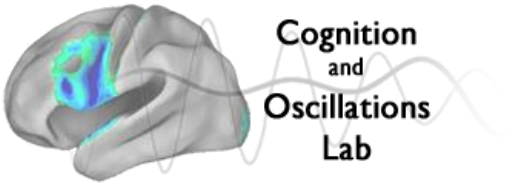
Decreased Beta Power As A Predictor Of Memory Encoding



Dr. Simon Hanslmayr

University of Birmingham, School of Psychology
www.uni-konstanz.de/oscillations-and-cognition/

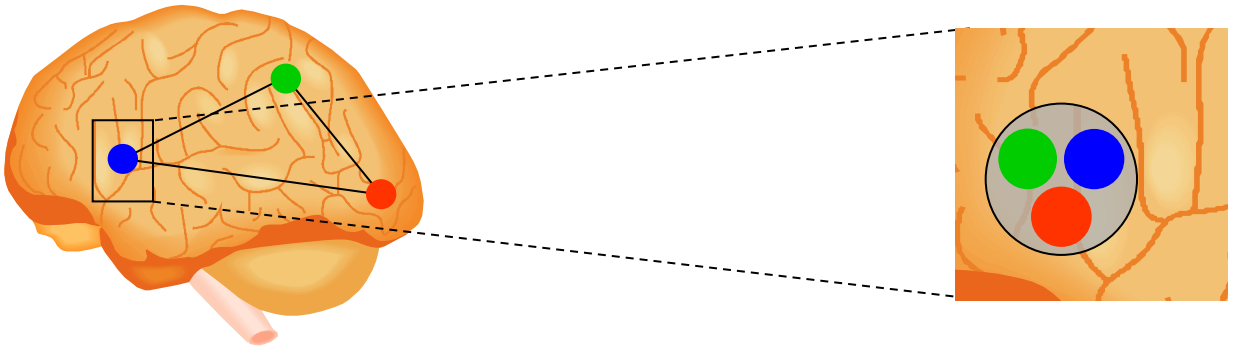
Why brain oscillations?

Brain Oscillations = Communication Mechanisms!

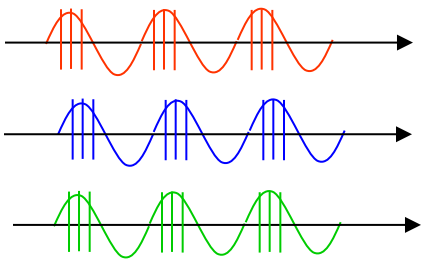
(Varela et al., 2001; Nat Neurosci; Fries et al., 2005; Trends in Cogn Sci)

Large Scale

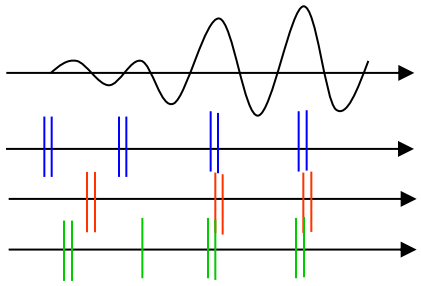
Local Scale



Phase:

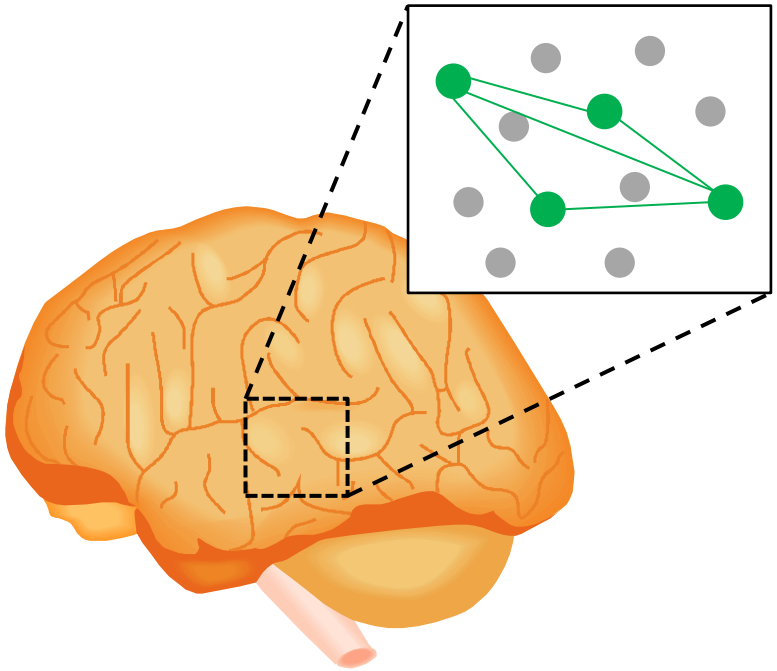


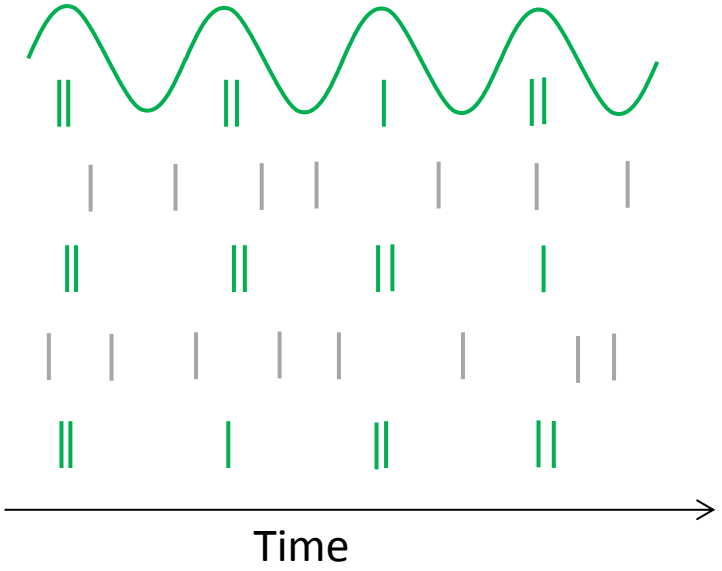
Power:



