

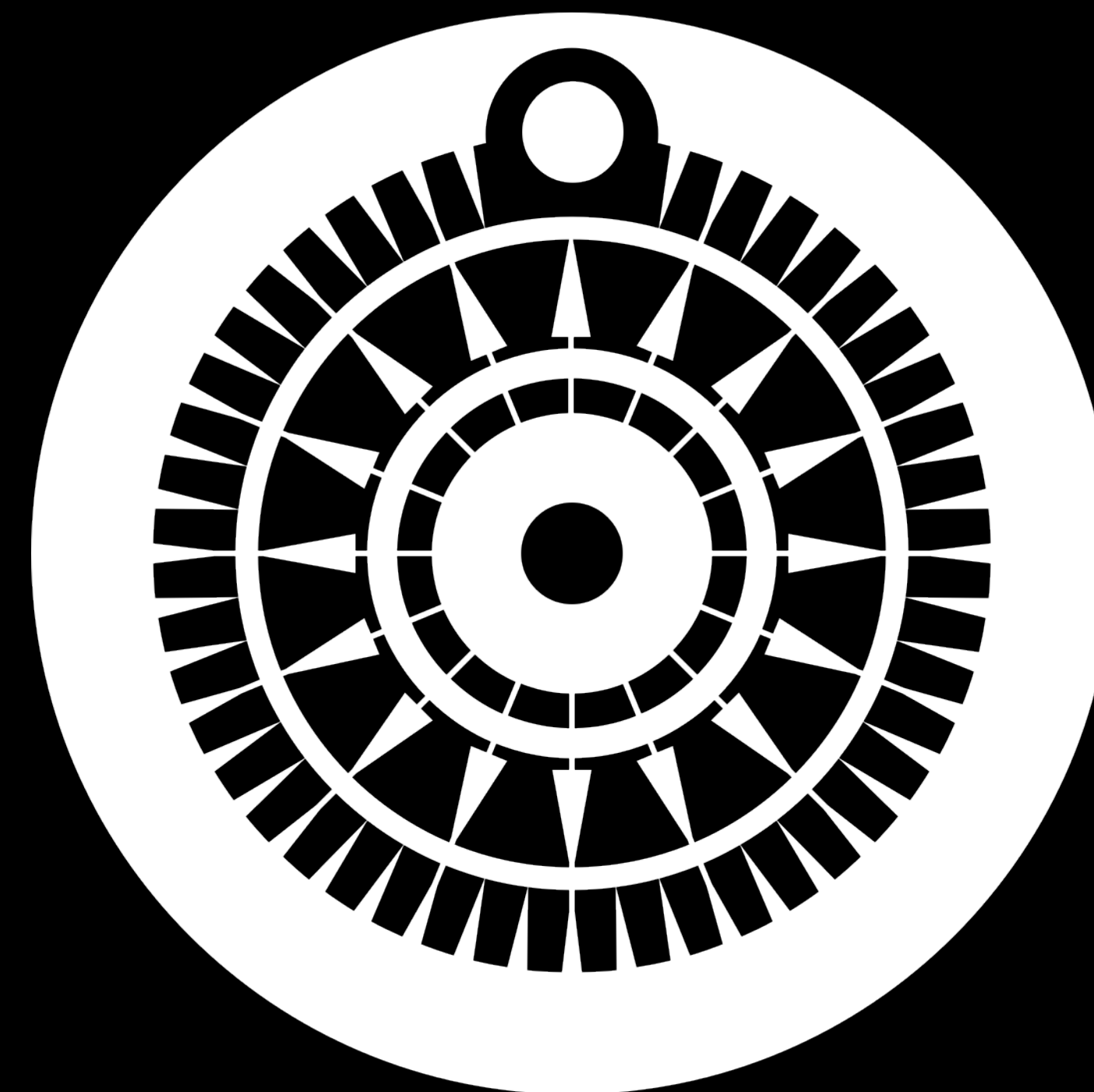


INTERNATIONAL SYMPOSIUM  
“INVENTING THE FUTURE”

Neuro-enhancement by Non Invasive  
Brain Stimulation: Can we really  
boost brain functions?

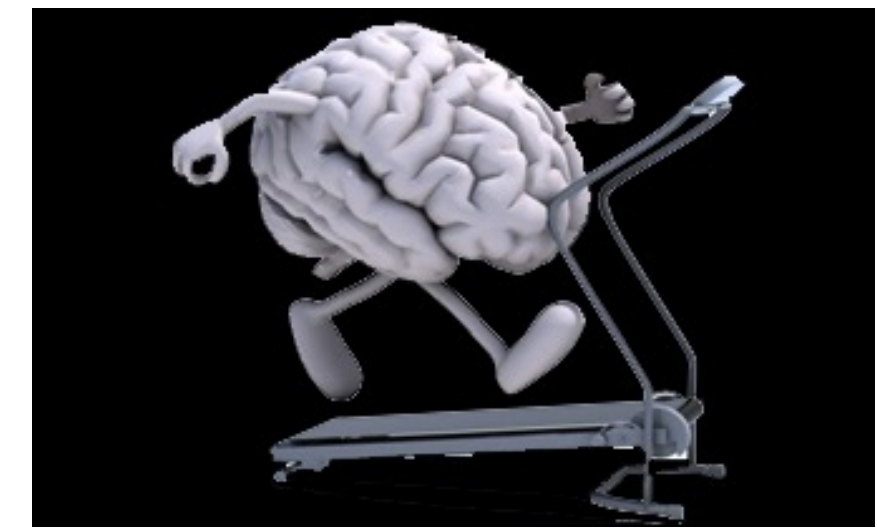
MATTEO FEURRA

ASSOCIATE PROFESSOR, CENTRE FOR  
COGNITION AND DECISION MAKING,  
INSTITUTE FOR COGNITIVE  
NEUROSCIENCE, NATIONAL RESEARCH  
UNIVERSITY, HIGHER SCHOOL OF  
ECONOMICS



EVOLUTION OF THE BRAIN:  
HOW DOES THE WORLD  
CHANGE US?

# What is Neuroenhancement?

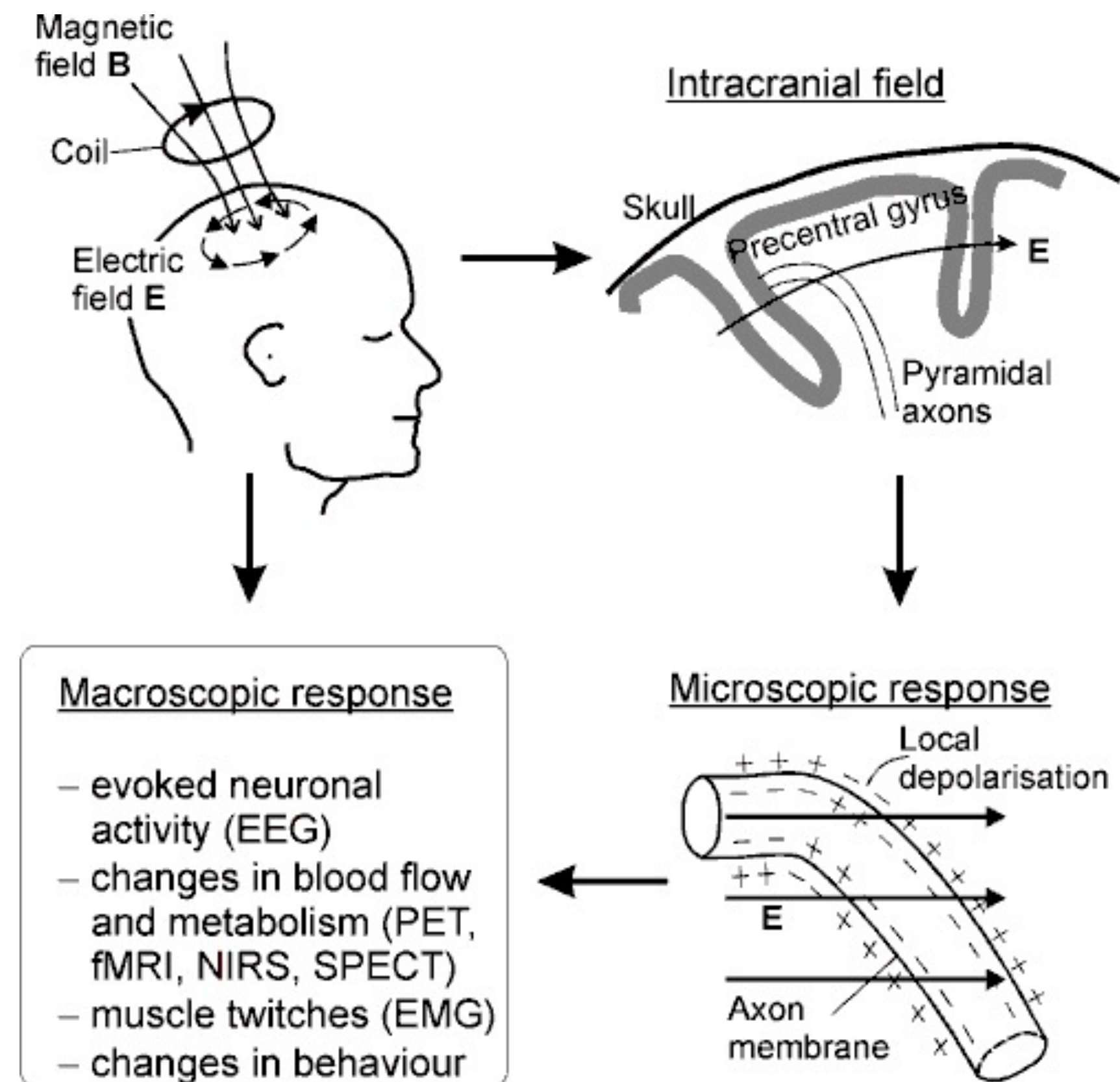
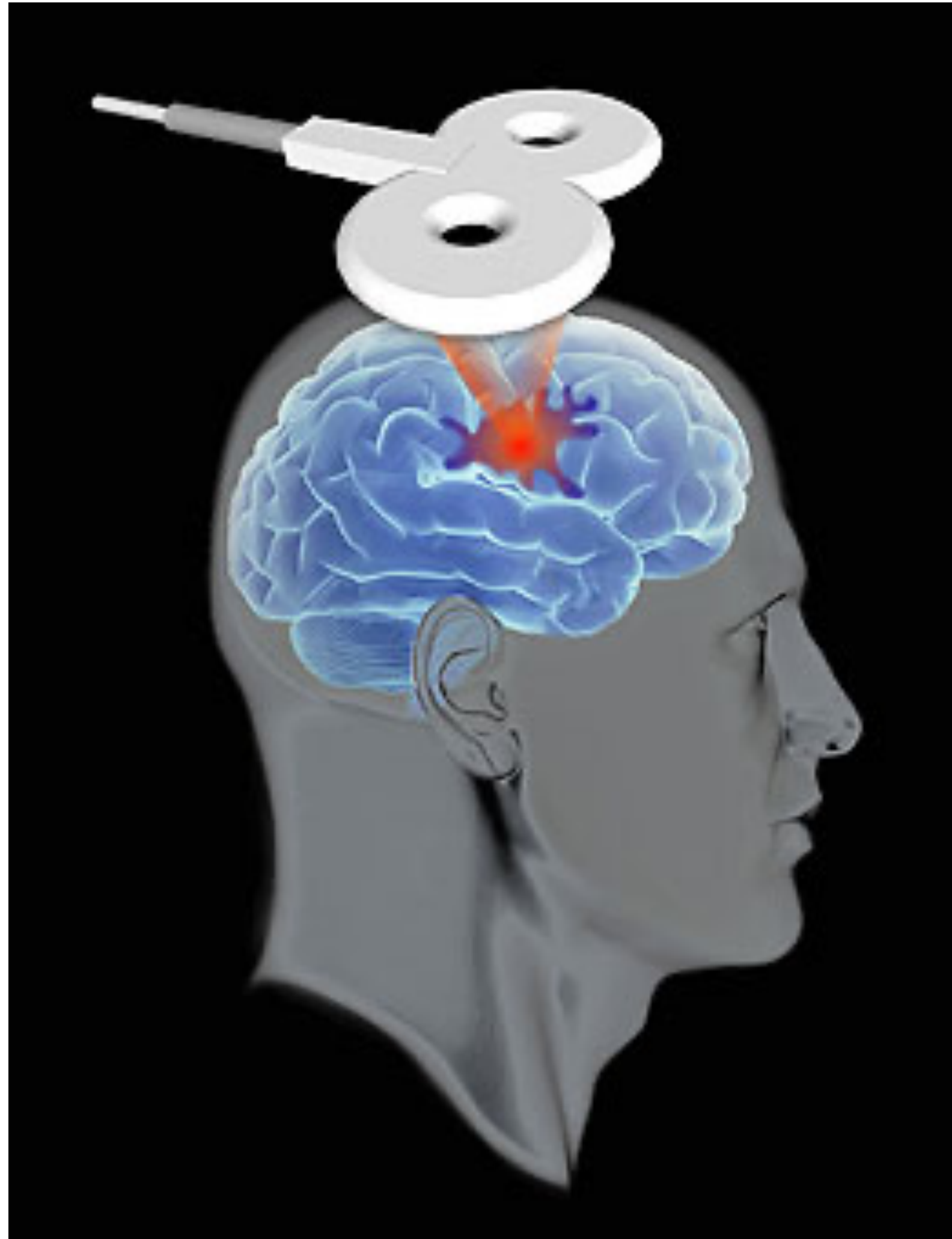


