

ALPINE CHAPTER

3rd Alpine Chapter Symposium, November 4th 2017

Unexpected CBF response to anxiety reinforcing transcranial direct current stimulation

Matthias Grieder, PhD

Division of Systems Neuroscience of
Psychopathology

Translational Research Center

University Hospital of Psychiatry Bern

Organization for Human Brain Mapping

ALPINE CHAPTER

ÖG-FMRIT

Organisation for Human Brain Mapping

Alpine Chapter

Austrian Society fMRI

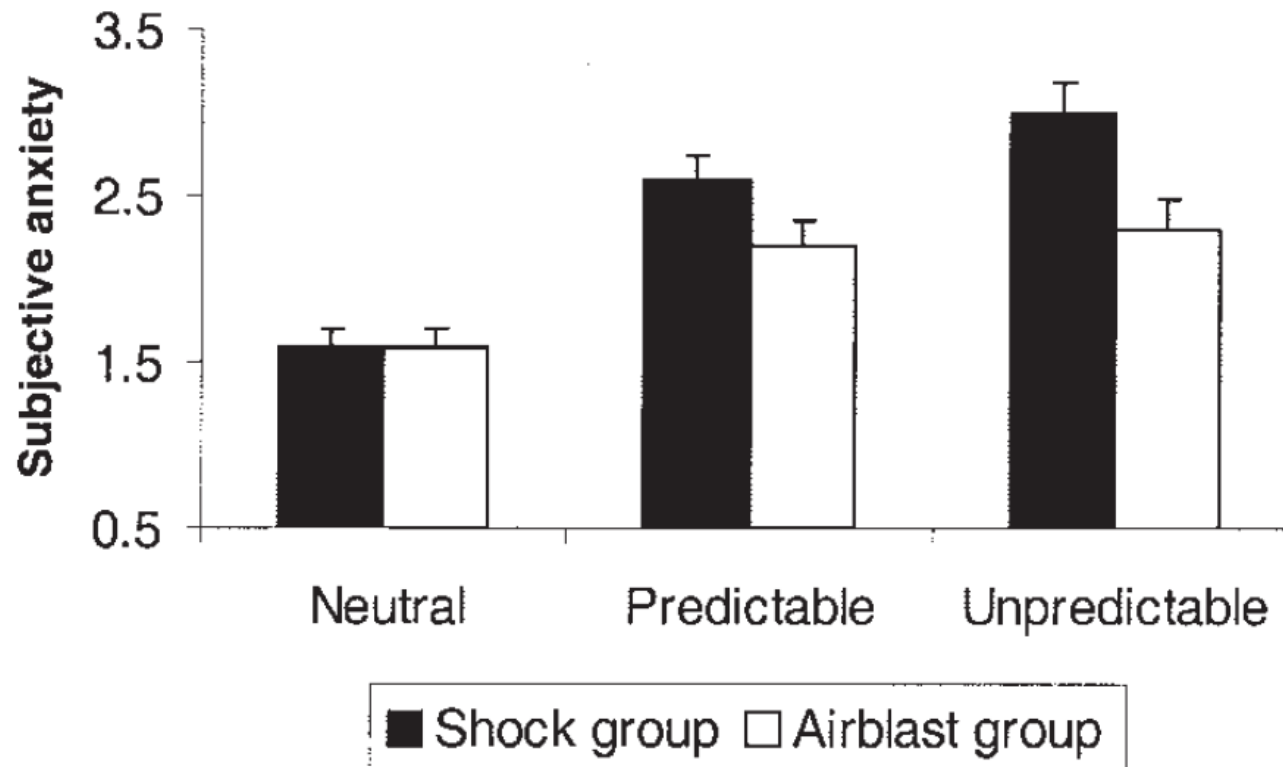
3rd ALPINE CHAPTER SYMPOSIUM
+
HALF DAY EEG-FMRI TRAINING COURSE

November 3rd – 4th, 2017
Inselspital, University of Bern

SCAN
Super Center for Neural Recovery

INSELSPITAL
UNIVERSITÄTSSPITAL BERN
HOPITAL UNIVERSITAIRE DE BERNE
BERN UNIVERSITY HOSPITAL

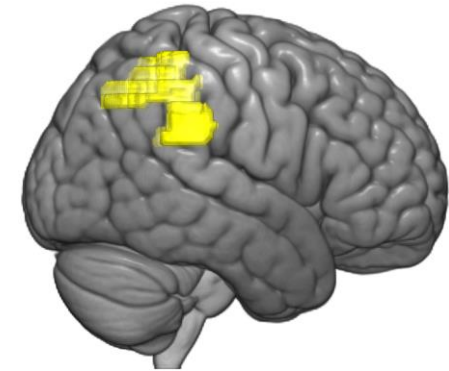
Background: anxiety vs. fear



Grillon et al. (2004), *Behav Neurosci*

Background: **Rationale**

- > Sustained anxiety is a key symptom of anxiety disorders.
- > Anxiety magnitude is negatively correlated to the activation in the right inferior parietal lobe (rIPL).
 - Particularly under the threat of an unpredictable shock, but not under neutral or predictable shock conditions (Hasler et al. 2007, *J Neurosci*).



