

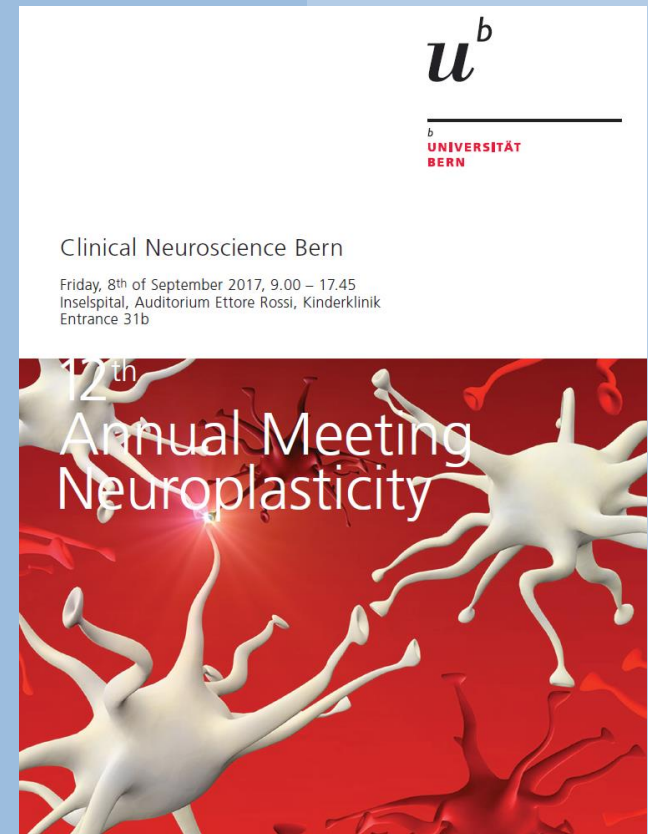
Clinical Neuroscience Bern

12th Annual Meeting, September 8, 2017

Bilateral temporal tDCS enhances sleep-dependent episodic memory consolidation

Matthias Grieder, Sarah Mueller, Stephanie Winkelbeiner, and Thomas Dierks

Division of Systems Neuroscience of
Psychopathology
Translational Research Center
University Hospital of Psychiatry Bern



Background: **Rationale**

»The relationship between sleep disorders and neurological disorders is often reciprocal, such that sleep disorders are worsened by neurological symptoms and that neurological disorders are aggravated by poor sleep.«

Ebajemito, J. K., et al. (2016). Frontiers in Neurology, 7, 54.

Background: Promising Results

The Journal of Neuroscience, November 3, 2004 • 24(44):9985–9992 • 9985

Behavioral/Systems/Cognitive

Transcranial Direct Current Stimulation during Sleep Improves Declarative Memory

Lisa Marshall, Matthias Mölle, Manfred Hallschmid, and Jan Born
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Background: Promising Results

nature

Vol 444 | 30 November 2006 | doi:10.1038/nature05278

LETTERS

Boosting slow oscillations during sleep potentiates memory

Lisa Marshall¹, Halla Helgadóttir¹, Matthias Mölle¹ & Jan Born¹

Background: Promising Results

The Journal of Neuroscience, July 26, 2017 • 37(30):7111–7124 • 7111

Behavioral/Cognitive

Promoting Sleep Oscillations and Their Functional Coupling by Transcranial Stimulation **Enhances Memory Consolidation** in Mild Cognitive Impairment

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Background: Disillusioning Results

Behavioral Neuroscience
2017, Vol. 131, No. 4, 277–288

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0735-7044/17/\$12.00 <http://dx.doi.org/10.1037/bne0000202>

REPLICATION

No Evidence for Enhancements to Visual Working Memory With Transcranial Direct Current Stimulation to Prefrontal or Posterior Parietal Cortices

Matthew K. Robison, William P. McGuirk, and Nash Unsworth
University of Oregon

Background: Disillusioning Results

Brain Stimulation 9 (2016) 730–739



Contents lists available at ScienceDirect

Brain Stimulation

journal homepage: www.brainstimjrnl.com



Boosting Slow Oscillatory Activity Using tDCS during Early Nocturnal Slow Wave Sleep **Does Not Improve** Memory Consolidation in Healthy Older Adults



Sven Paßmann ^{a,b,*}, Nadine Külzow ^{a,b}, Julia Ladenbauer ^{a,b}, Daria Antonenko ^{a,b},
Ulrike Grittner ^{c,d}, Sascha Tamm ^e, Agnes Flöel ^{a,b,d,**}

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Background: Disillusioning Results

Brain Stimulation 10 (2017) 567–575



Contents lists available at ScienceDirect

Brain Stimulation

journal homepage: <http://www.journals.elsevier.com/brain-stimulation>



A single session of prefrontal cortex transcranial direct current stimulation **does not modulate** implicit task sequence learning and consolidation