- It refers to a potential improvement ranging from perceptual to motor, cognitive and social abilities, which rely on the underlying brain activity and more specifically neural activity.
- Represents the ability to facilitate state transitions within and between networks (Schutter, 2014)
- Non Invasive Brain Stimulation (NIBS) induces brain plasticity changes.

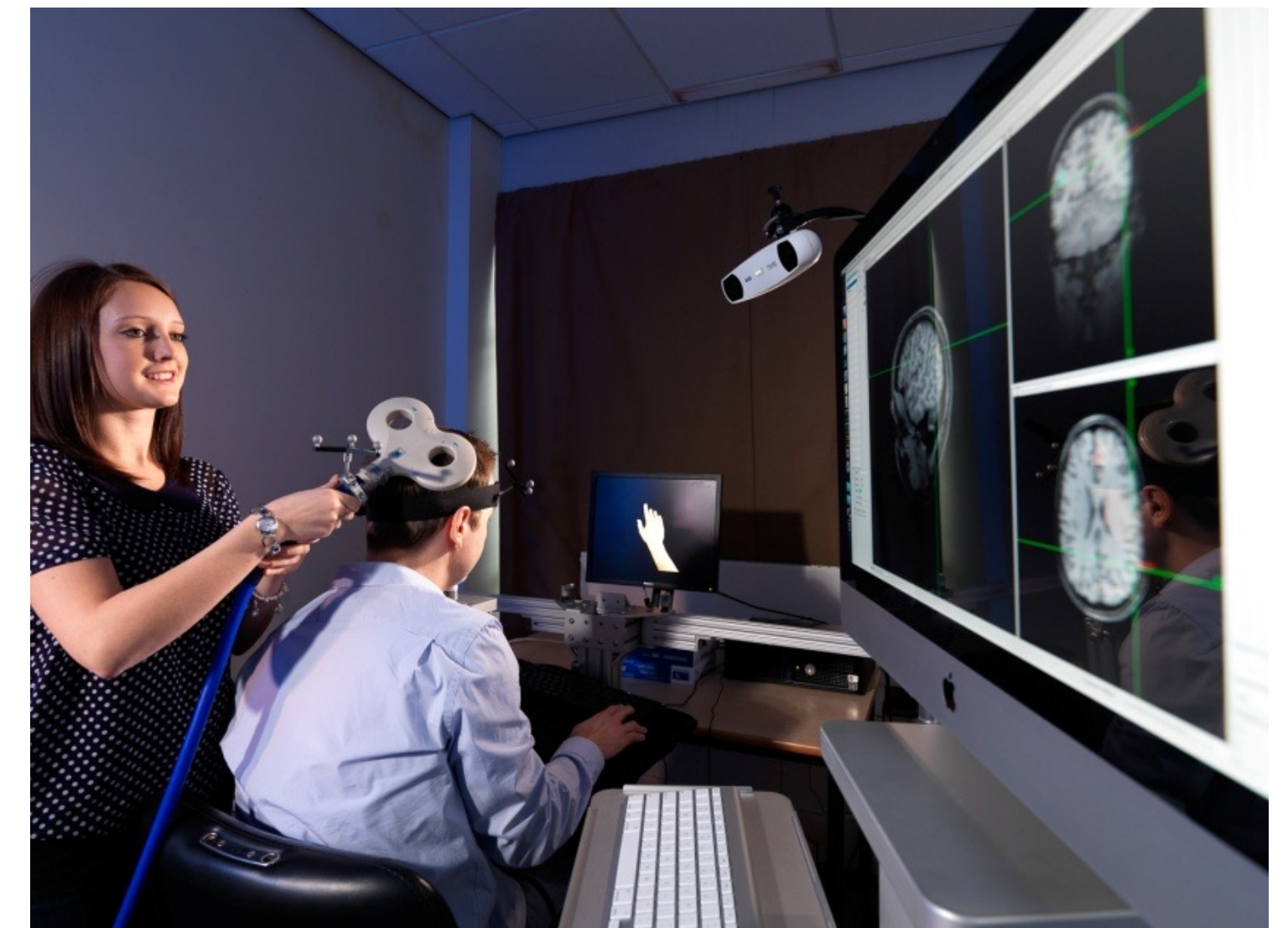
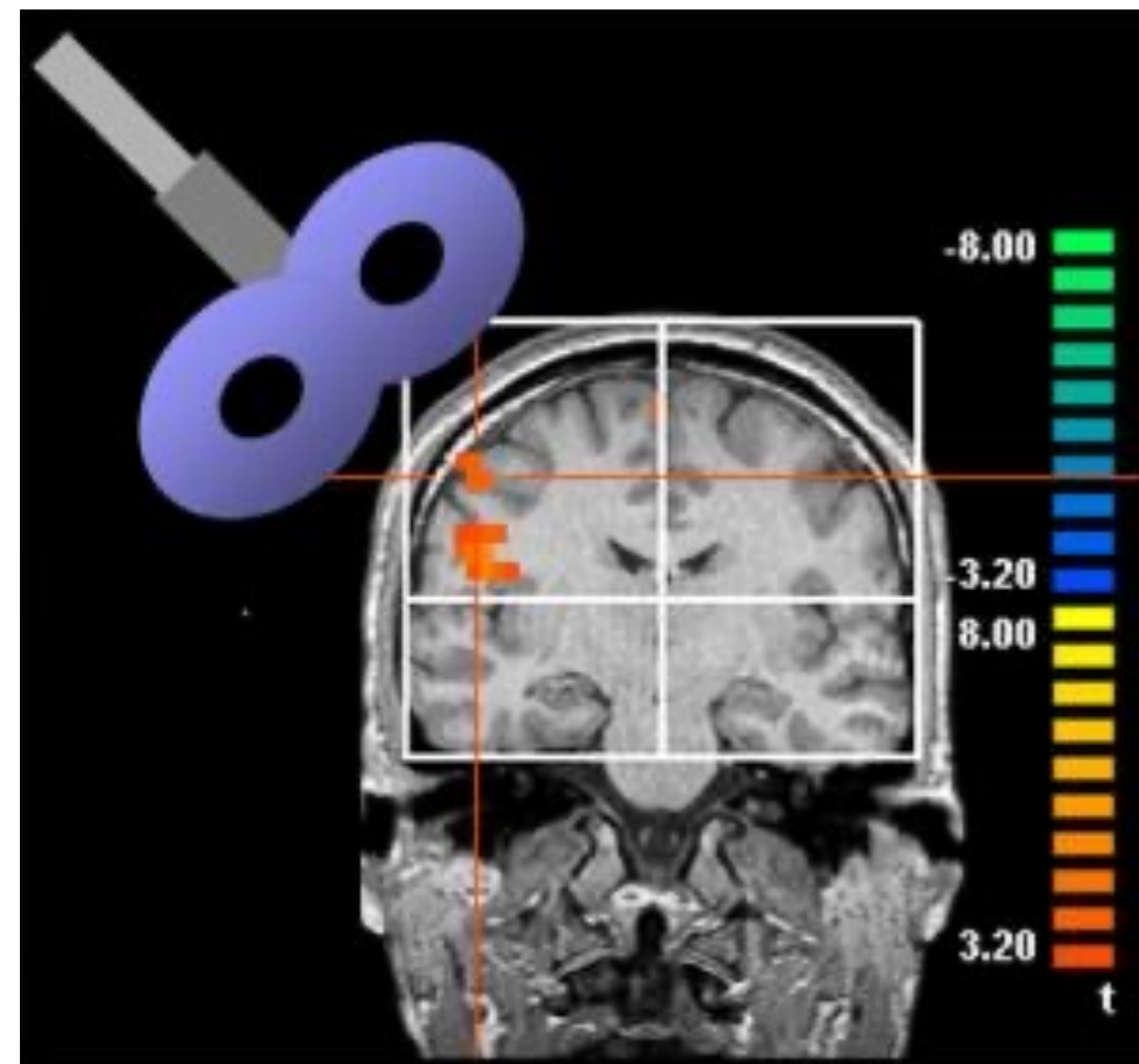
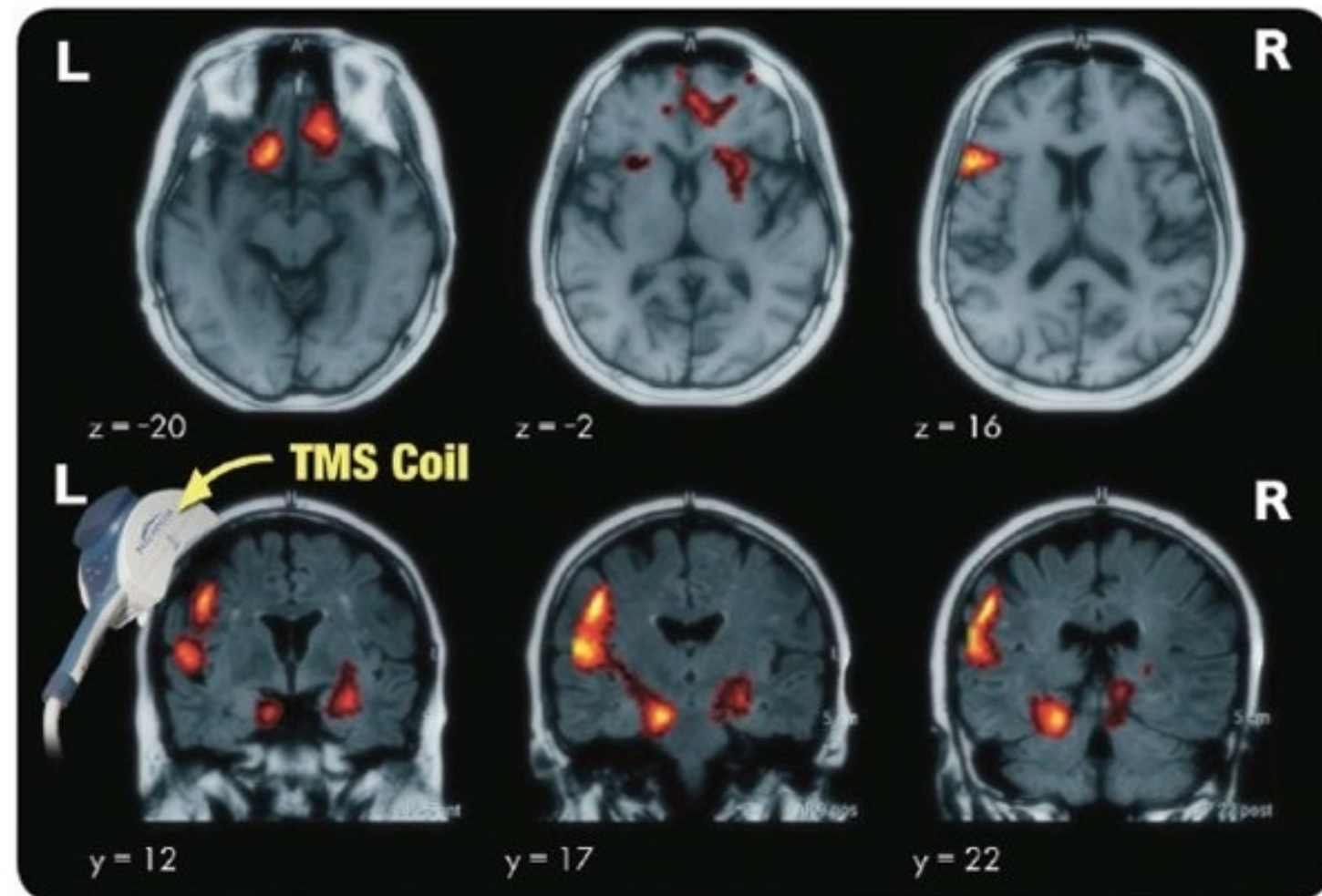
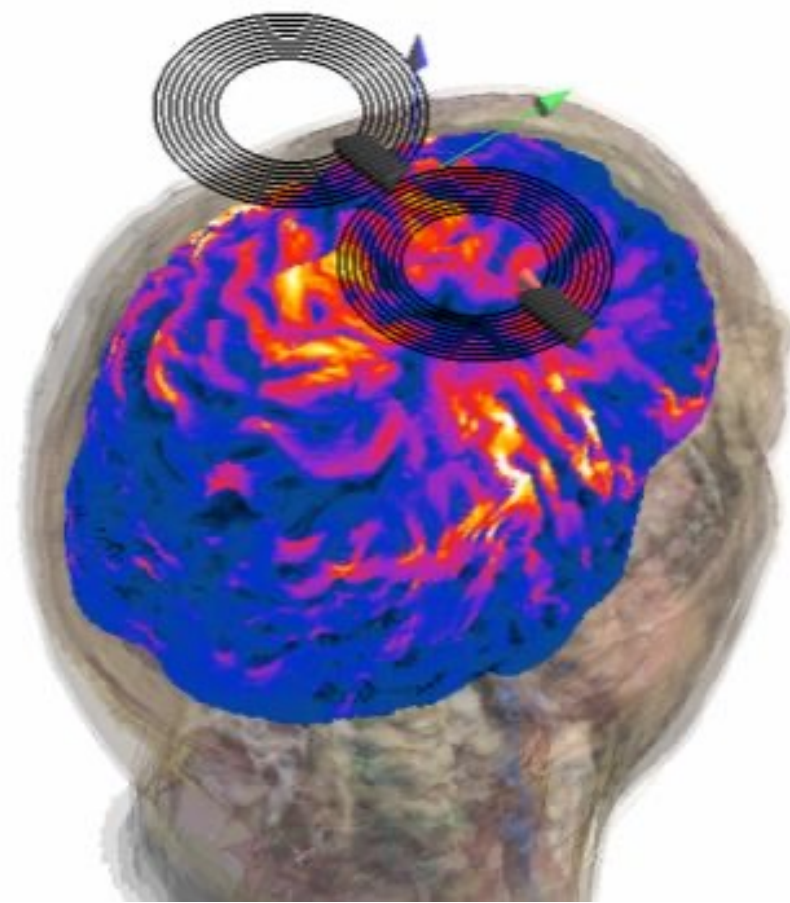
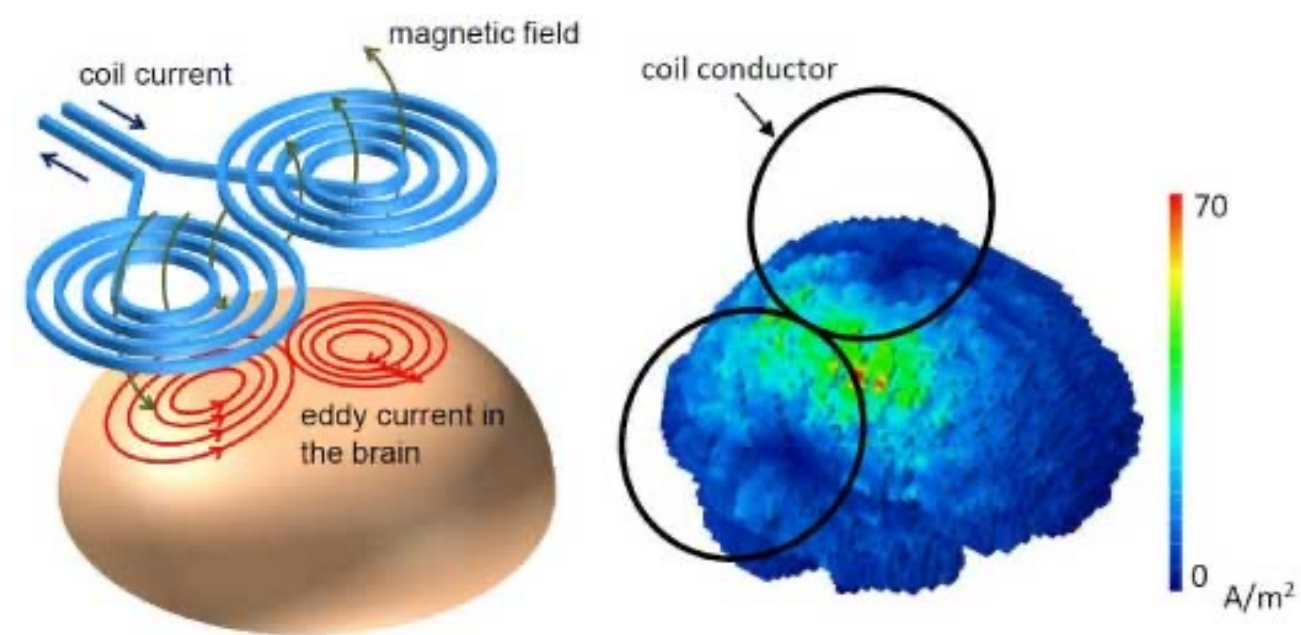
**Better to say that induce short-term synaptic plasticity (neuroplasticity), which refers to changes in how neurons connect to each other.**