The Classic Model

„Fire together wire together“

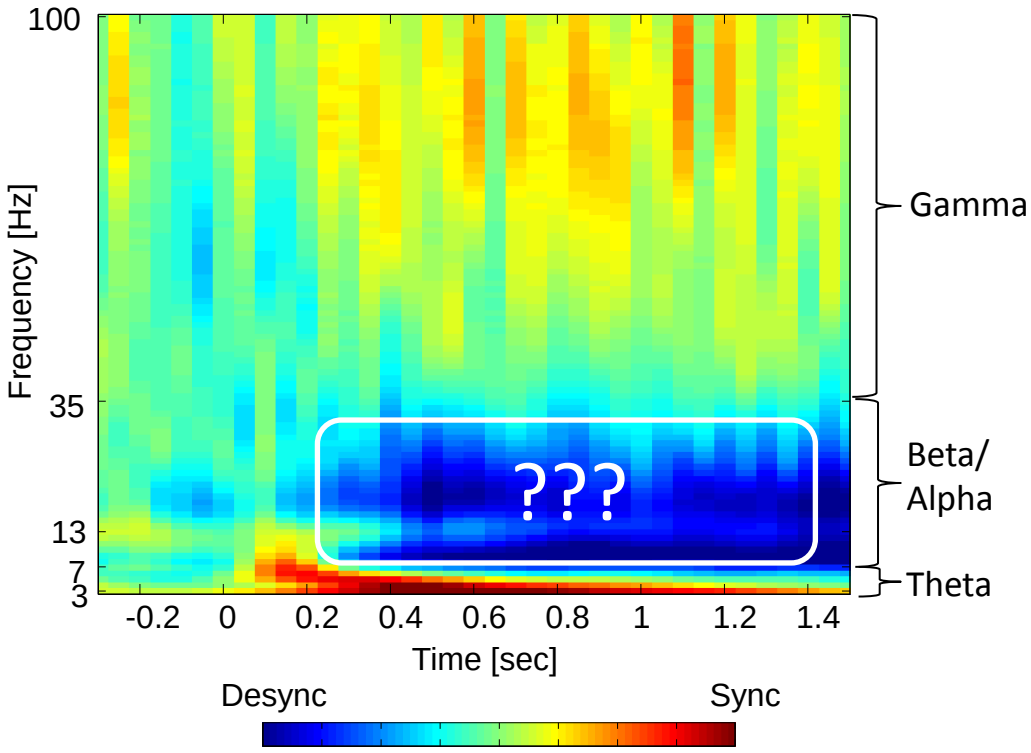




Brain Oscillations = Neural Synchronization = Memory

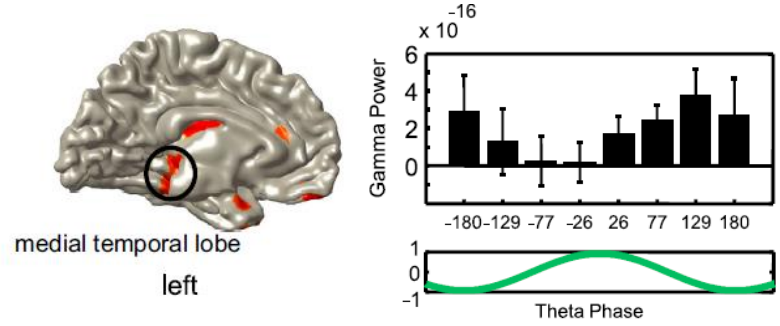
Brain Oscillations and Memory

How is desynchronization related to memory?



Theta and Gamma Sync. positively related to memory

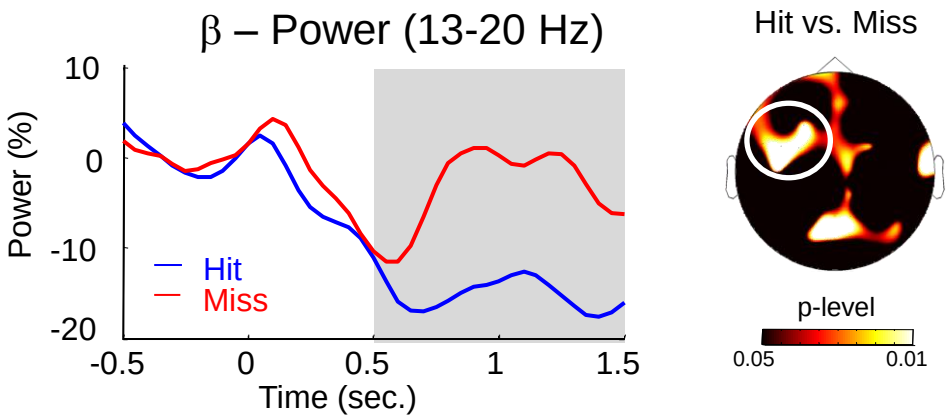
- Rutishauser et al. (2010) *Nature*
- Fell & Axmacher (2011) *Nat Rev Neurosci*