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^b Department of Neurology, Bern University Hospital Inselspital, and Center for Cognition, Learning, and Memory, University of Bern, Bern, Switzerland

Background: Disillusioning Results

Brain Stimulation 8 (2015) 528–534



Contents lists available at ScienceDirect

Brain Stimulation

journal homepage: www.brainstimjrnل.com



Oscillating Square Wave Transcranial Direct Current Stimulation (tDCS) Delivered During Slow Wave Sleep **Does Not Improve** Declarative Memory More Than Sham: A Randomized Sham Controlled Crossover Study



Gregory L. Sahlem^{a,*}, Bashar W. Badran^{a,d}, Jonathan J. Halford^b, Nolan R. Williams^{a,b}, Jeffrey E. Korte^c, Kimberly Leslie^a, Martha Strachan^a, Jesse L. Breedlove^d, Jennifer Runion^a, David L. Bachman^b, Thomas W. Uhde^a, Jeffery J. Borckardt^a, Mark S. George^{a,b,d,e}

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Background: Disillusioning Results

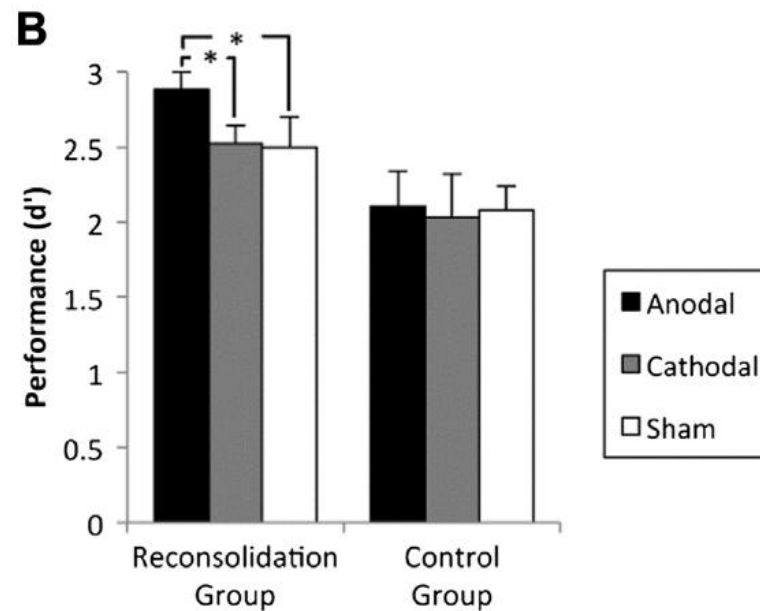


No Significant Effect of Prefrontal tDCS on Working Memory Performance in Older Adults

Jonna Nilsson, Alexander V. Lebedev and Martin Lövdén*

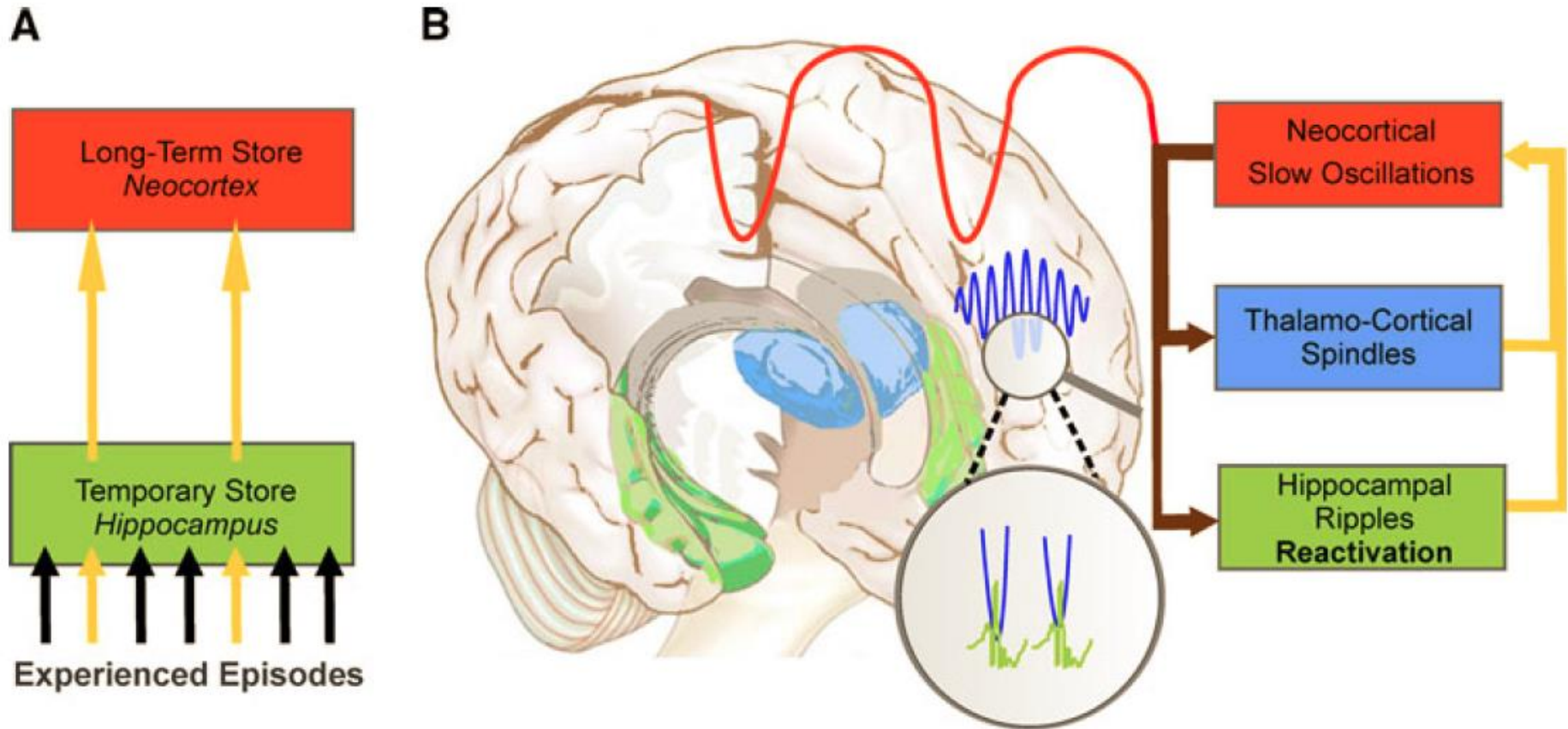
Aging Research Center, Karolinska Institutet and Stockholm University, Stockholm, Sweden

