

## **Ongoing Project:**

Transcranial direct current stimulation (tDCS) is a promising method for noninvasive brain stimulation that gained interest in numerous scientific fields in the past years. Although there is strong evidence that support the effectiveness of tDCS, the tDCS outcomes are not consistent between or within subjects even under identical stimulation dose. The main causes of inter- and intra-individual variability in response to tDCS remain unclear. However, generally, one potential source of variability is the electric field (EF) distribution pattern; which is a function of stimulation dose and brain anatomical traits. Computational head models (CHMs) based on structural MRI (sMRI) are accepted as a standard forward modeling method to simulate EFs inside the brain. These anatomical-based models might be a good predictor for trait-based inter-individual variability in response to tDCS. But intra-individual variability cannot be explained by CHMs and might be related to brain-state. Functional MRI (fMRI) provides an indirect measure of neural activity to examine tDCS outcomes based on brain-state. It seems that the association between brain-traits and brain-state could form a predictive model for the investigation of variability in response to tDCS. Furthermore, this combination might lead to a better understanding of the underlying mechanisms of the tDCS. We are interested in integrating EF patterns with fMRI data and we want to explore the underlying methods to determine the methodological aspects of this integration. To the best of our knowledge, there have been no published studies exploring the actual relationship between EF distributions and functional imaging data in response to tDCS in a group of subjects. The results of our studies will hopefully shed more light on what are the main causes of variability in response to tDCS and it will help to predict the individual's responsiveness based on modeling and neuroimaging techniques with the ultimate goal of individualized stimulation paradigm. To evaluate methodological aspects of CHMs-fMRI combination, we focus on a group of participants with methamphetamine use disorder (MUD). We want to explore the potential predictors for tDCS responses in MUD population. We will elucidate the relationships between EF distribution patterns and fMRI data in different perspectives. The results will hopefully help to find a linkage between tDCS as an active intervention in the field of addiction and neural basis of cognitive process in this group of subjects.

# Summary of challenges and solutions for tDCS response prediction