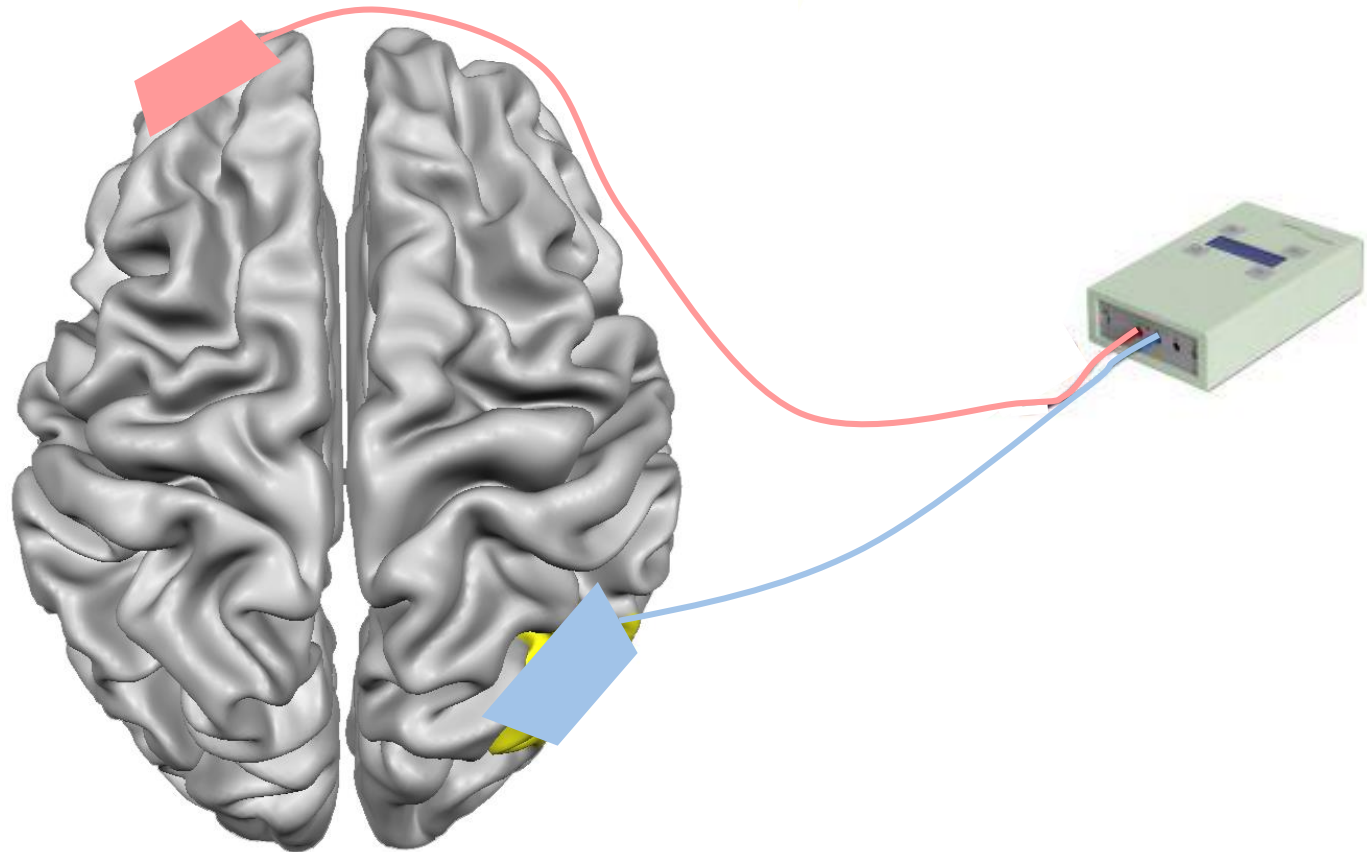
Background: **Aim of study**

- > Causal role of right inferior parietal lobe on anxiety

Background: region of interest – rIPL

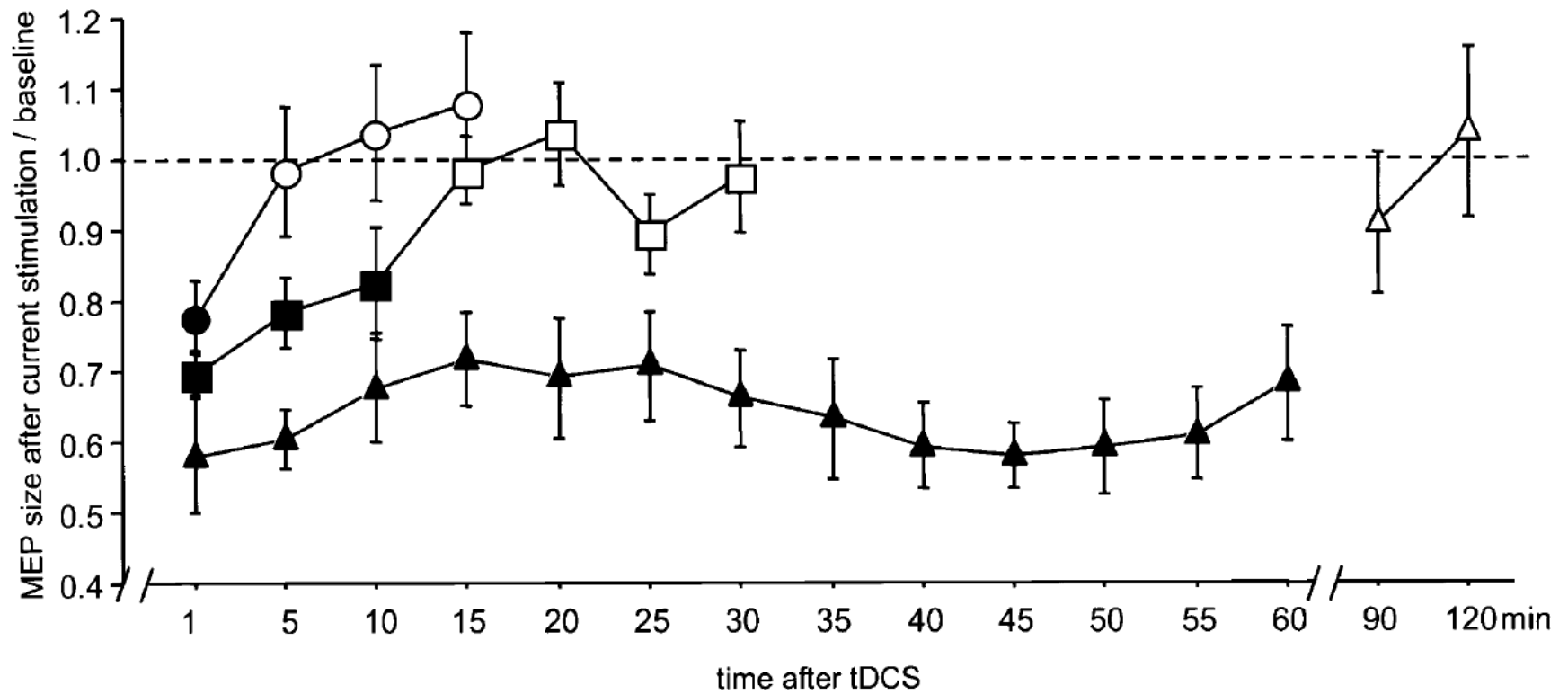
- > Lower CBF in anxiety (Kimbrell et al. 1999, Biol Psychiatr)
- > Resilience factor of stress in unpredictable threat situations
(Hasler et al. 2007, J Neurosci)
- > Decision making in ambiguous situations (Huettel et al. 2006, Neuron)
- > Spatial attention and distractibility (Small et al. 2003, NeuroImage)