**Neuroplasticity refers to the potential that the brain has to reorganize by creating new neural pathways to adapt, as it needs.**

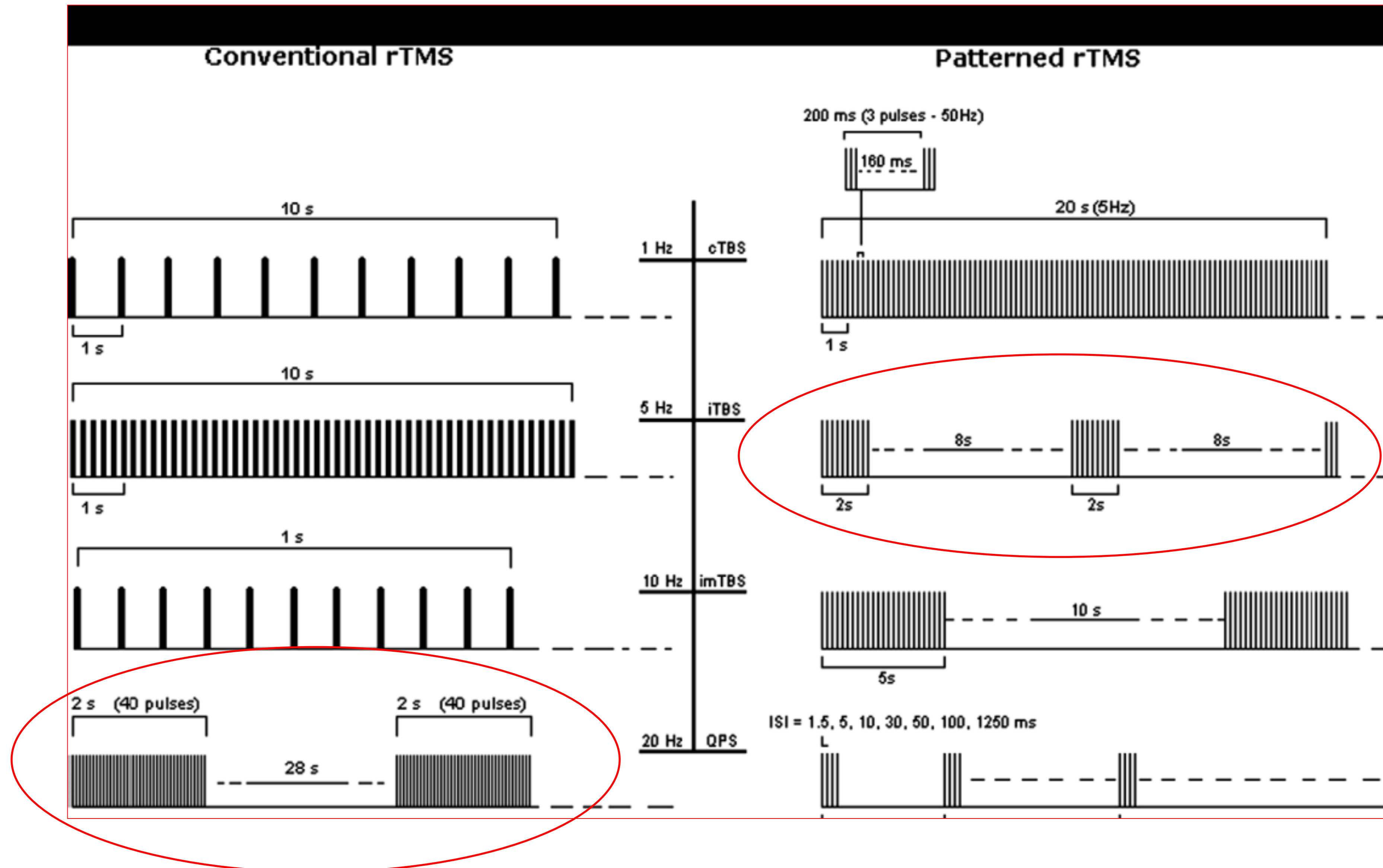
# Transcranial Magnetic Stimulation





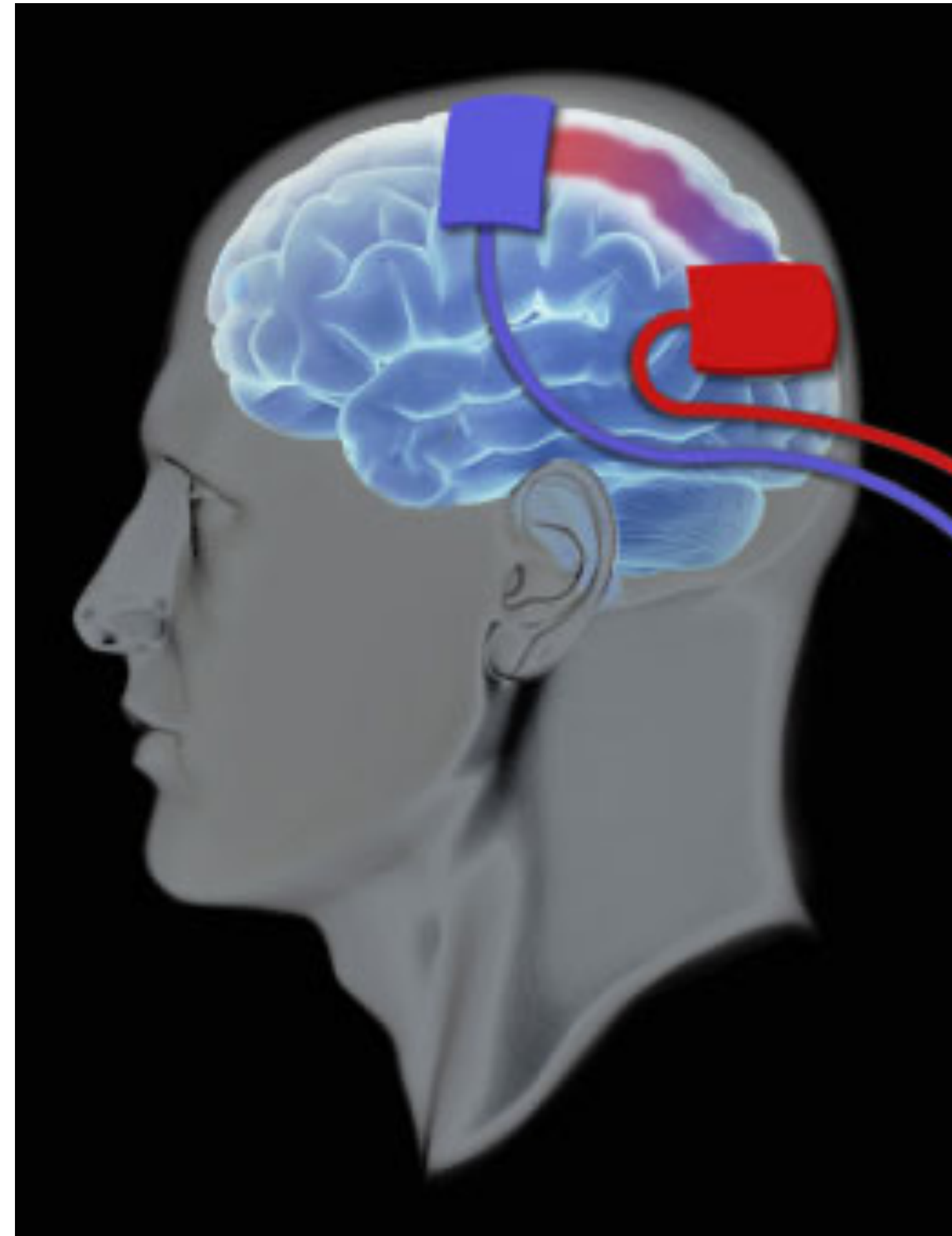