Background: tDCS and Memory Consolidation



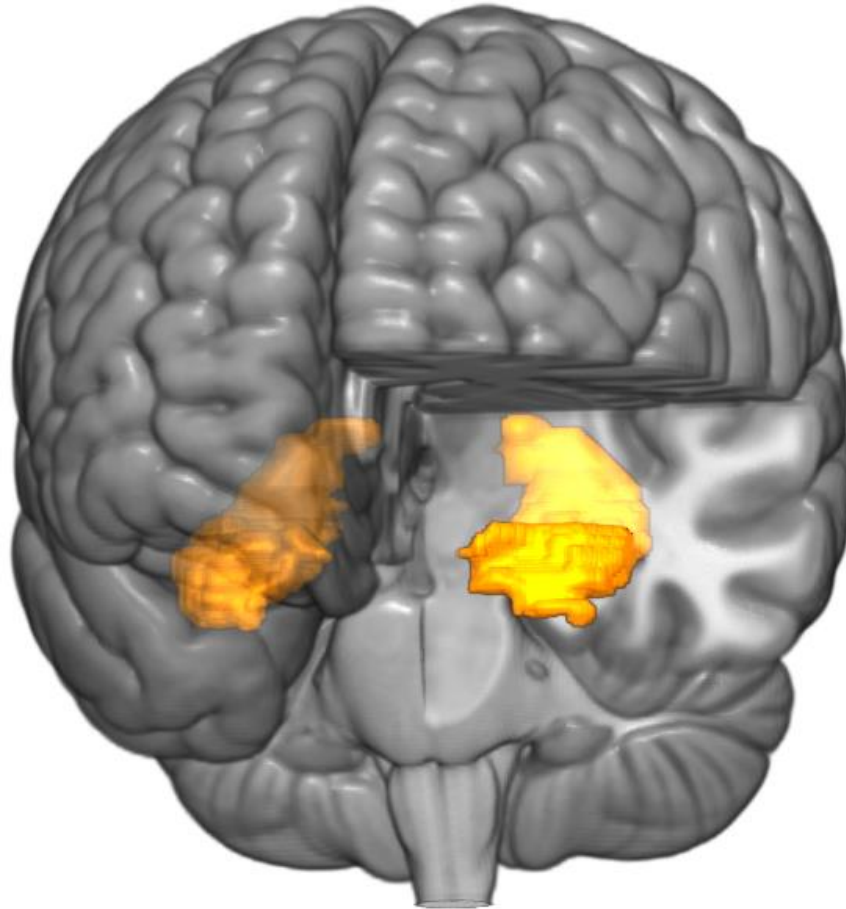
Javadi & Cheng (2013) *Brain Stim*

Methods: tDCS target region – Hippocampus