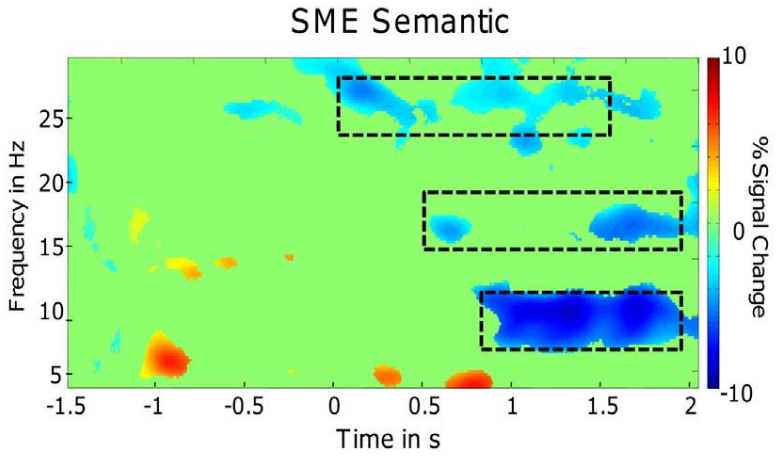
Staudigl & Hanslmayr (2013) *Curr Biol*

Alpha/Beta power decreases predict memory formation

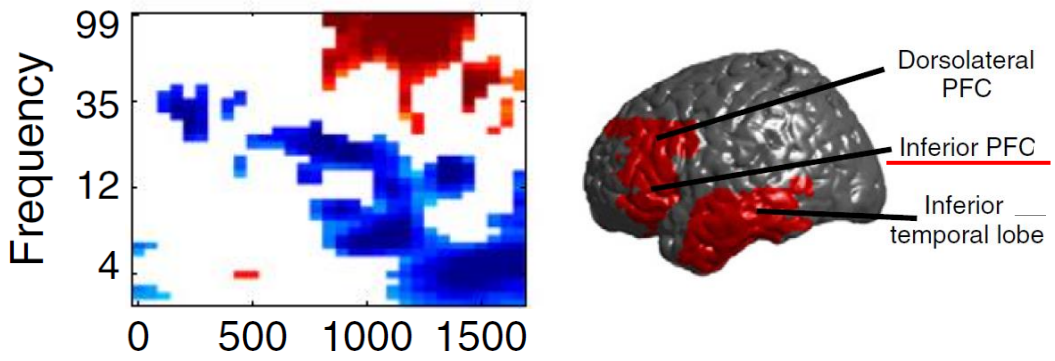
Hanslmayr et al. (2009) *Cereb Cortex*



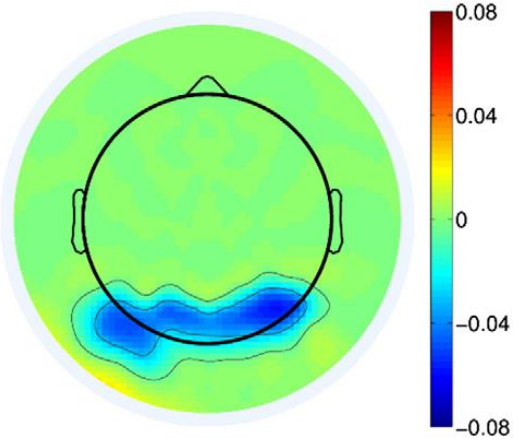
Fellner et al. (2013) *NeuroImage*



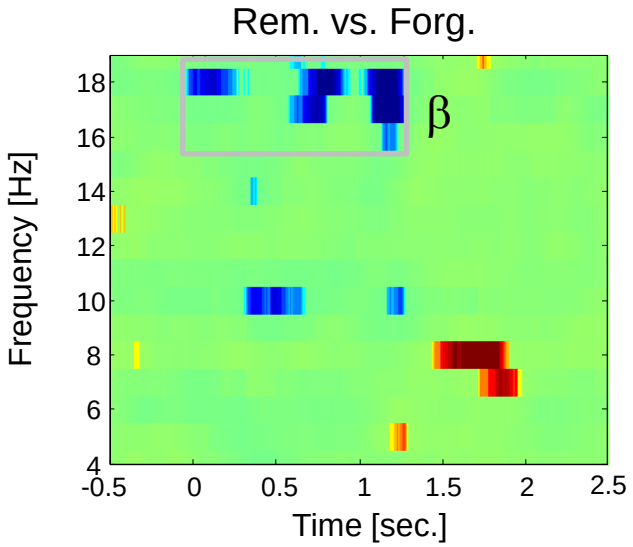
Long et al. (2013) *NeuroImage*