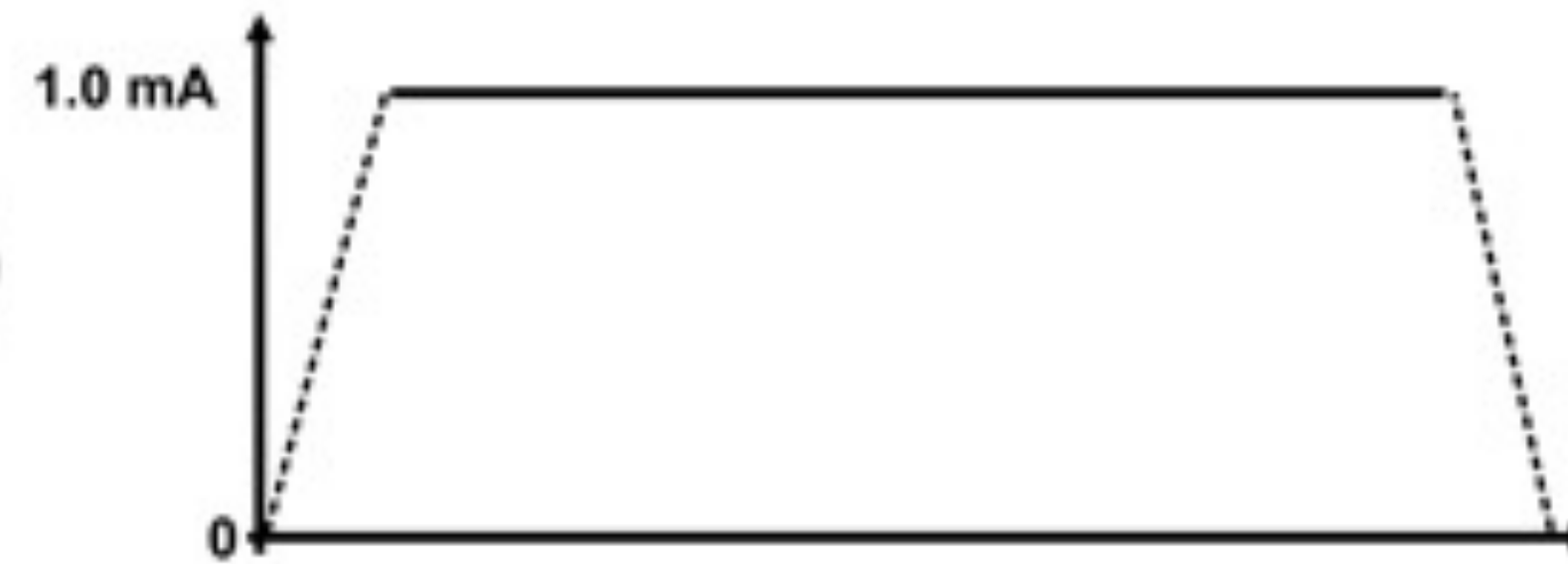
**Rossi et al., 2009**

# Transcranial Electrical Stimulation (TES)

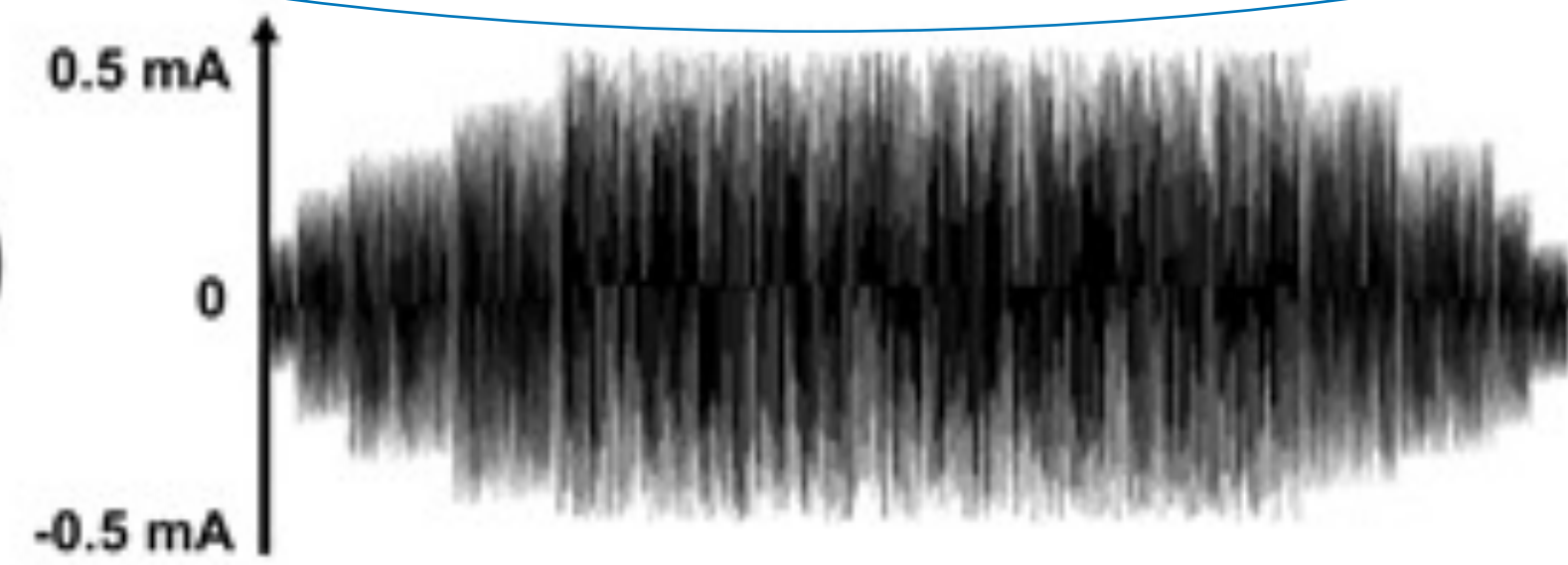


# TES

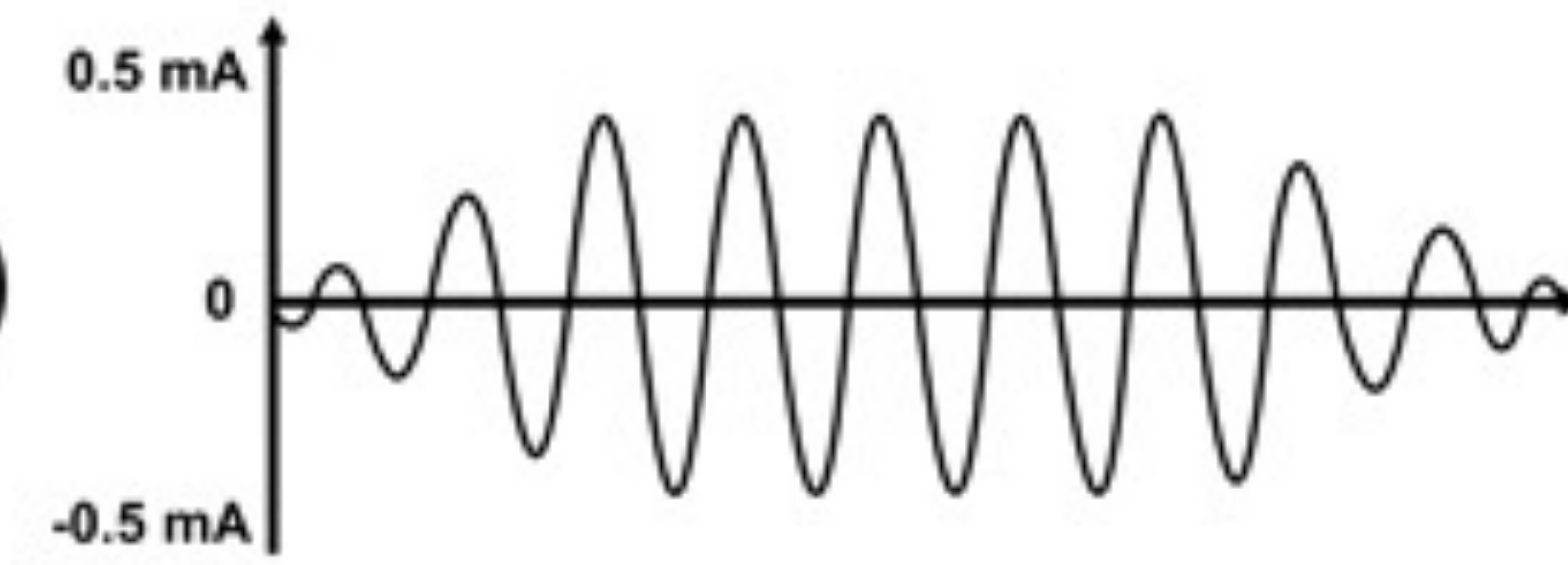
tDCS