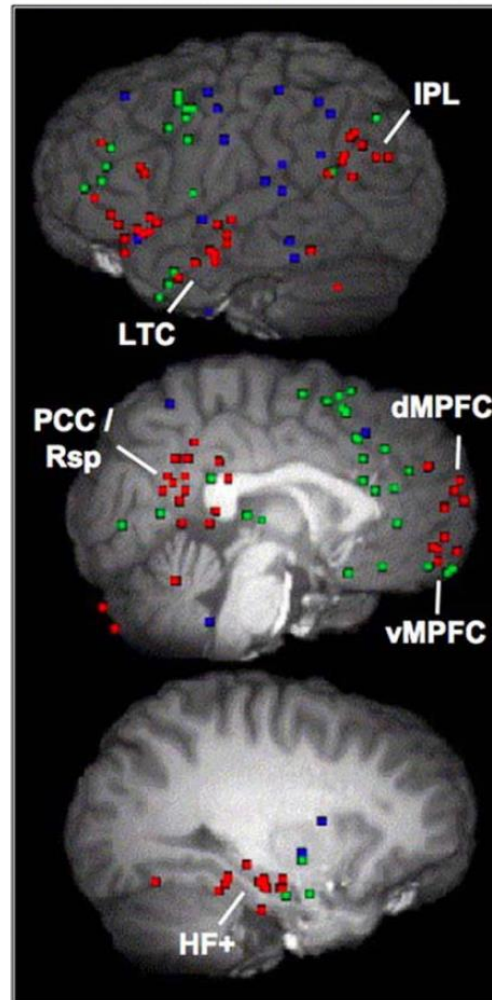
Born & Wilhelm (2012) *Psychol Res*

Methods: tDCS target region – Hippocampus



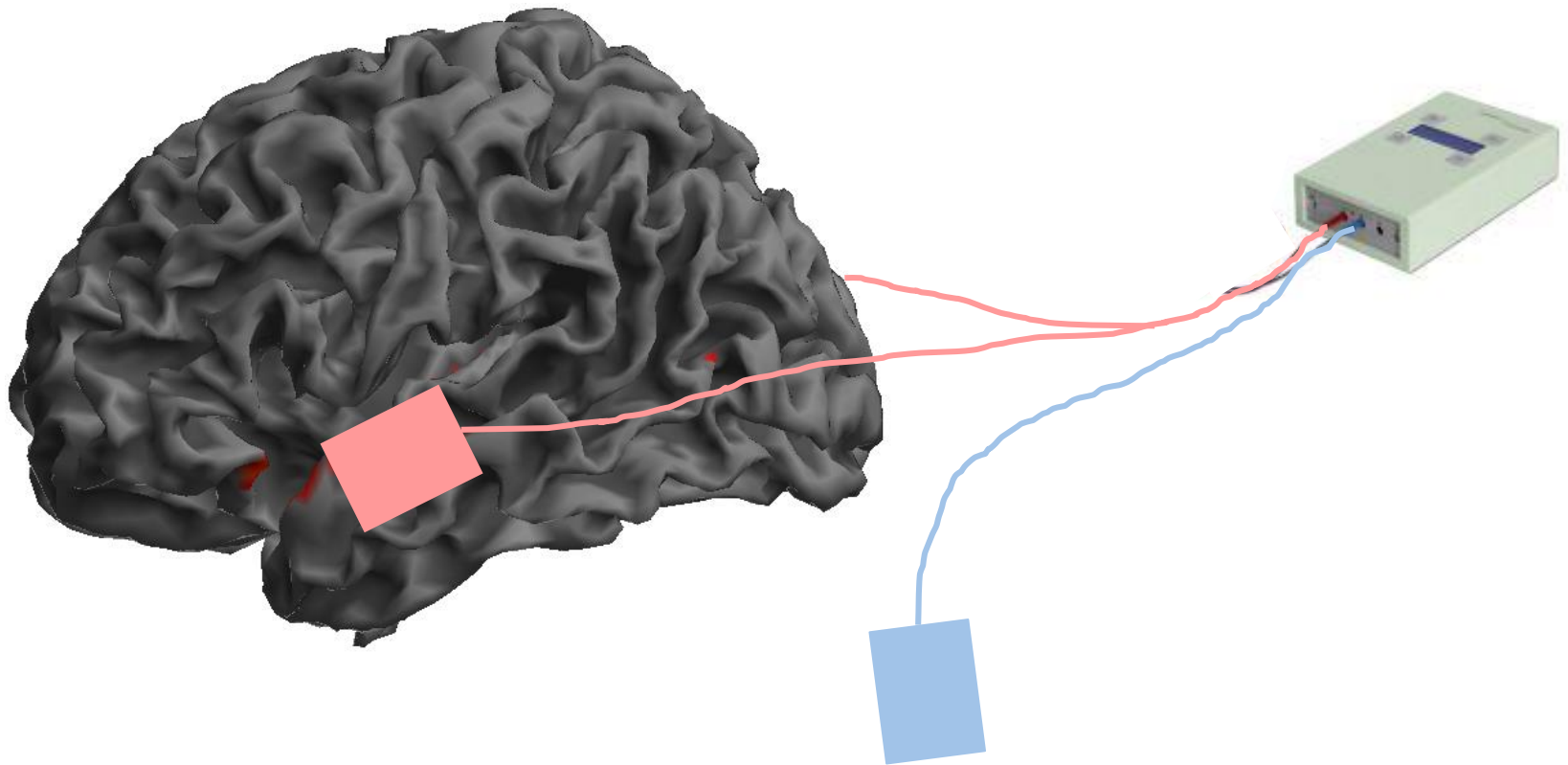
