

## Recognition of facial expressions that predict mind-wandering using deep neural networks

Dr. Stefan Dürschmid,  
AG Sensory Learning and Prediction

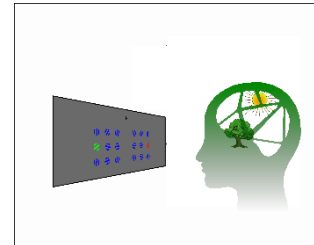
Stefan.duerschmid@med.ovgu.de  
Tel: 626392531

Dr. Pavol Bauer  
AG Neural Data Science

Pavol.bauer@lin-magdeburg.de  
Tel: 626393361

### An exciting master's project has become available

The human's mind wanders frequently between the conscious perception of external events and the internal milieu (1). For example, we drift away to the shopping list while we read a book. This can be so severe that smokers regularly give in to craving which intrudes their thinking or that patients suffering from major depression cannot find a way out of ruminations. **Mind wandering (MW) is a brain state, during which we involuntarily retrieve memory and become aware of episodic content.** One issue in the assessment of MW is that we cannot say objectively when people's minds wander. To assess MW for neuroscientific research, we present so called *thought probes* (TPs) and ask subjects to rate the depth of MW at pseudo-randomly chosen time points. **But subjective reports are not always reliable.** Moreover, when asking subjects we interrupt the mind's tendency to wander. **Finding an objective feature to discriminate episodes of MW from focusing on the external world is needed.** Previous studies revealed that people were less happy when their minds wandered than when they were not (1). Importantly, even though negative moods cause mind-wandering it has been shown that **MW itself causes negative emotions** (1).



**Figure 2** Depiction of mind wandering during which we retrieve and become aware of episodic content, even though we have to solve an experimental task.

There is a longstanding line of research into the expression and understanding of emotions. Most, if not all studies, starting with the seminal studies by Ekman et al. (2), rely on facial expression of emotions. Within cultures, there is a very high mutual understanding of facial expressions meaning that we can easily distinguish among the set of different facial expressions.

### Who we are

[Pavol Bauer](#) is head of the Neural Data Science working group who focuses on computational neuroscience, signal processing and machine learning, pursuing two main lines of investigation. The first focuses on how behavior and decision making is encoded in the brain's neuronal networks. This involves finding the right models and techniques to interpret noisy, high-throughput neural data. The second line of research focuses on building new types of machine learning models to detect patterns in behavioral data that cannot be detected natively.

[Stefan Dürschmid](#)'s group investigates when and why our brains independently retrieve things from memory? And: How can we continue to learn the structure of the environment in order to make predictions, even though we are mentally busy with other things? Answering these questions helps to understand how our brain learns to improve our interaction with the environment. We pursue our long term goal using a combination of invasive and non-invasive recording techniques (MEG, EEG, Eyetracking, ECoG) to understand how automatic memory retrieval and implicit learning are represented and interact at different physiological levels of the brain.

### What we want to do with you in this project

In this project we want to exploit changes of facial expression concomitant with a change of emotions. We seek to establish a reliable index using facial expressions, which can differentiate the focus on episodic from to focus on external content. The potential candidate will develop an empirical measure which is based on continuous tracking of facial movements. For the development of a potential index

sample data have to be decoded using the software package Deep Lab Cut (3). The task of the student will be the development of tools to define and pick up facial states from footage of facial expressions. Specifically, the tools will be suited to classify facial states with respect to their prognostic value to predict the transition from surveillance of the external to the internal world.

### **What you should bring to the party**

- Advanced programming skills, preferably experience with Python and Matlab
- interest in statistical learning, deep learning, signal processing, and neuroscience

### **References**

1. Killingsworth MA, Gilbert DT. A wandering mind is an unhappy mind. *Science* (80- ). 2010;330(6006):932.
2. Ekman P, Sorenson ER, Friesen W V. Pan-cultural elements in facial displays of emotion. *Science* (80- ). 1969;164(3875):86–8.
3. Luxem K, Fuhrmann F, Kürsch J, Remy S, Bauer P. Identifying Behavioral Structure from Deep Variational Embeddings of Animal Motion. 2020;