Project title: **Forgetting the bad while remembering the good: Manipulating neural mechanisms in adaptive mnemonic control after stress using transcranial magnetic stimulation.**

Project leader: Sack, Alexander

Function: full professor

Collaborators: Quaedflieg, Conny PhD

Proposal Introduction:

Active mnemonic control describes the repeated voluntary retrieval (positive control) or suppression (negative control) of memories, leading to memory enhancement or voluntary forgetting, respectively. People with stress-related disorders such as posttraumatic stress disorder (PTSD) and depression show deficits in negative mnemonic control. In the brain, stress hormones activate the salience network and downregulate the executive control network including the right dorsolateral prefrontal cortex (*rdlPFC*). The *rdlPFC* has been suggested to be the key neural substrate for mnemonic control.

Hypothesis and Objectives:

We propose that the downregulation of the *rdlPFC* network in the aftermath of stress interferes with successful negative mnemonic control, which in turn promotes the development of stress-related disorder symptology. This research projects aims at investigating 1) how and to what extent stress affects memory control, 2) how this is reflected in neural oscillations that have been associated with cognitive control and 3) whether this effect can be counteracted by brain stimulation.

Setting and Methods:

Combining behavioural measures with EEG, study 1 will investigate how stress (vs. control condition) affects mnemonic control and how this is reflected in the communication between these networks assessed by neural oscillations. Non-invasive brain stimulation can be used to stimulate and even entrain network oscillations, thereby changing behaviour and cognition. Study 2 aims to counteract the stress-induced downregulation of the *rdlPFC* mnemonic control network by applying fMRI-guided non-invasive brain stimulation.

Impact:

Brain stimulation could be a potential early intervention method to prevent loss of mnemonic control after stress, which may in turn prevent the emergence of the above described stress-related disorders.

Requirements candidate: Highly motivated student with good English communication skills and proactive and resolute attitude.

Keywords: Memory control, Stress, TMS, EEG

Top 5 selected publications:

1. de Graaf, T. A., Hsieh, P. J., & **Sack, A. T.** (2012). The 'correlates' in neural correlates of consciousness. *Neurosci Biobehav Rev, 36*(1), 191-197. doi: 10.1016/j.neubiorev.2011.05.012 Number of times cited: 101
2. Bien, N., ten Oever, S., Goebel, R., & **Sack, A. T.** (2012). The sound of size: crossmodal binding in pitch-size synesthesia: a combined TMS, EEG and psychophysics study. *Neuroimage, 59*(1), 663-672. doi: 10.1016/j.neuroimage.2011.06.095 Number of times cited: 74
3. Smeets, T., Cornelisse, S., **Quaedflieg, C. W. E. M.**, Meyer, T., Jelicic, M., & Merckelbach, H. (2012). Introducing the Maastricht Acute Stress Test (MAST): a quick and non-invasive approach to elicit robust autonomic and glucocorticoid stress responses. *Psychoneuroendocrinology, 37*(12), 1998-2008. doi: 10.1016/j.psyneuen.2012.04.012 Number of times cited: 64
4. Riecke, L., Formisano, E., Herrmann, C. S., & **Sack, A. T**. (2015). 4-Hz Transcranial Alternating Current Stimulation Phase Modulates Hearing. *Brain Stimul, 8*(4), 777-783. doi: 10.1016/j.brs.2015.04.004 Number of times cited: 33
5. **Quaedflieg, C. W. E. M.**, Meyer, T., Smulders, F. T., & Smeets, T. (2015). The functional role of individual-alpha based frontal asymmetry in stress responding. *Biol Psychol, 104*, 75-81. doi: 10.1016/j.biopsycho.2014.11.014 Number of times cited: 22