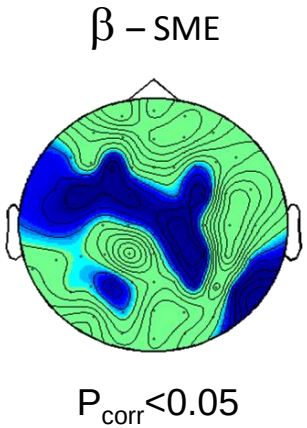


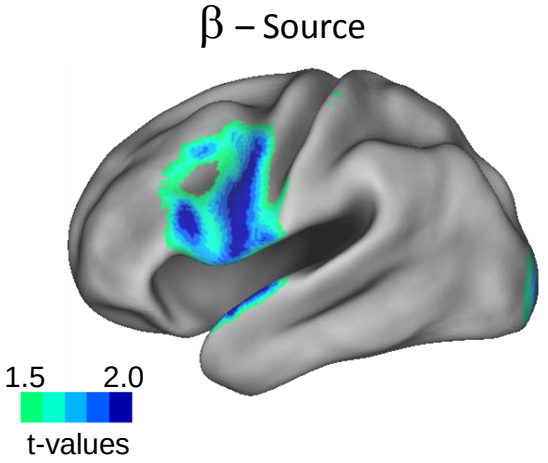
Noh et al. (2014) *NeuroImage*

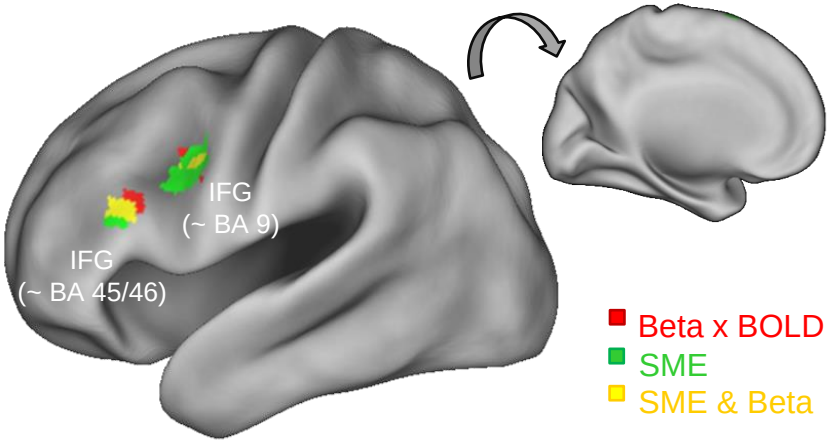


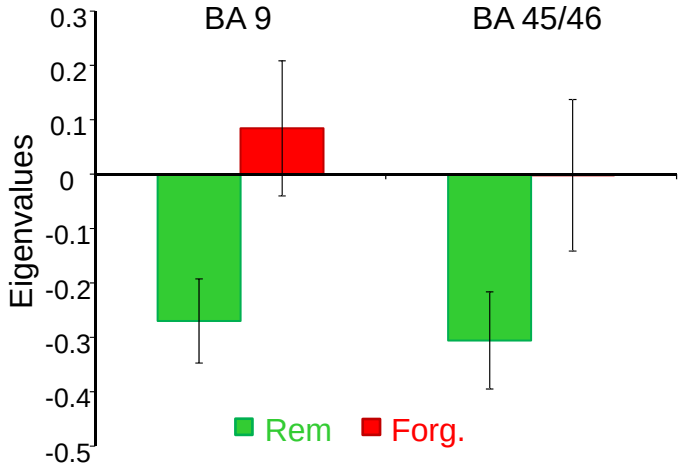
EEG-fMRI during encoding









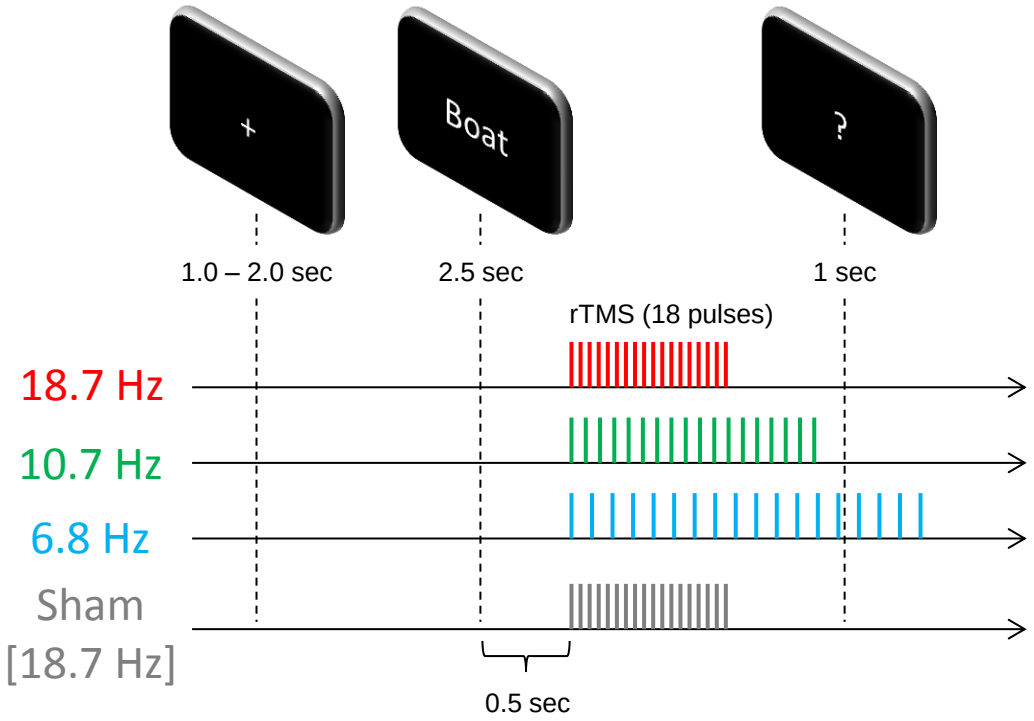


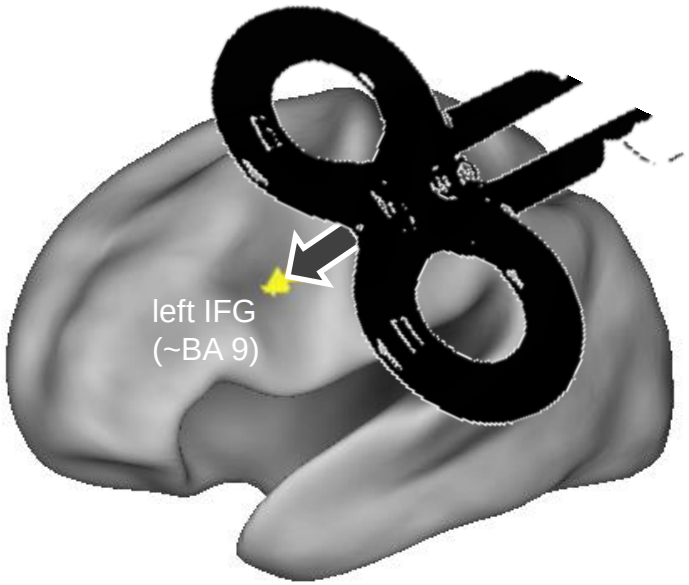
Hanslmayr et al. (2011) *J Neurosci*

EEG-BOLD correlations

- Question