Methods: tDCS setup



Background: tDCS

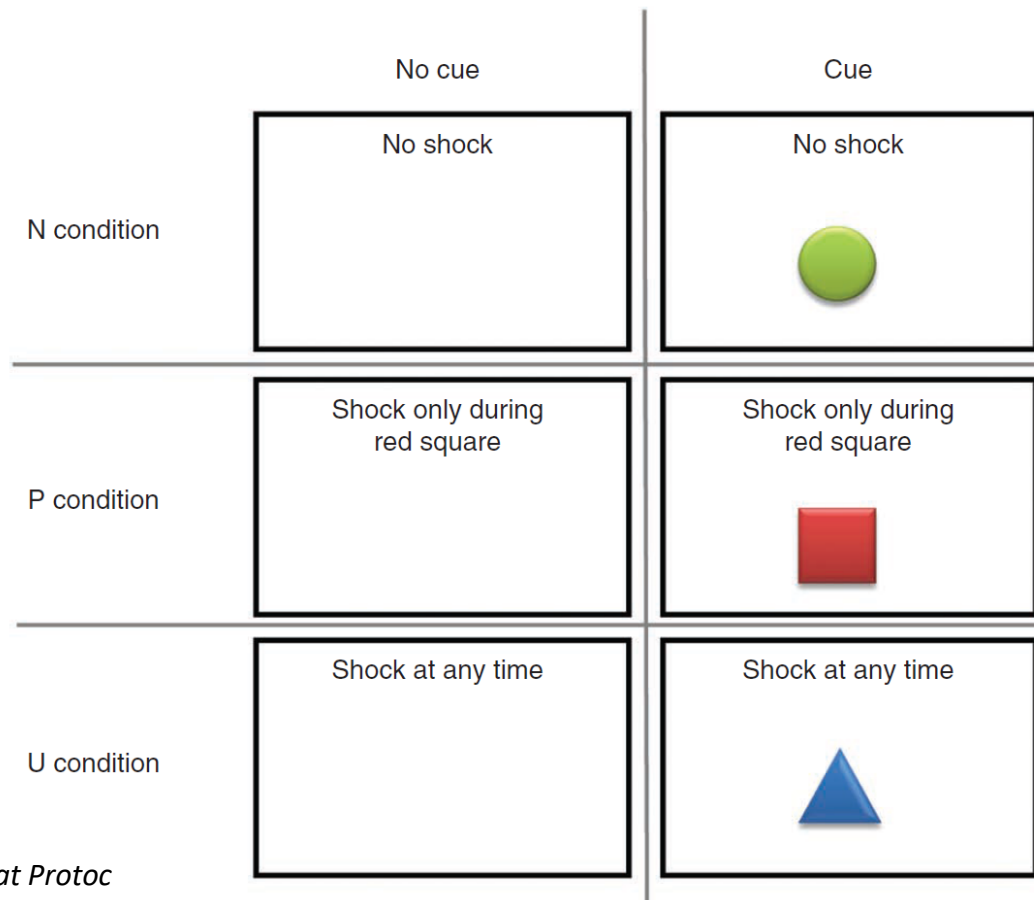
– Cathodal tDCS → decrease of cortical excitability