Methodological Challenge

AUTOBIOGRAPHICAL MEMORY

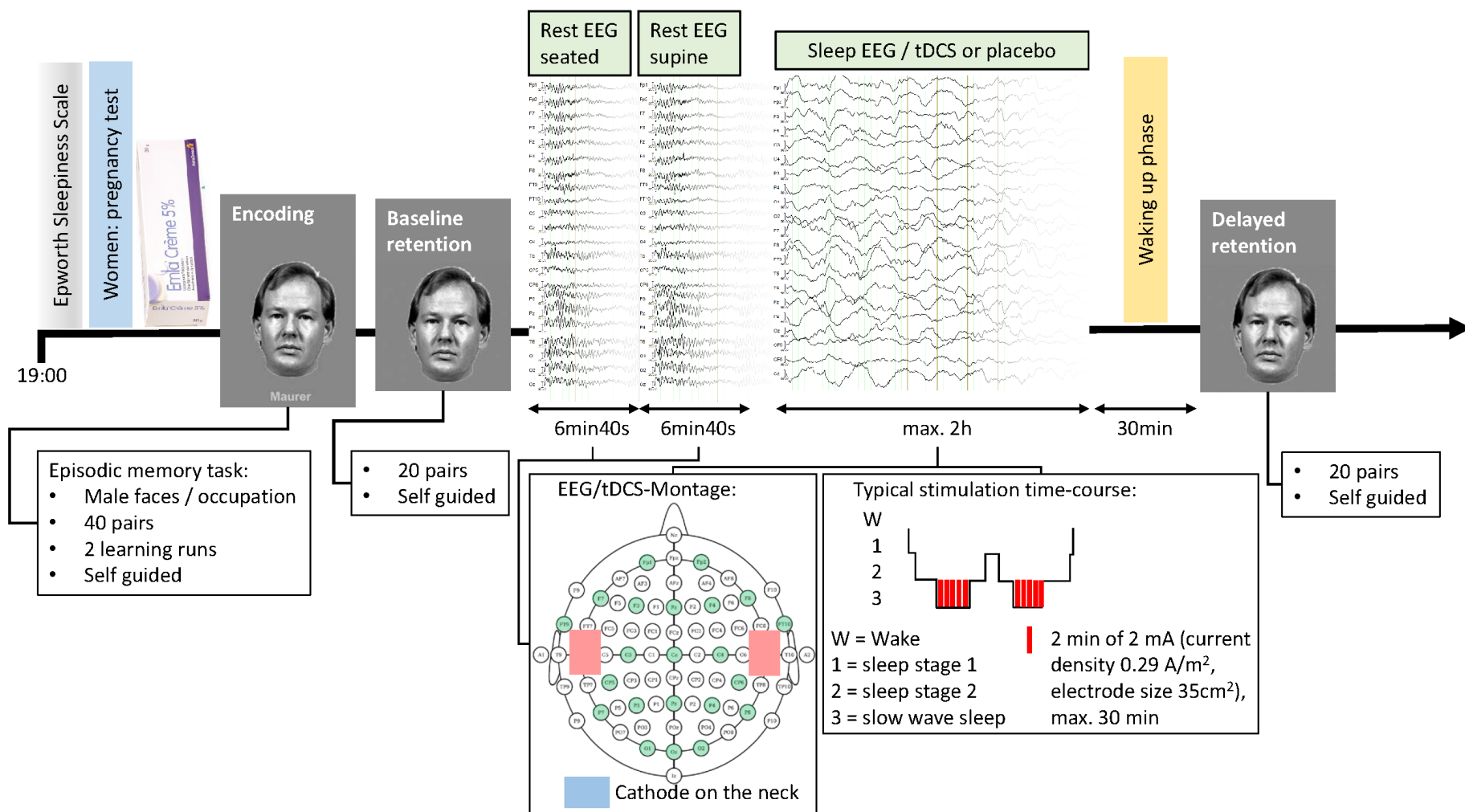


Monte-Silva et al. (2013)
Svoboda et al. (2006)