  - Are beta power decreases in the left IFG epiphenomenal?
  - Are they causally relevant to memory formation?
  - Can we entrain beta oscillations in the left IFG and would that impair memory formation?

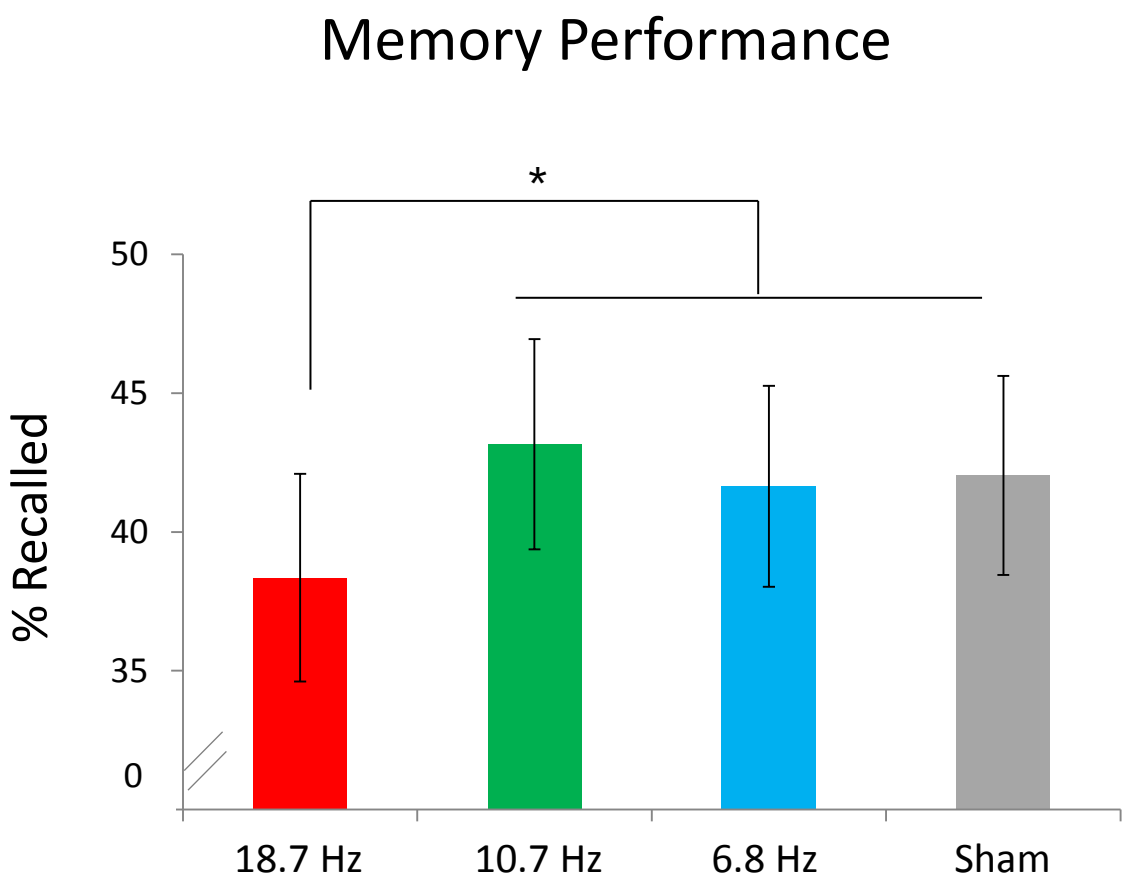
rTMS-EEG and Encoding





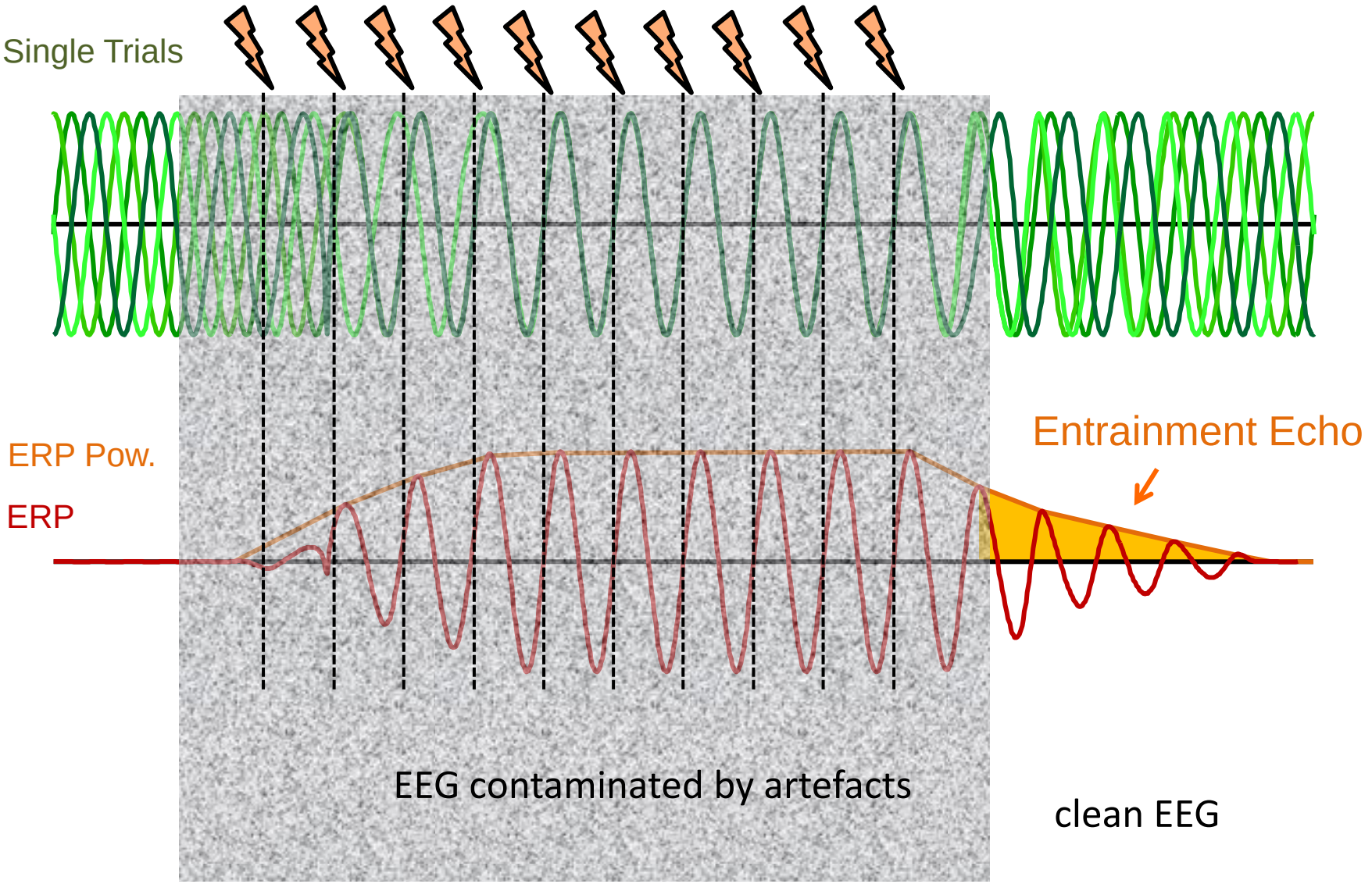
Hypothesis: Entrainment of beta oscillations at left IFG specifically impairs memory encoding