Nitsche et al. (2003), *Clin Neurophysiol*

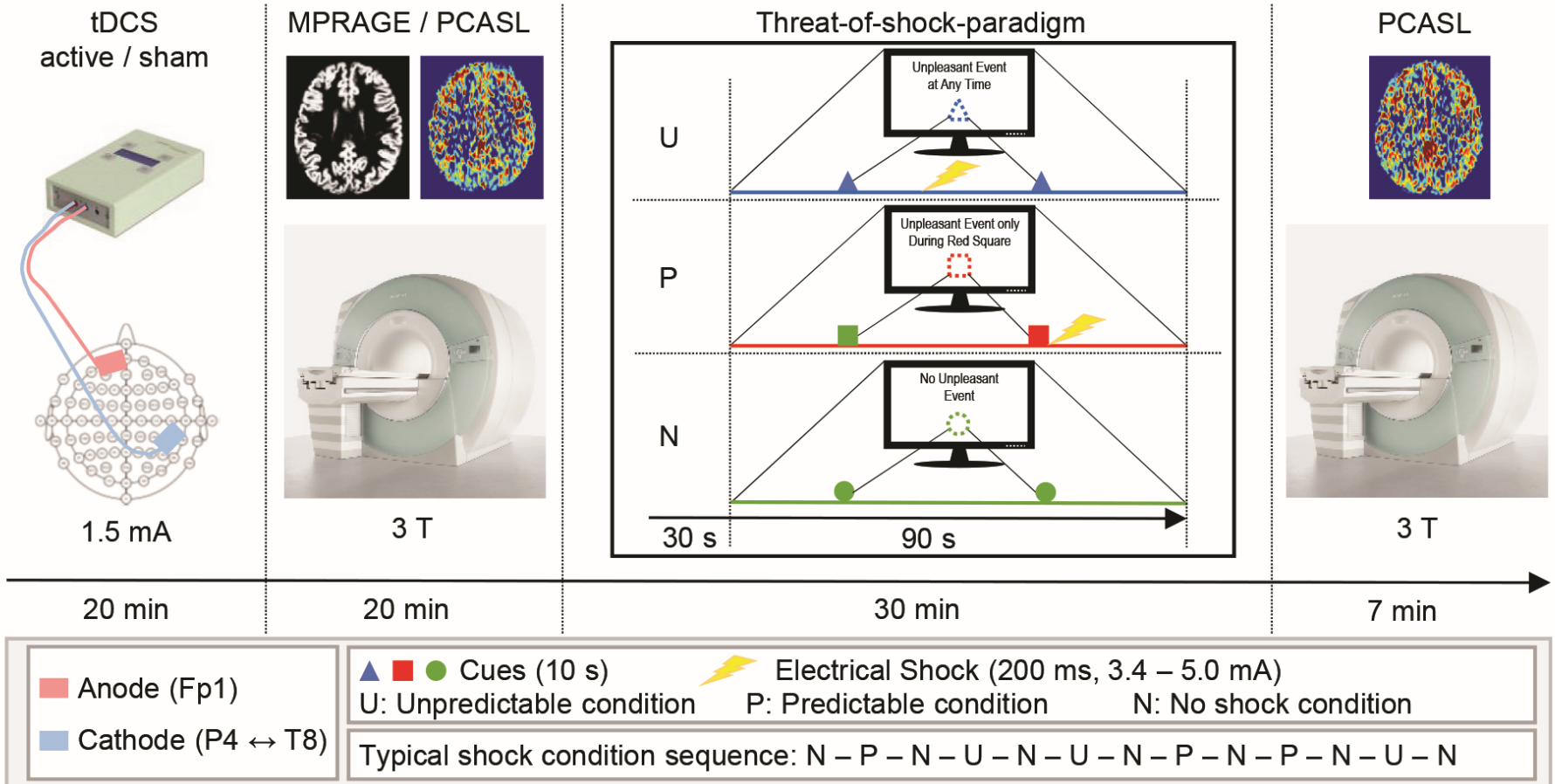
Methods: anxiety-inducing task

> Threat-of-shock-paradigm



Schmitz & Grillon (2012), *Nat Protoc*

Methods: Experimental procedure



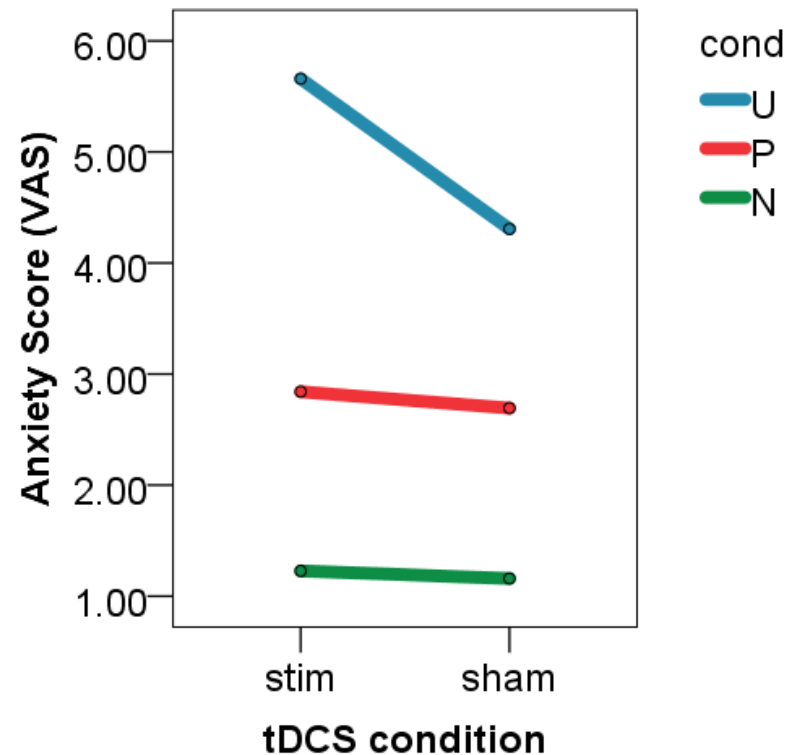
Grieder et al. (in prep.)

Hypotheses

- > tDCS reduces cerebral blood flow in the rIPL (Zheng et al. 2011, *NeuroImage*).
- > tDCS increases anxiety levels relative to sham tDCS, in the unpredictable threat condition (Hasler et al. 2007, *J Neurosci*; Nitsche et al. 2003, *Clin Neurophysiol*).
- > Possible effect of tDCS on the CBF time course in neuronal networks that are either hyperactive or hypoactive in anxiety disorders (Jensen et al. 2003, *Neuron*; Etkin & Wager 2007, *Am J Psychiatr*).