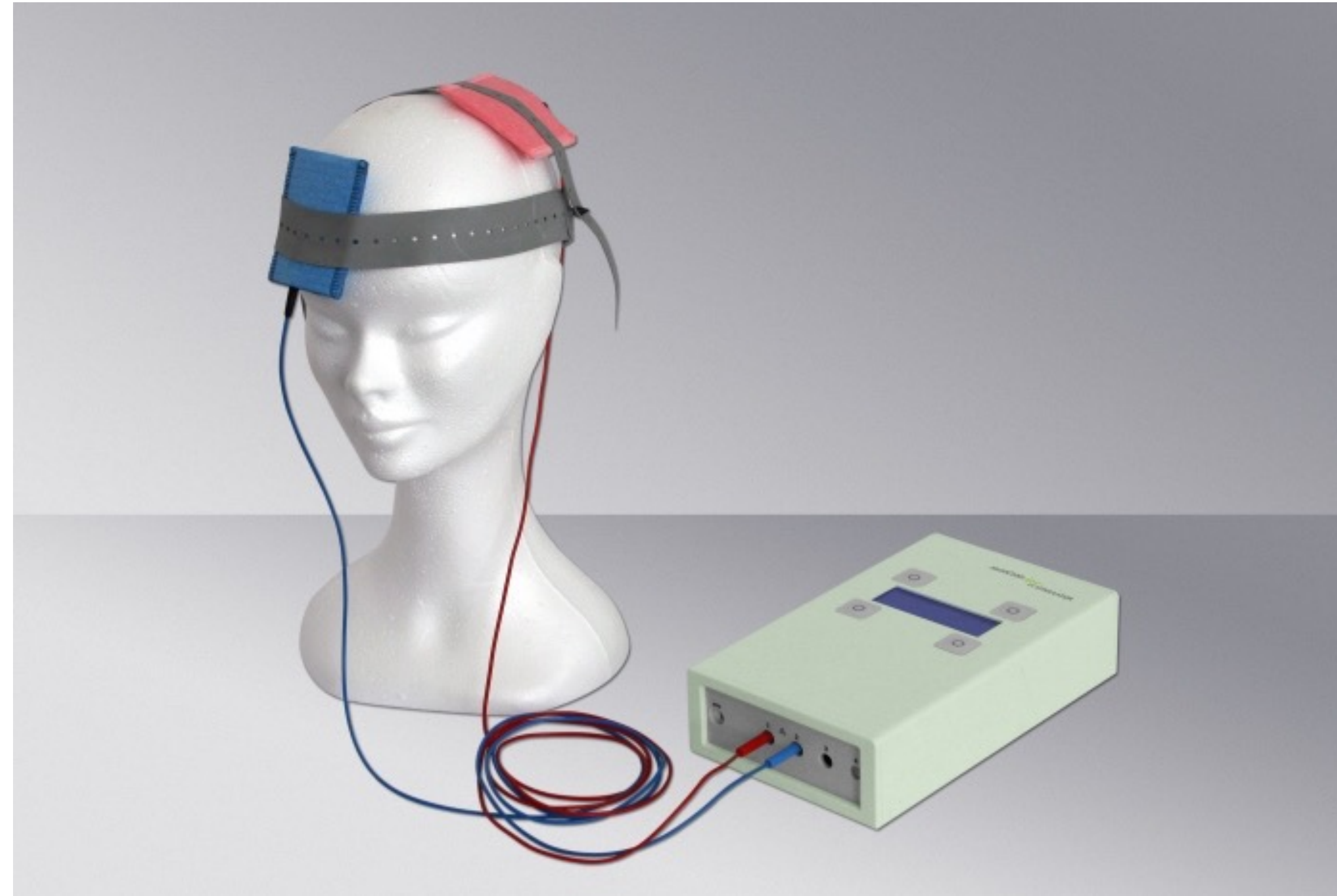
tRNS



tACS

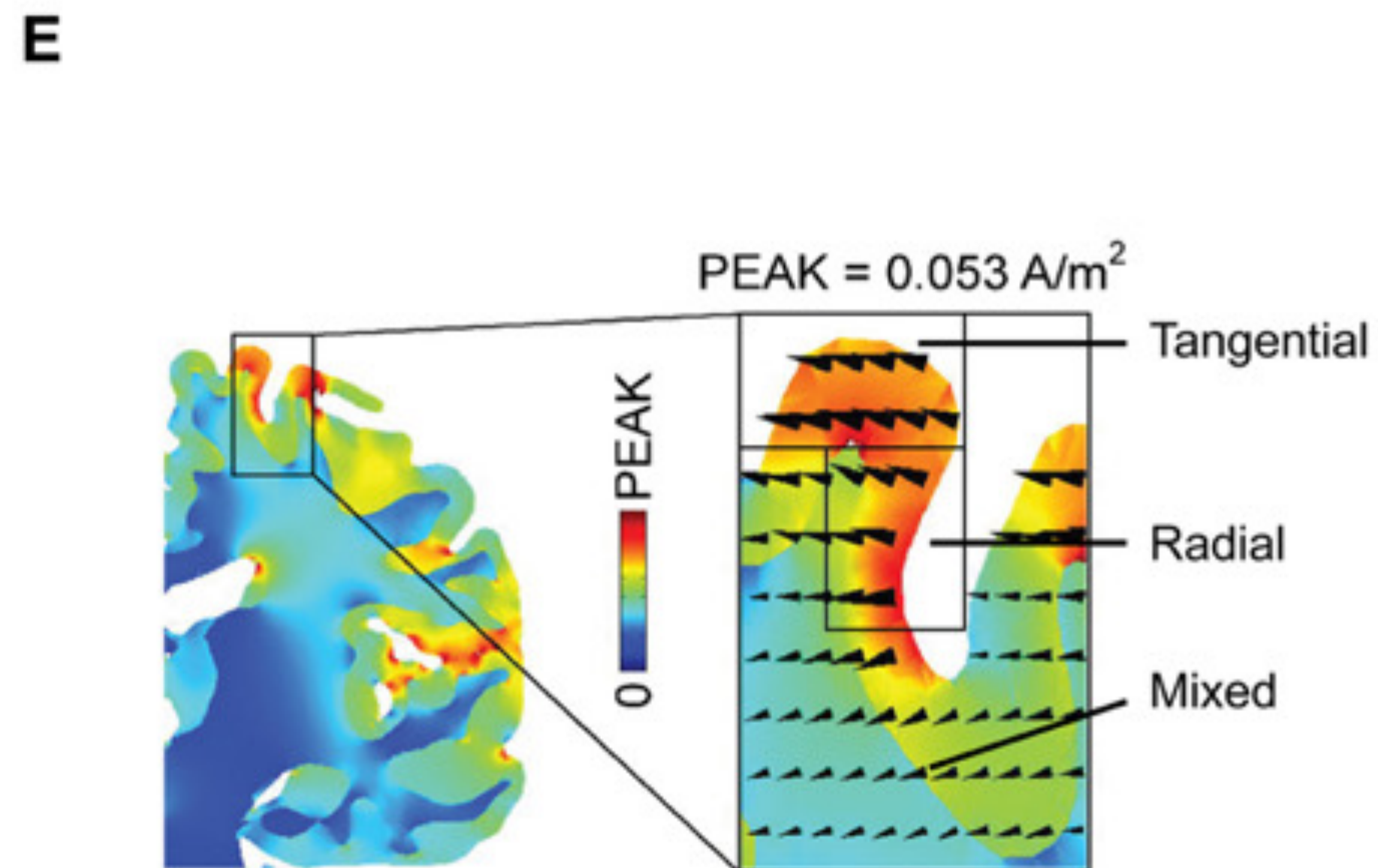
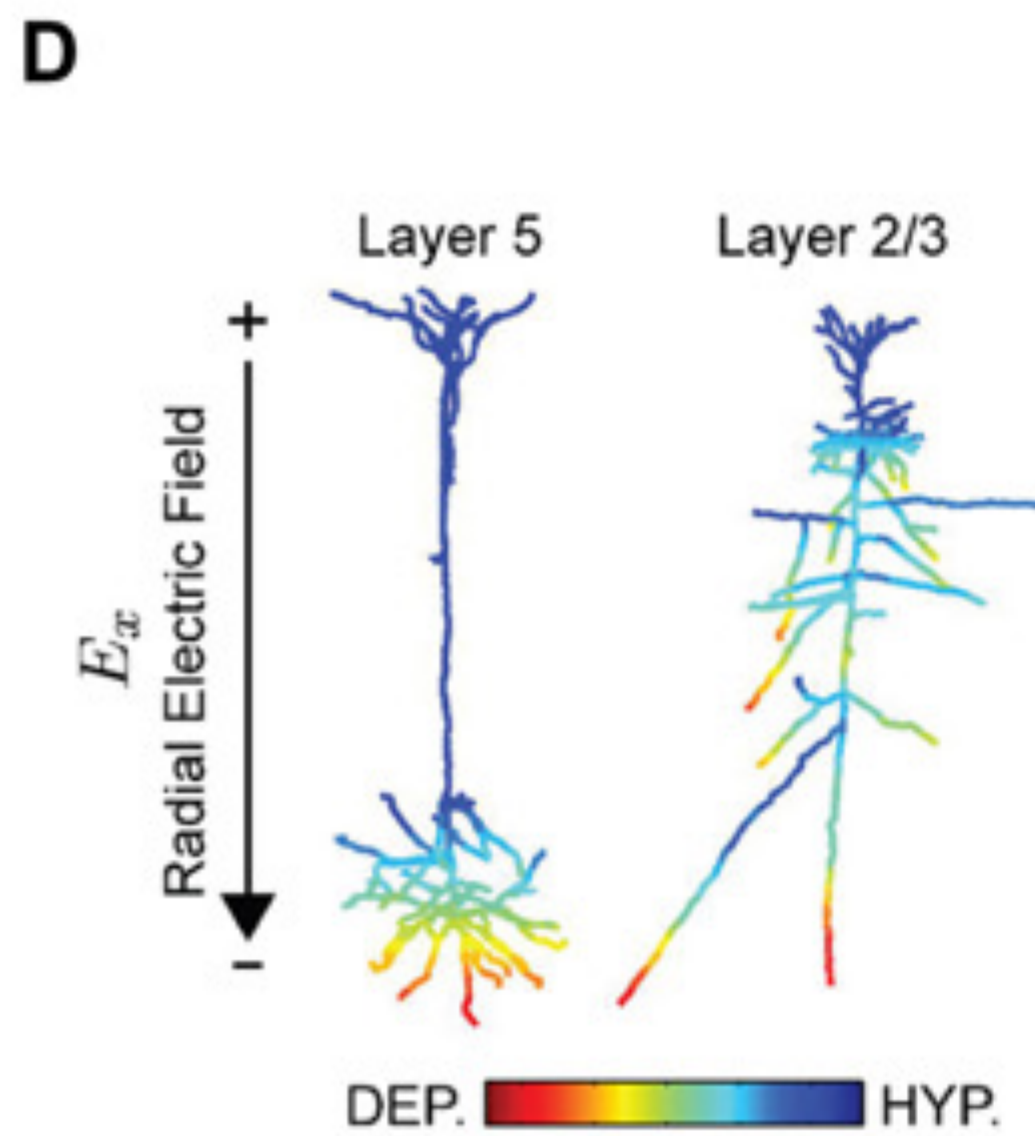
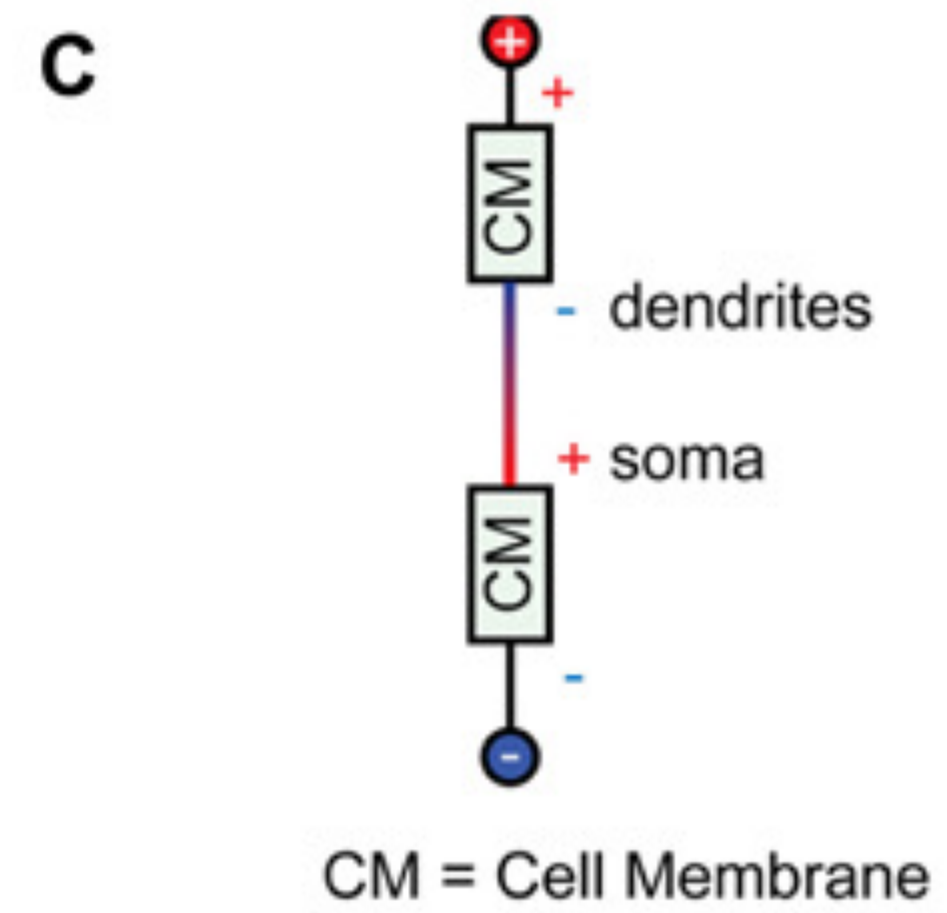
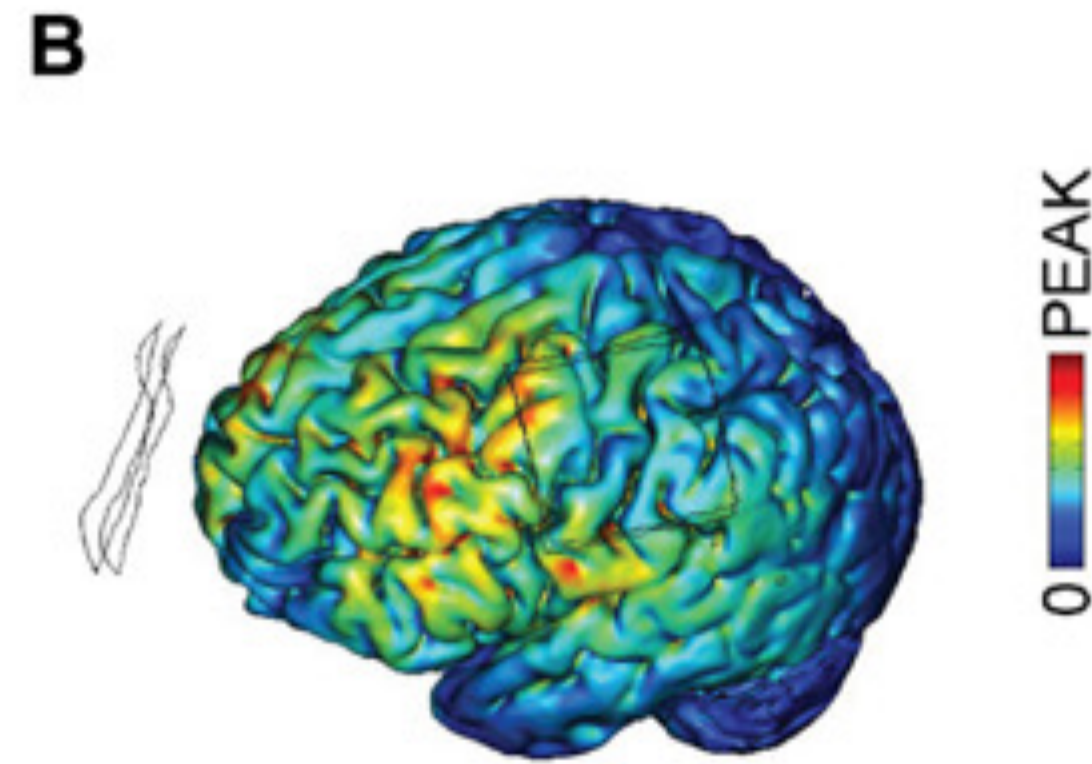
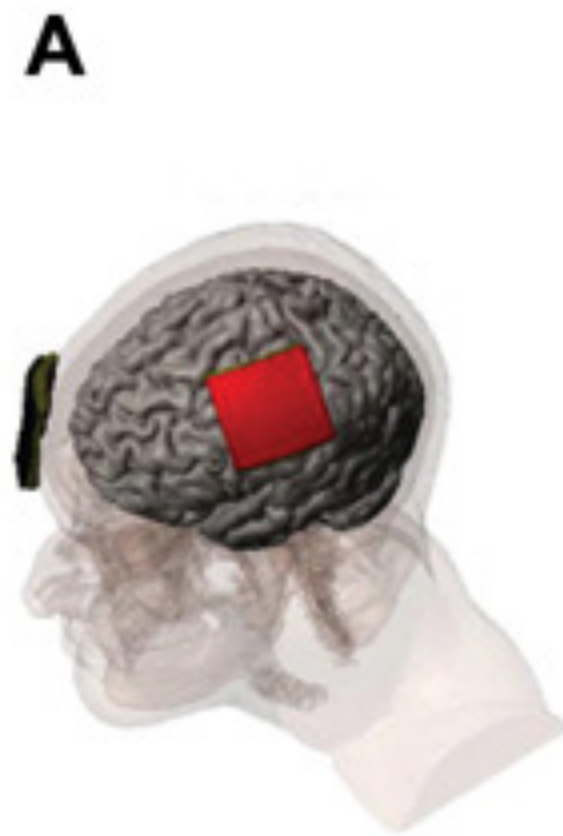