rTMS-EEG - *Behavioral Data*

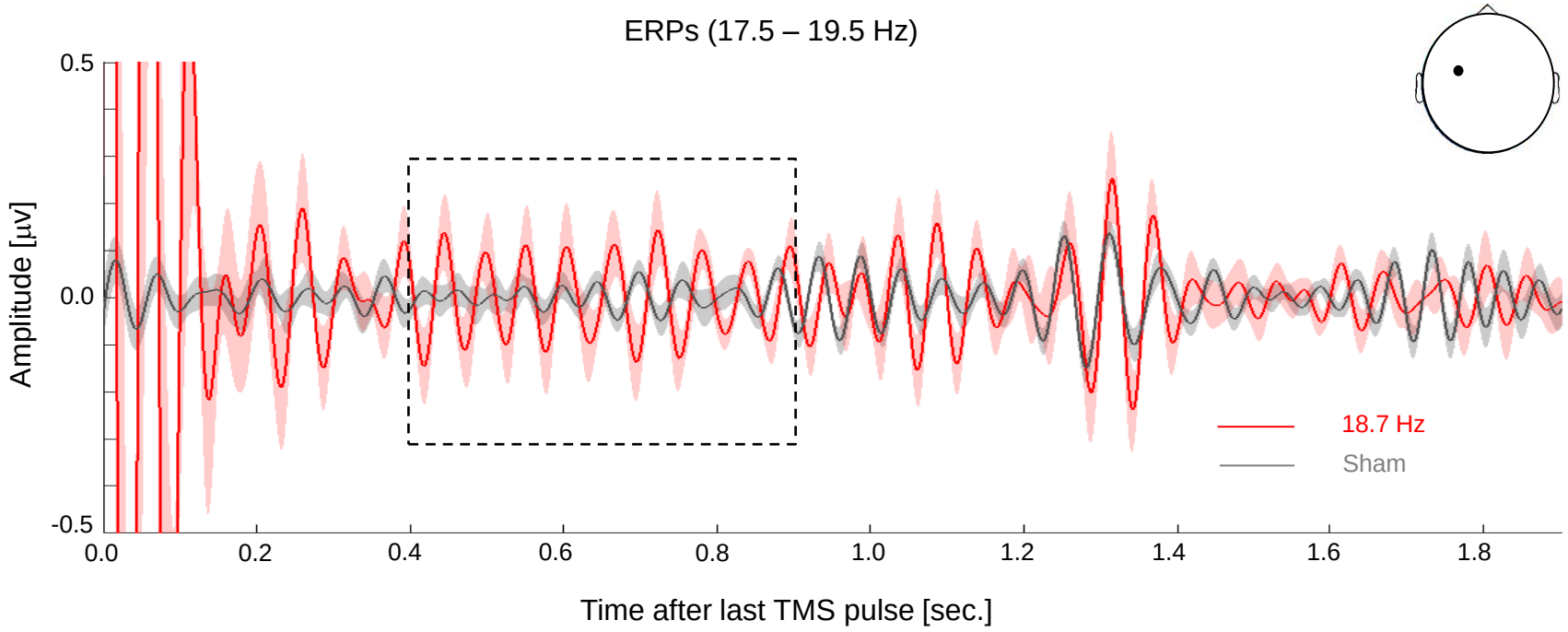


Hanslmayr, Matuschek, Fellner (2014) *Curr Biol*

rTMS-EEG – *Evidence for Entrainment*

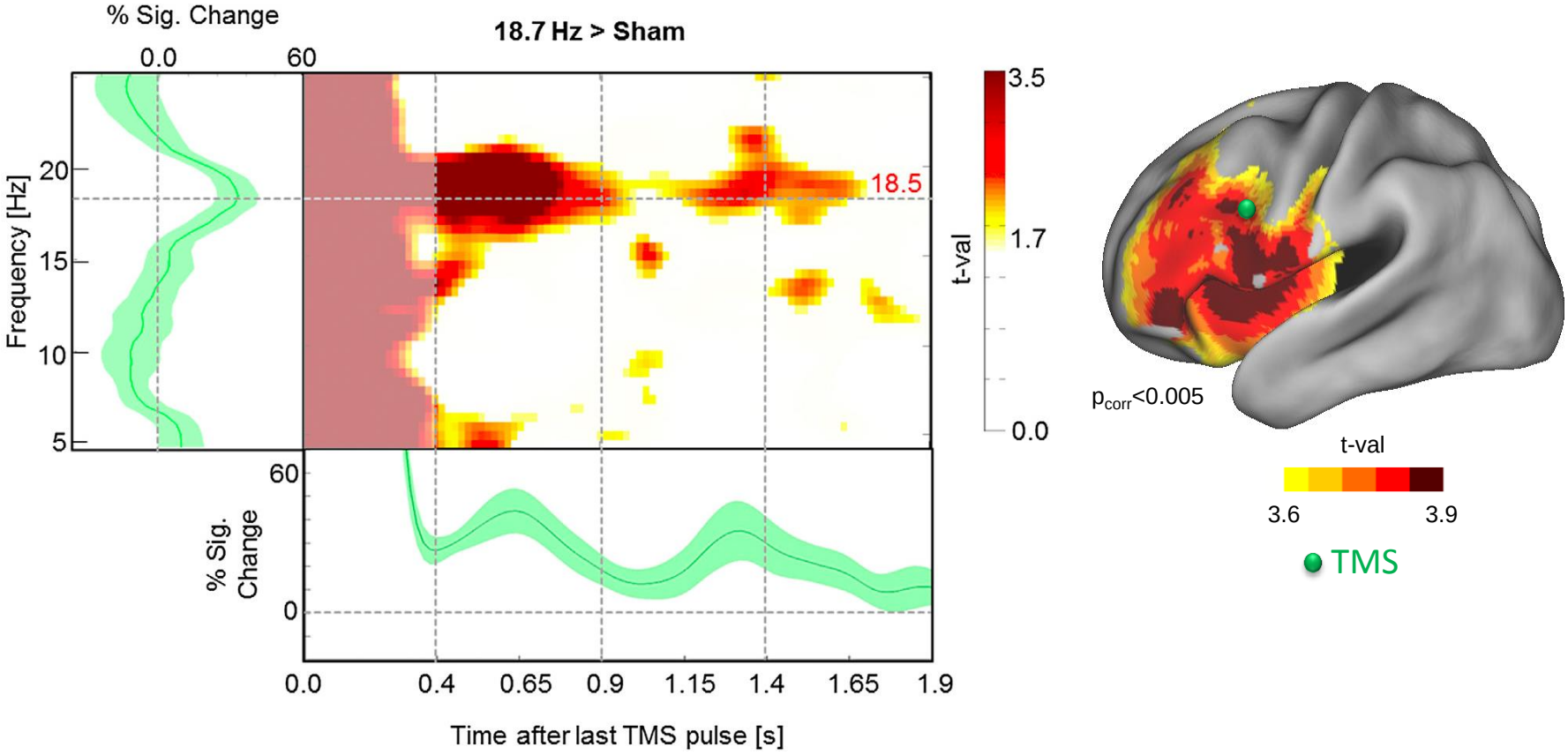


rTMS-EEG – *Evidence for Entrainement*



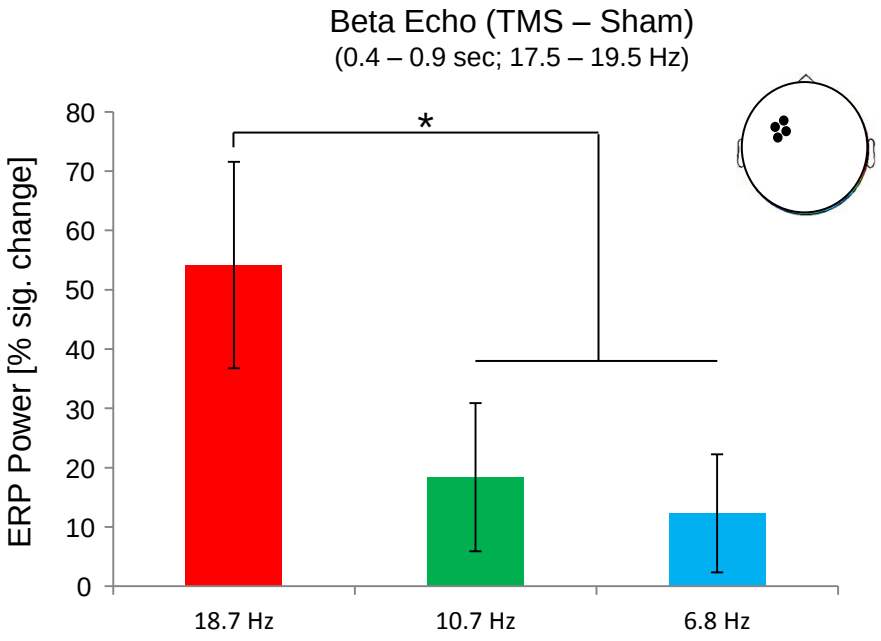
Hanslmayr, Matuschek, Fellner (2014) *Curr Biol*