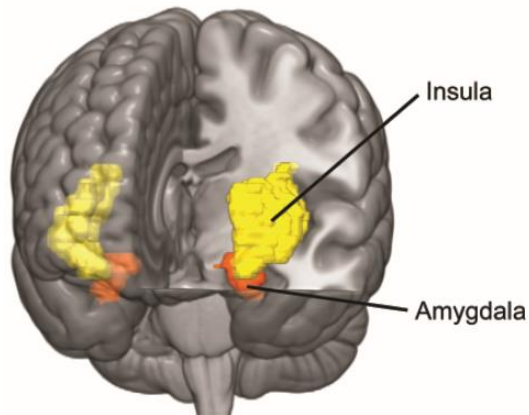
Results: Anxiety

- > anxiety levels: U > P > N ($F = 207.15$, $p < 0.001$, partial $\eta^2 = 0.91$)
- > tDCS augmented anxiety only in U ($F = 27.6$, $p < 0.001$, partial $\eta^2 = 0.57$)

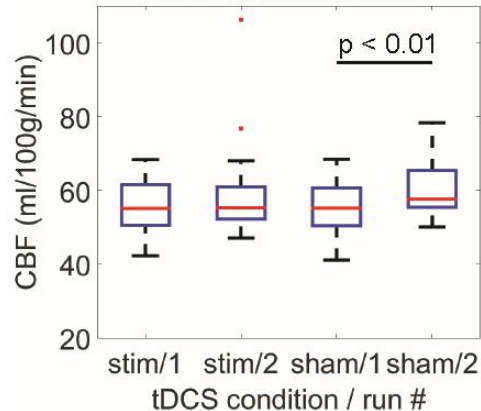


Results: Cerebral Blood Flow

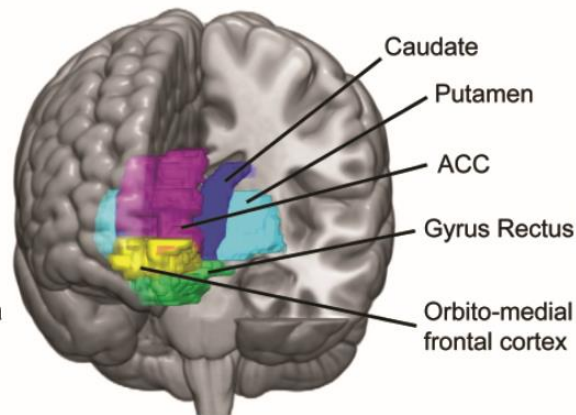
Anxiety hyperactivation network



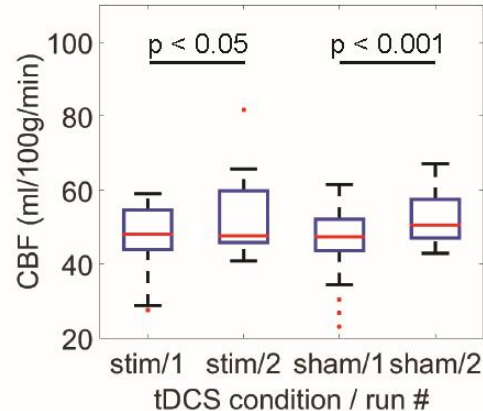
CBF course of time



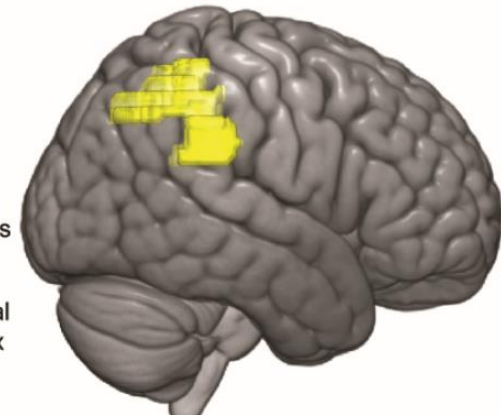
Anxiety hypoactivation network



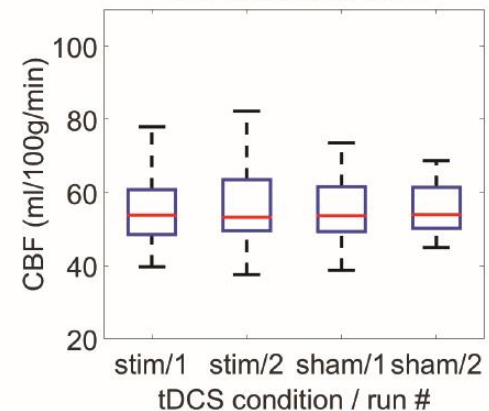
CBF course of time



right IPL (cathode region)