# Transcranial Electrical Stimulator (TES)

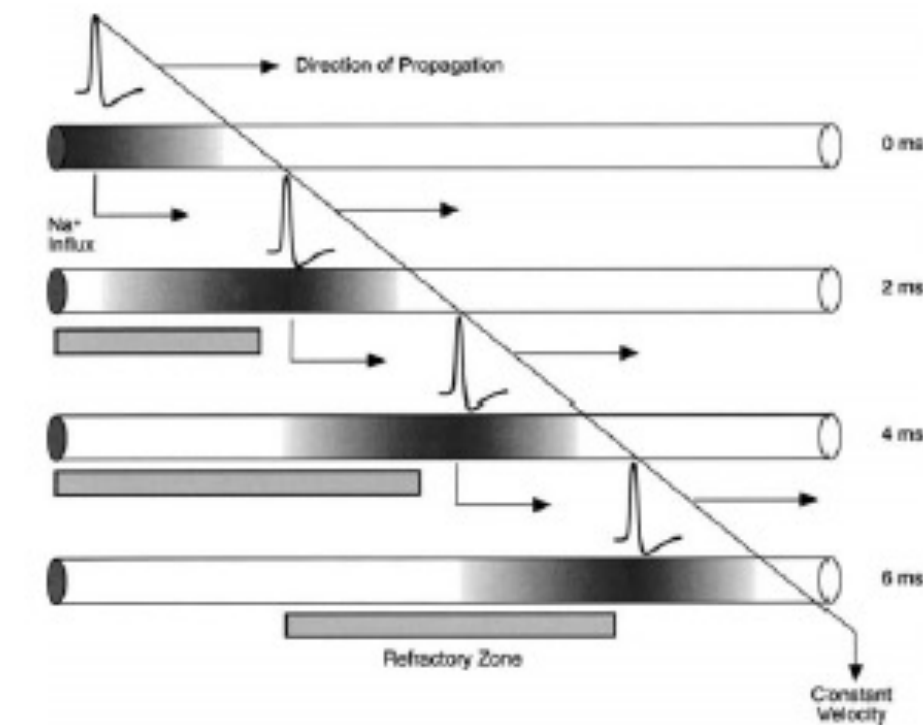
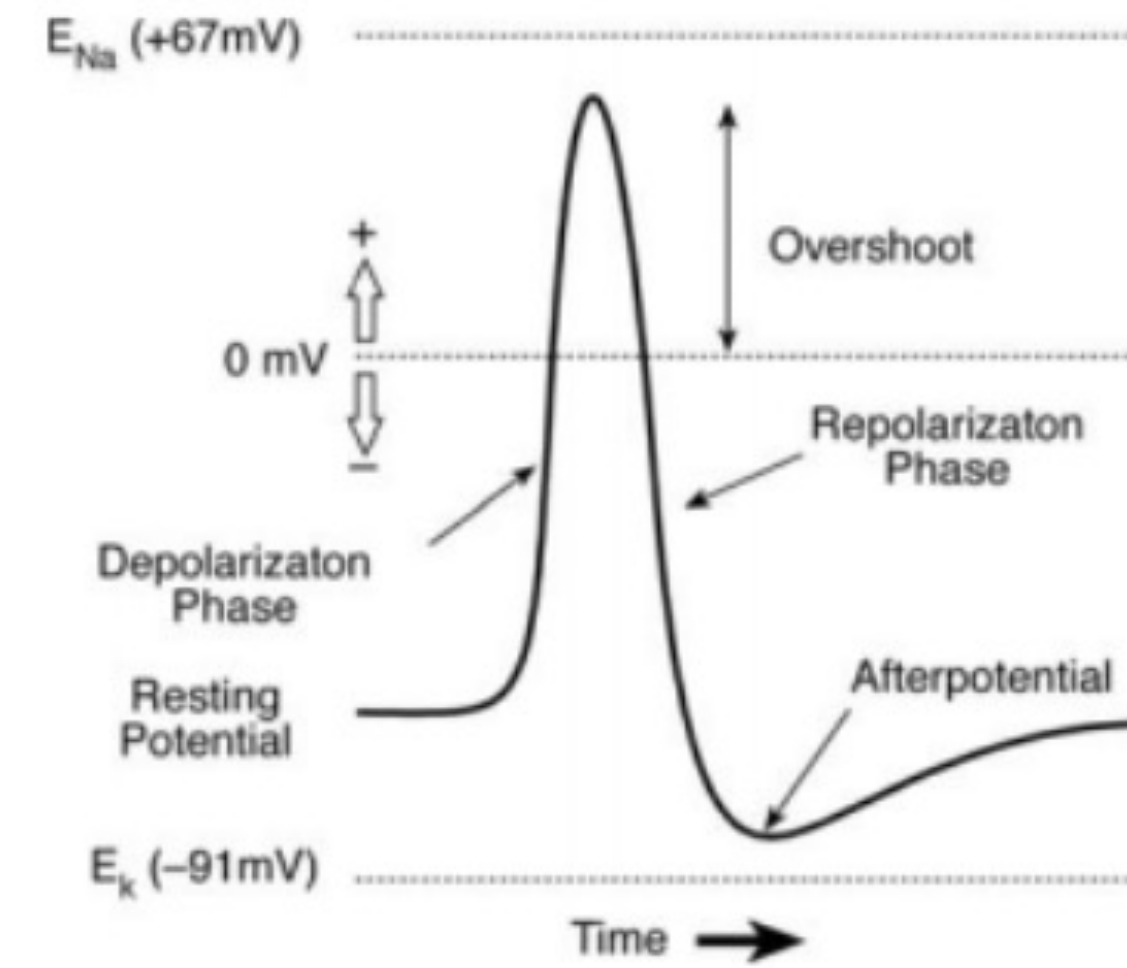
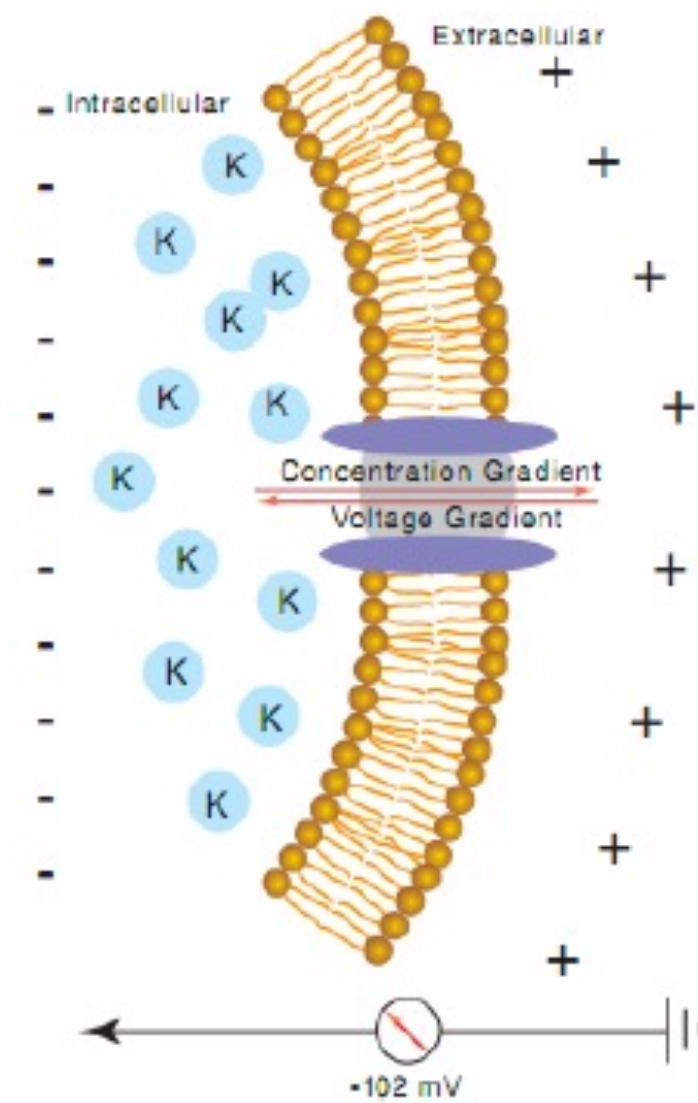