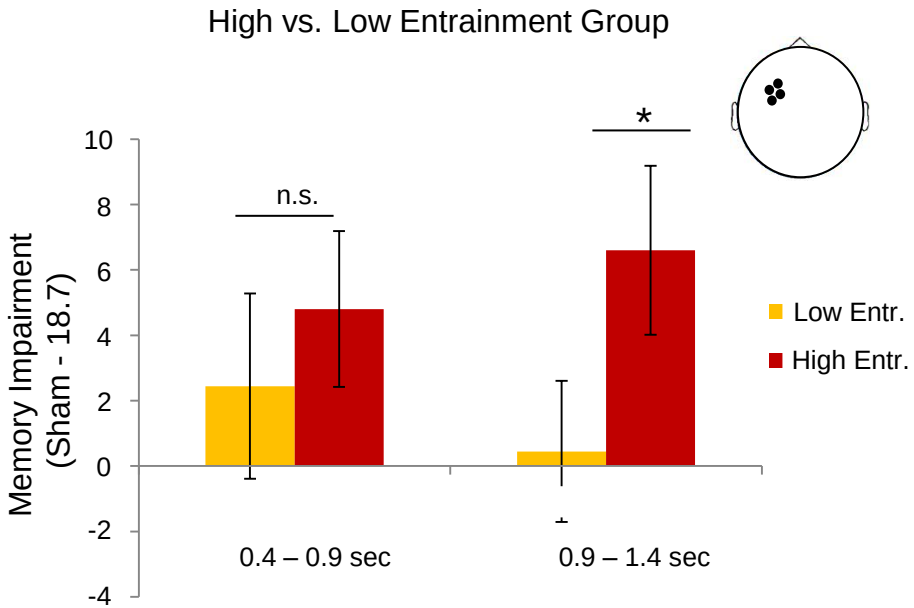
rTMS-EEG – *Evidence for Entrainement*



Hanslmayr, Matuschek, Fellner (2014) *Curr Biol*

rTMS-EEG – *Evidence for Entrainement*

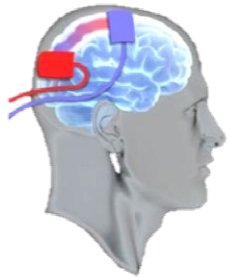




Hanslmayr, Matuschek, Fellner (2014) *Curr Biol*

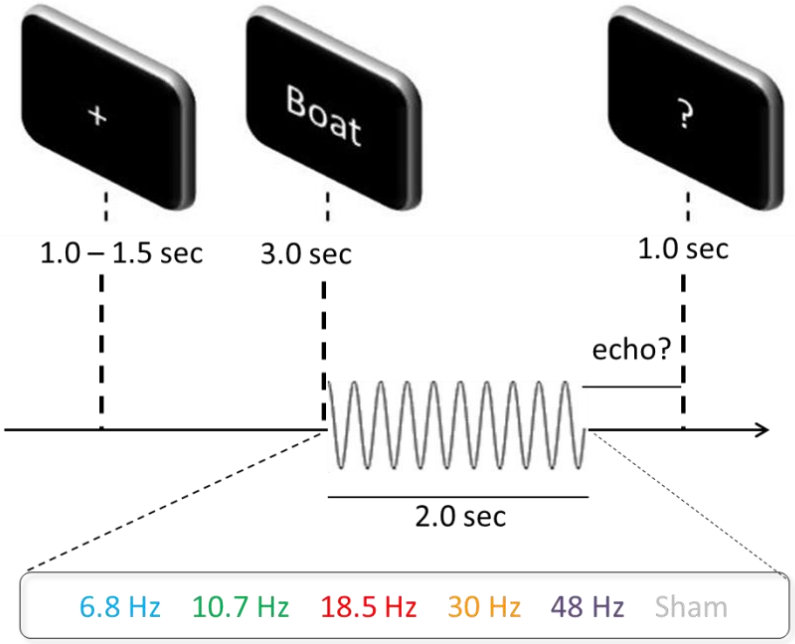
Verena Braun

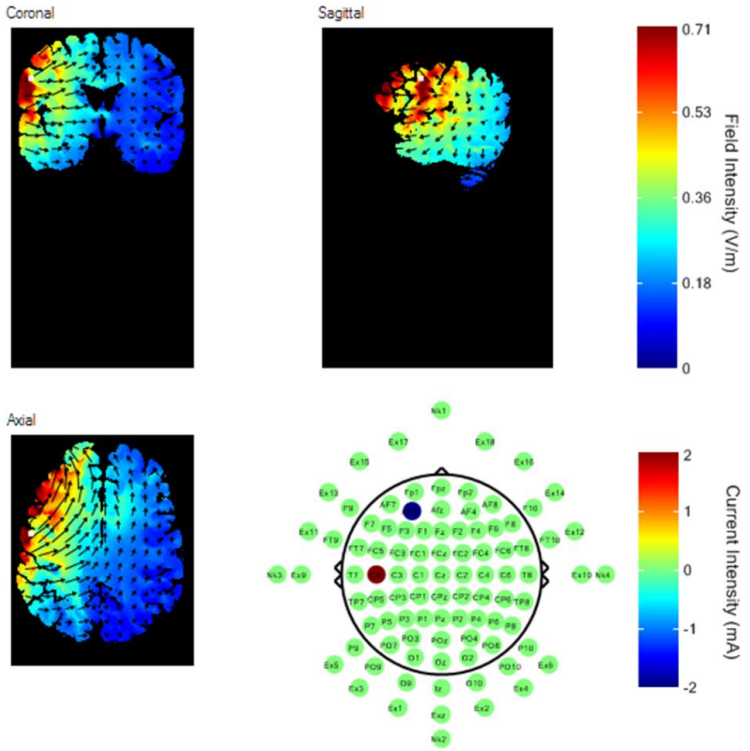
Open Question



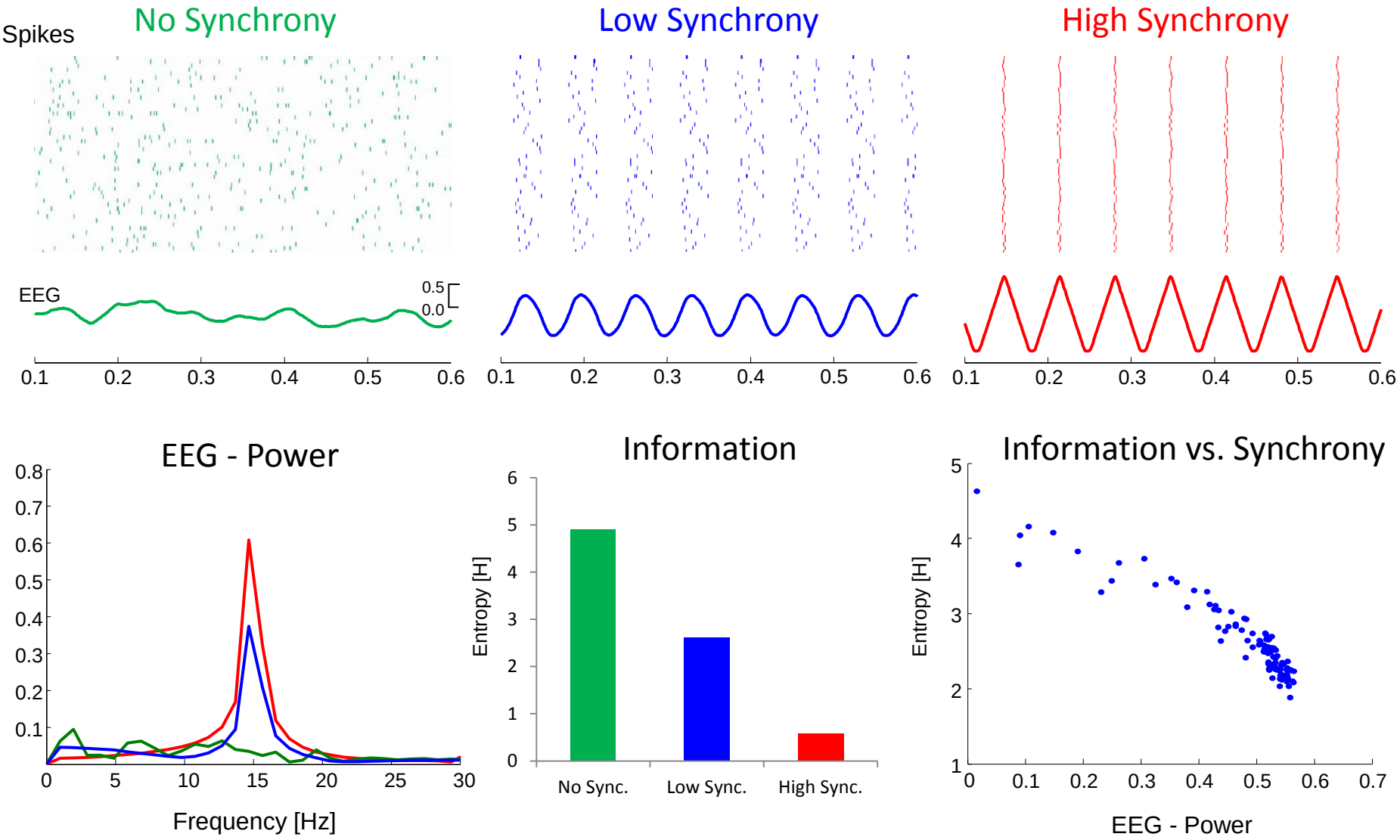
tACS

- Higher frequencies?





The information via desynchronization hypothesis



Hanslmayr, Staudigl, Fellner (2012) *Front Hum Neurosci*

Take home messages

- Alpha/Beta desynchronization plays a very active and causal role for memory formation and may represent information.
- Brain oscillations can be entrained by external stimulation and observed in terms of echoes.

WML019: Temporal Pattern Similarity In Human MEG And Intracranial EEG Reveals The Reinstatement Of Episodic Memory Trajectories

Presented by: **Tobias Staudigl, University of Konstanz, Germany**

Authors: Tobias Staudigl, Christian Vollmar, Soheyl Noachtar, Simon Hanslmayr

Wednesday, 4pm-6pm
Poster Session 3
Rooms P9-P11

Thank you for your attention …

- Cognition and Oscillations Lab:

Gerd Waldhauser
(Konstanz Univ.)

Tobias Staudigl
(Konstanz Univ.)

Marie-Christin Fellner
(Konstanz Univ.)