Methods: tDCS setup



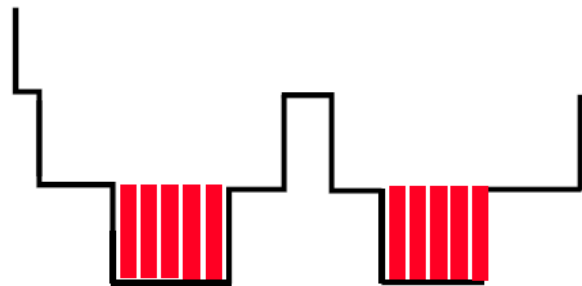
Methods: Experimental procedure



Methods: Experimental procedure

Typical stimulation time-course:

W
1
2
3

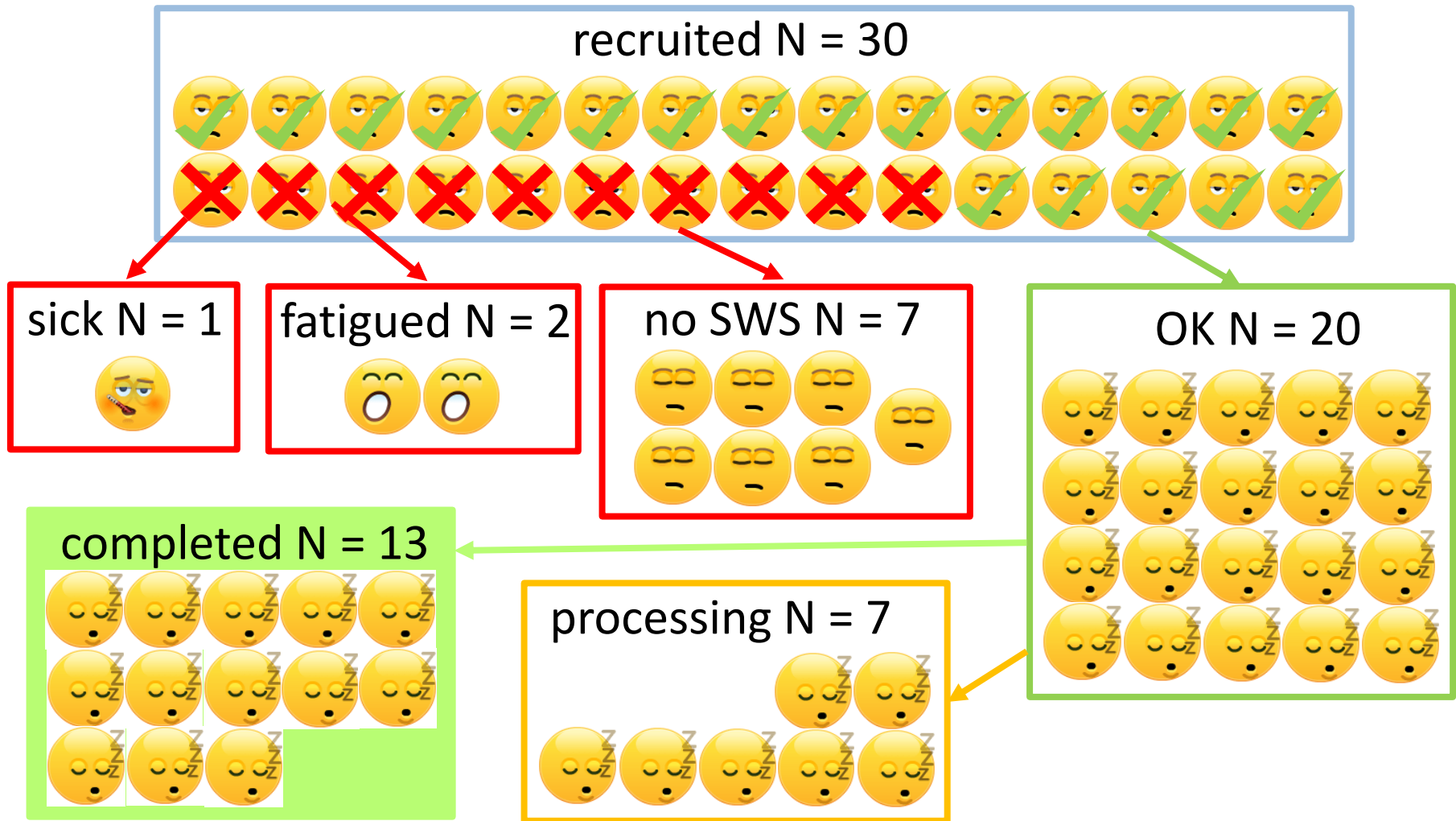


2 min of 2 mA (current density 0.29 A/m^2 , electrode size 35 cm^2), max. 30 min

Hypotheses

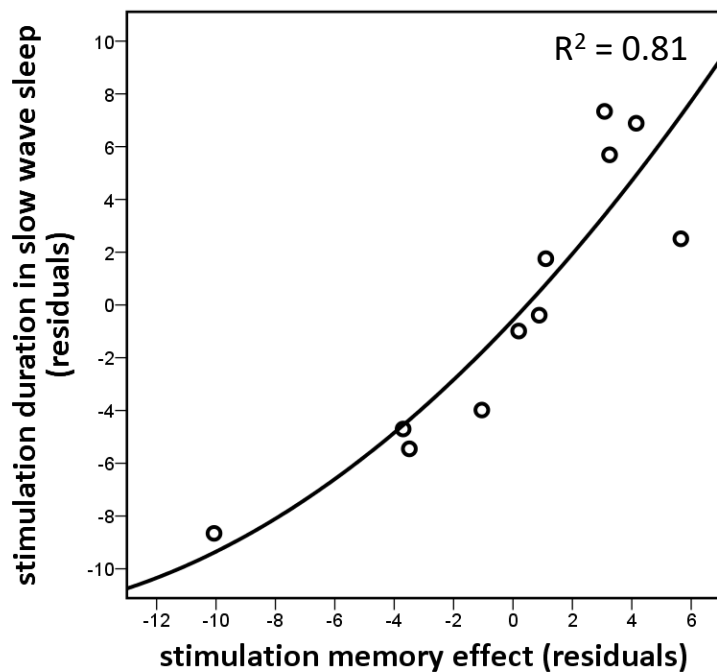
- > tDCS improves sleep-dependent memory consolidation as compared to placebo stimulation.
- > tDCS increases slow wave amplitudes as compared to placebo stimulation.