# *tDCS*

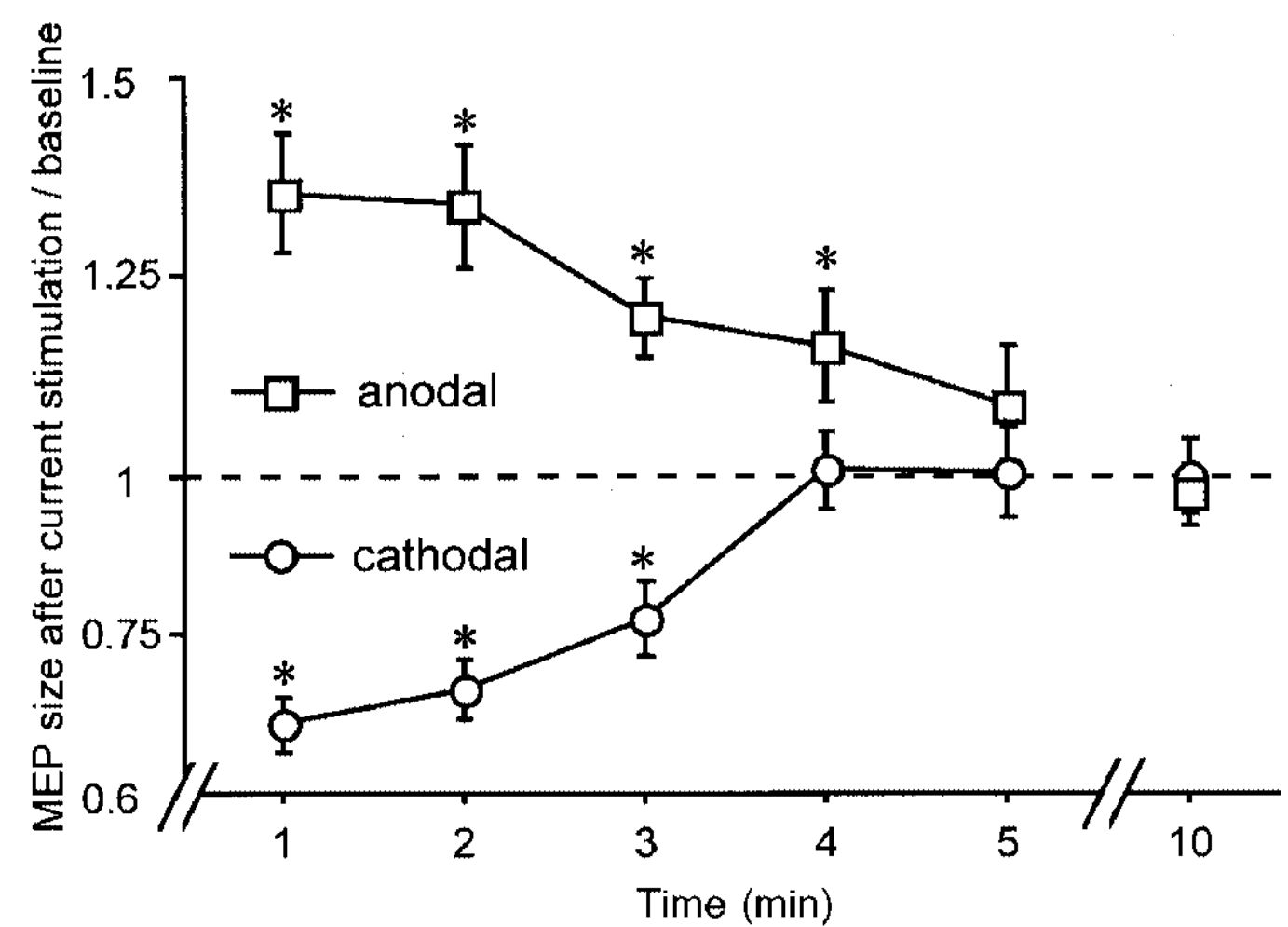


# Changing membrane resting potential



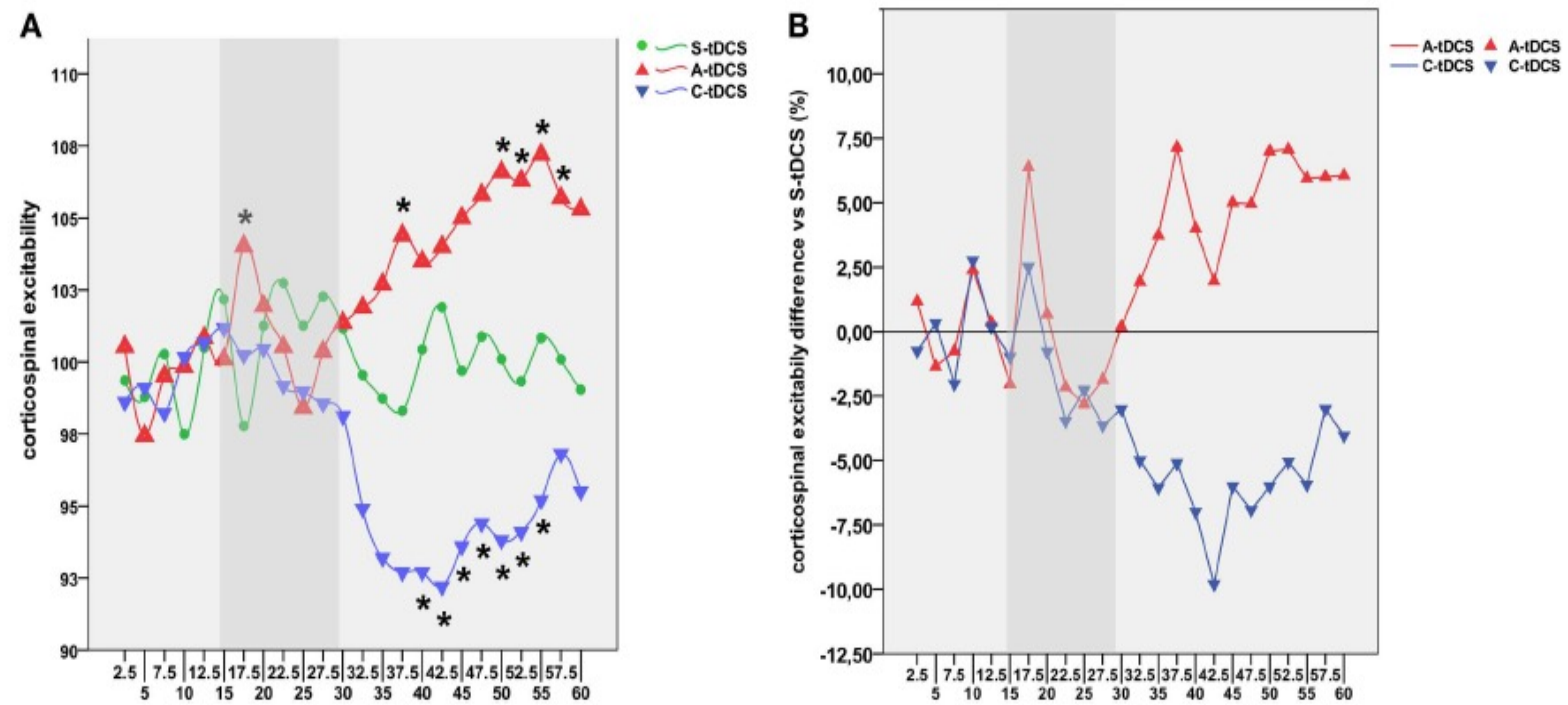


# Offline effects

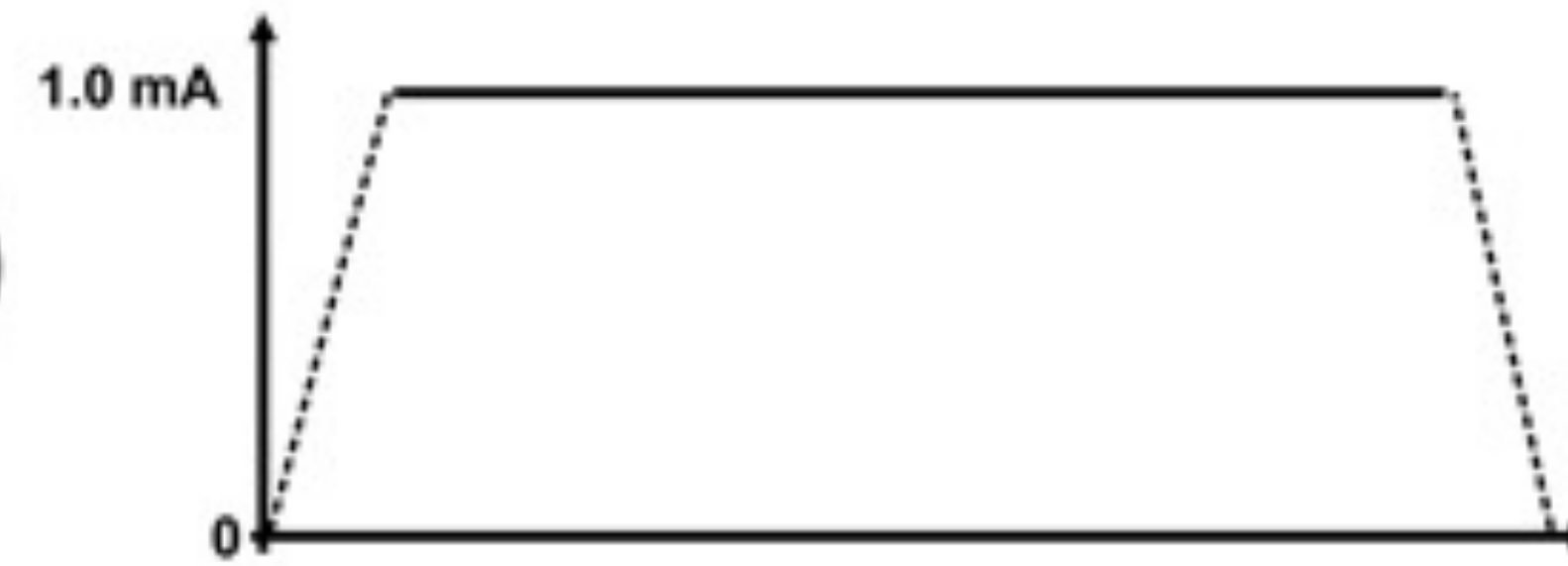