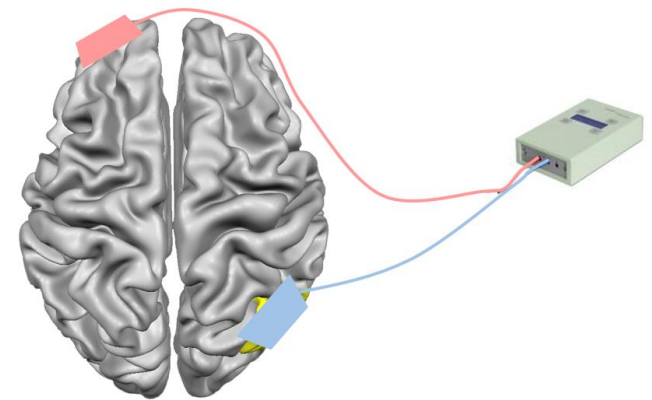


CBF course of time



Discussion

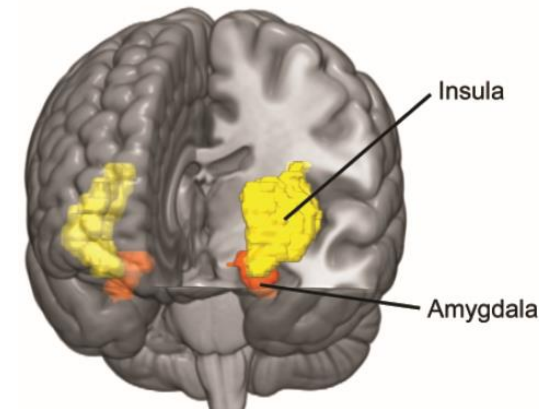
- > Right inferior parietal lobe **cathodal tDCS** reinforces anxiety response to unpredictable threat situations, but does **not alter cerebral blood flow in the same region.**
- > CBF-finding might have been influenced by anodal DLPFC stimulation



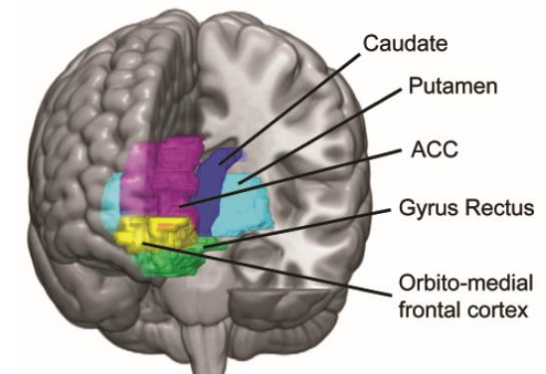
Discussion

- > Reinforced anxiety due to a dysbalanced activation in neuronal networks related to sustained anxiety.
- > CBF-increase in hypoactivation network might reflect relief after concluding shock-paradigm (caudate & putamen as reward system, Jensen et al. 2003, *Neuron*)

Anxiety hyperactivation network



Anxiety hypoactivation network



Acknowledgment



Philipp Homan



Center for Psychiatric Neuroscience, The Feinstein Institute for Medical Research Hofstra-Northwell School of Medicine, New York, NY, USA



Andrea Federspiel



Gregor Hasler



University Hospital of Psychiatry Bern, Translational Research Center, University of Bern, Switzerland



Claus Kiefer



Institute of Diagnostic and Interventional Neuroradiology, University Hospital Bern, Bern, Switzerland