Current Data Situation



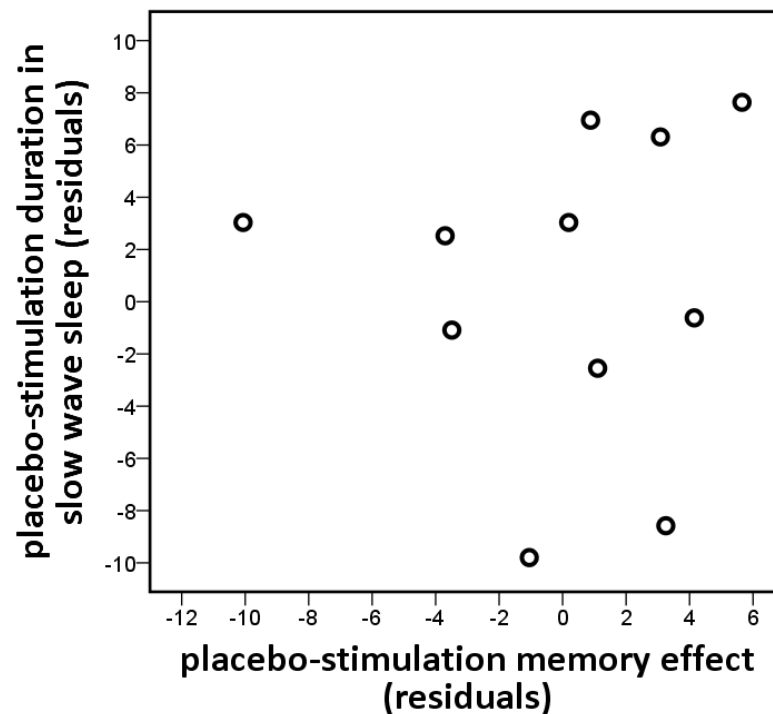
Results: tDCS and memory consolidation

Stimulation



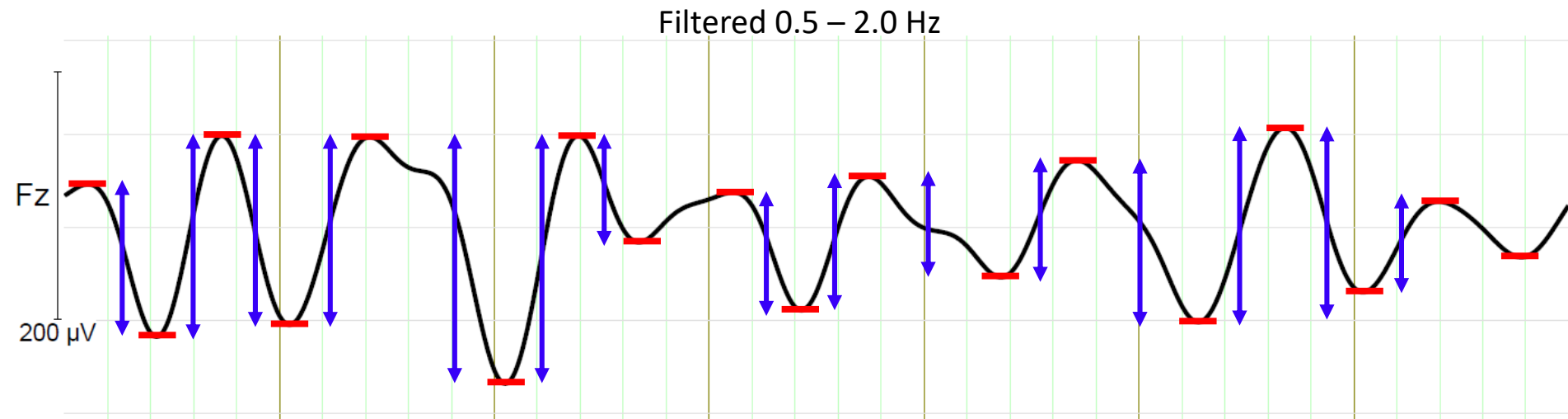
Pearson's $r = 0.89$, $p < 0.01$

Placebo-stimulation



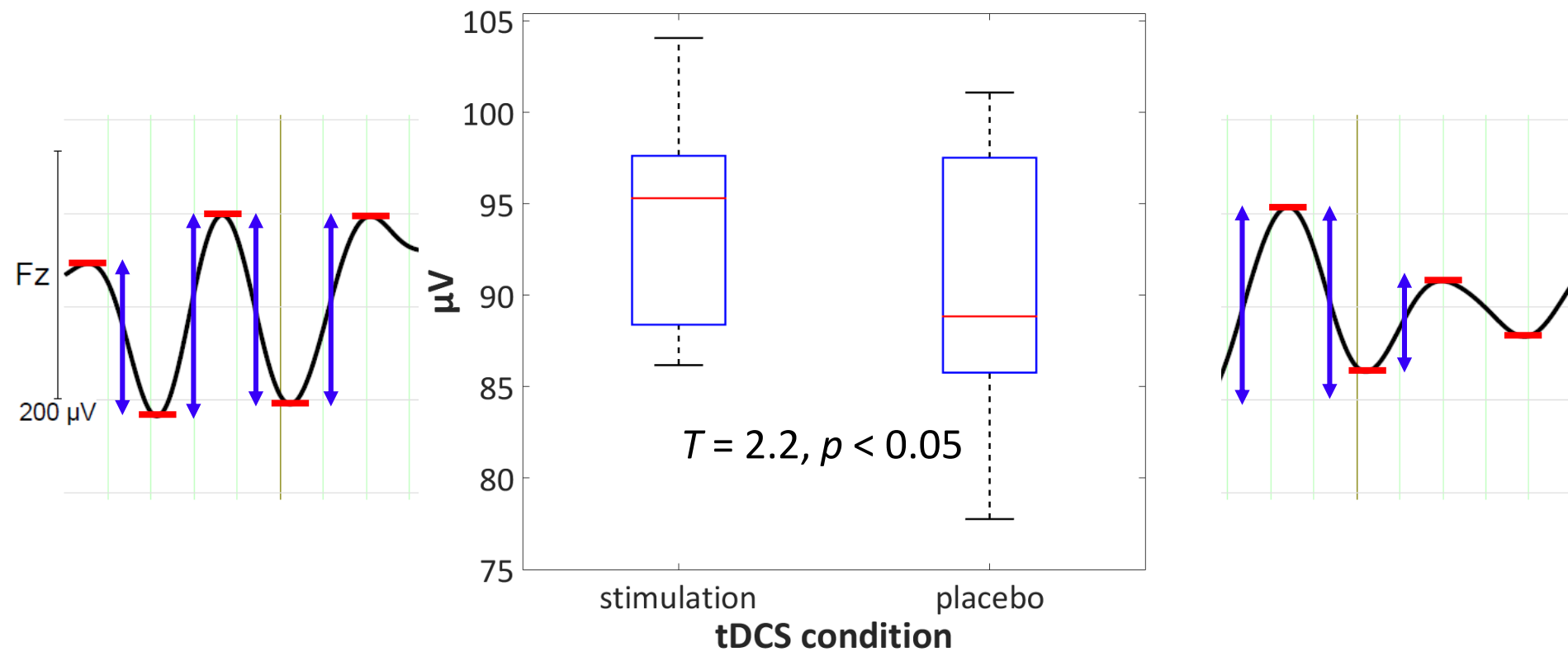
Pearson's $r = -0.22$, $p = 0.56$

Results: tDCS and slow waves



Results: tDCS and slow waves

Slow wave amplitudes



Discussion

- > tDCS during SWS can improve memory consolidation
 - The more SW are stimulated, the better the memory performance
- > Crucial factors that might influence effectiveness of tDCS:
 - Optimal timing of stimulation (Manenti et al., 2016, *Behav Brain Res*)
 - Evidence-guided electrode montage
- > Replication is needed
- > Classification of responders and non-responders

Acknowledgment



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