analyses.

**Topic 2: Sleep characteristics and memory retention (EEG/polysomnography)**

- **Potential research questions include**: Which sleep characteristics affect memory retention? Are sleep characteristics related to neural changes during learning? How well are rehearsed vs. non-rehearsed memories retained after sleep compared to sleep deprivation?
- **Students will collect, score, and analyze polysomnography data** to investigate sleep-dependent memory consolidation following learning. Analyses may include sleep architecture analyses, time-frequency analyses, or connectivity analyses.

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 interested in writing your thesis in the REHA project, get in touch with project leader Lena Schroeder via lena.schroeder@tuebingen.mpg.de

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