Jonas Matuschek
(Konstanz Univ.)

Verena Braun
(Birmingham Univ.)

Rolandas Stonkus
(Birmingham Univ.)

Sebastian Michelmann
(Birmingham Univ.)

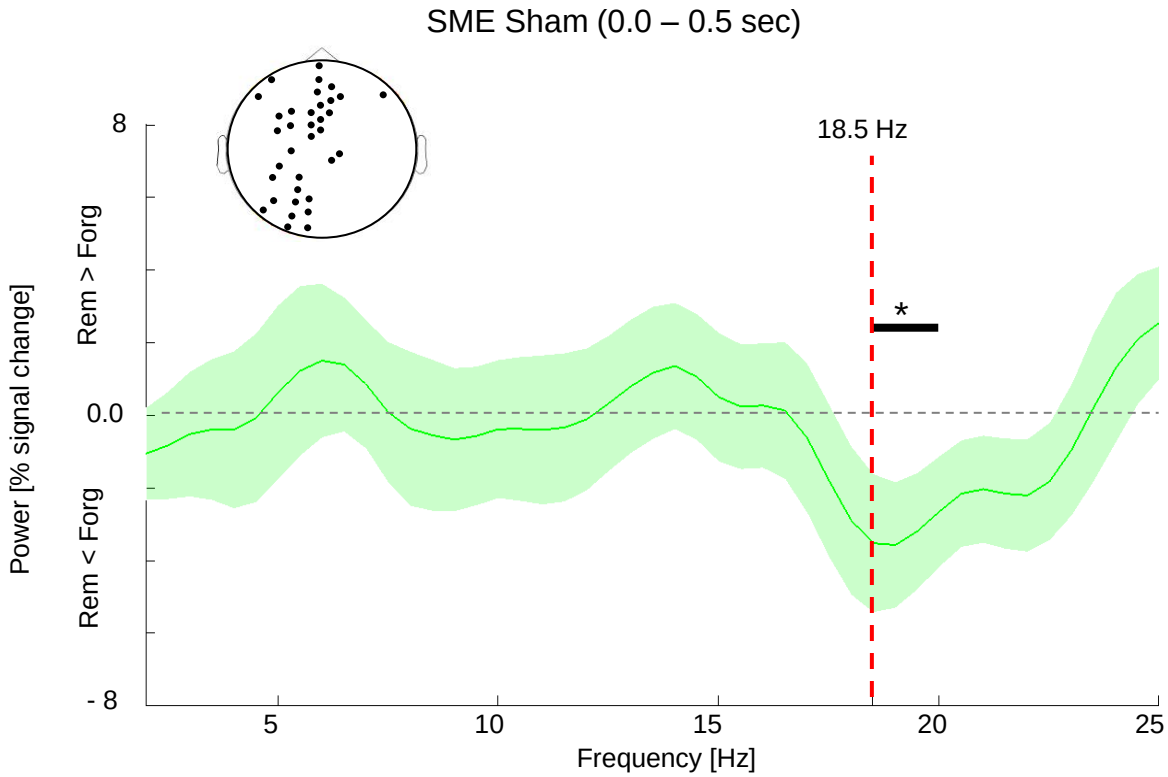
- Funding:


Zukunftskolleg
frei • kreativ • verbindend


Emmy
Noether-
Programm
Deutsche
Forschungsgemeinschaft
DFG

rTMS-EEG – *Evidence for Entrainement*

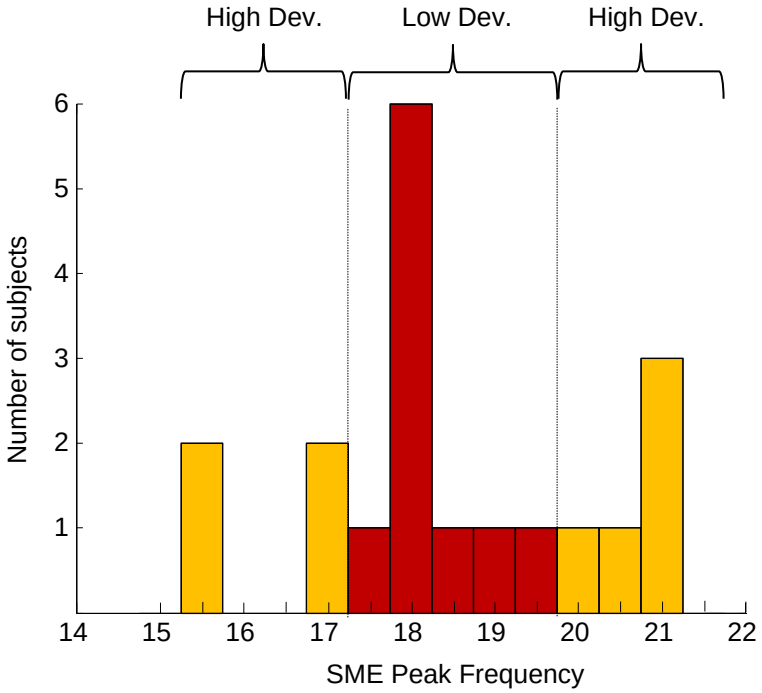
Relation between entrained frequency and spontaneous frequency

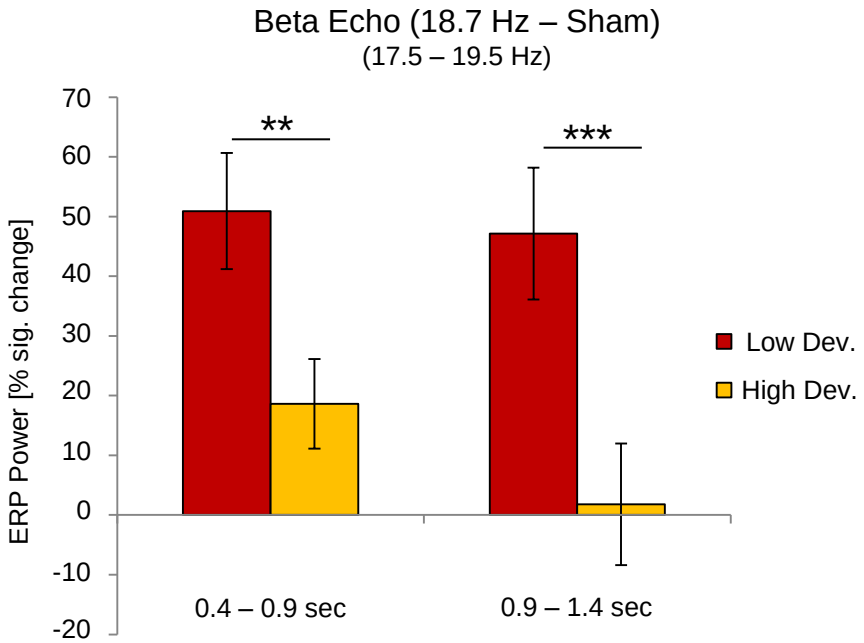


Hanslmayr, Matuschek, Fellner (2014) *Curr Biol*

rTMS-EEG – *Evidence for Entrainement*

Relation between entrained frequency and spontaneous frequency





Hanslmayr, Matuschek, Fellner (2014) *Curr Biol*