Nitsche and Paulus, 2000

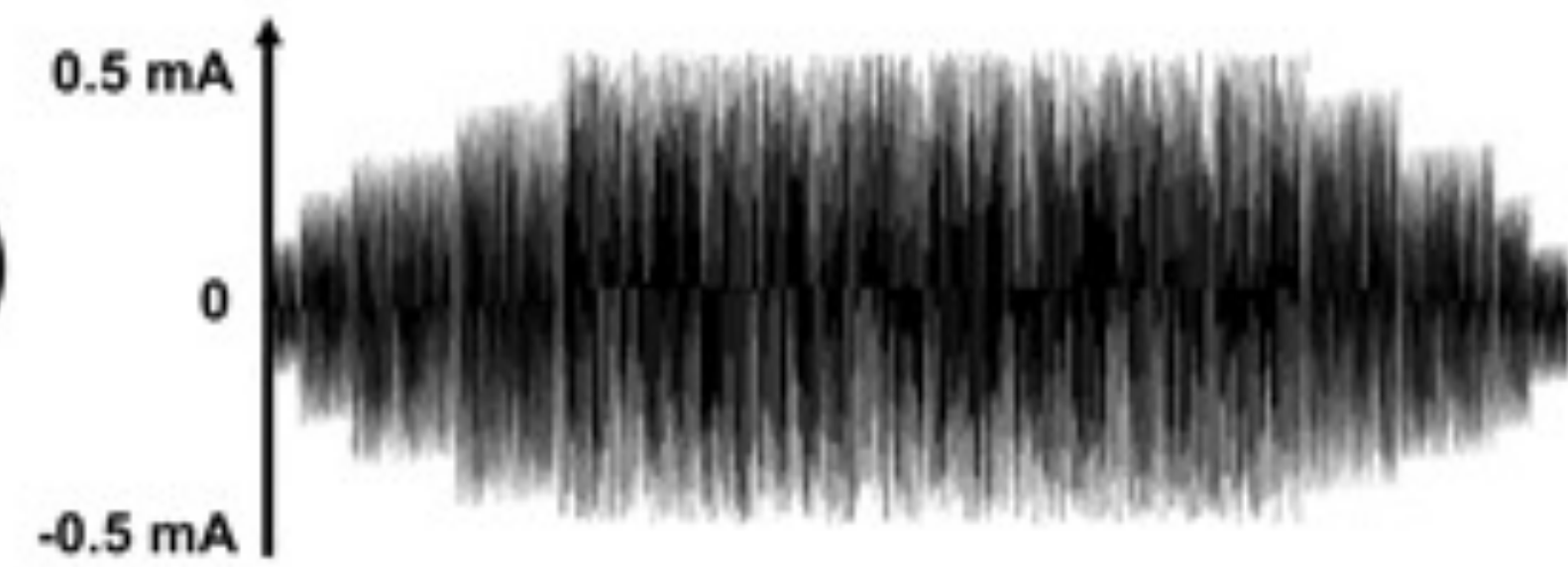
Santarneckchi et al., 2014



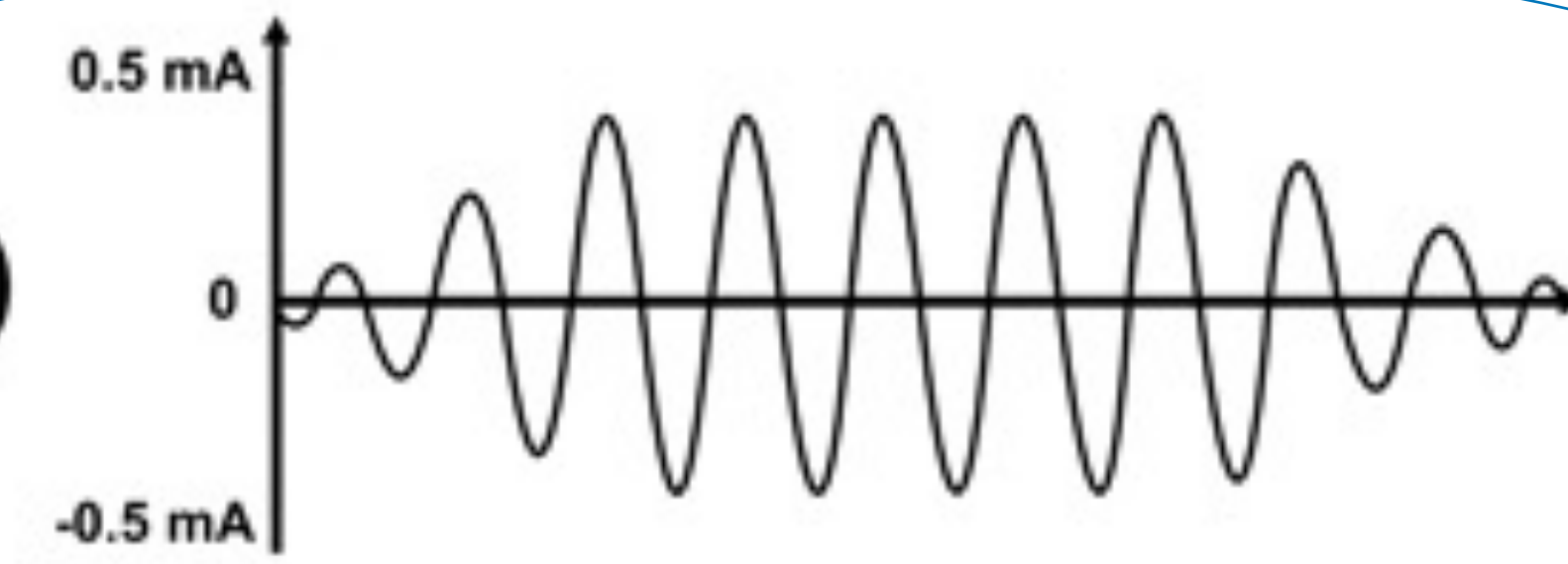
**tDCS**



**tRNS**

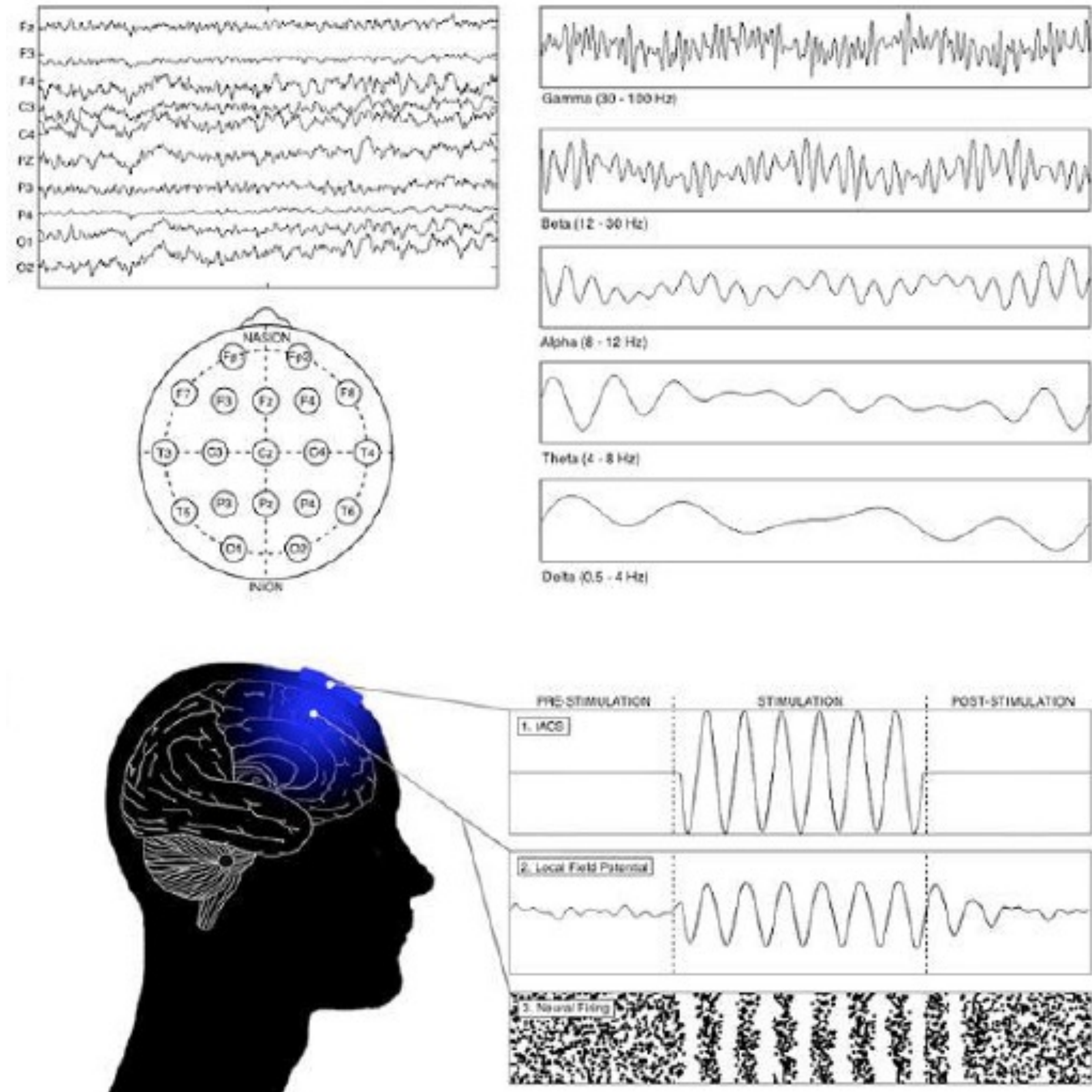


**tACS**

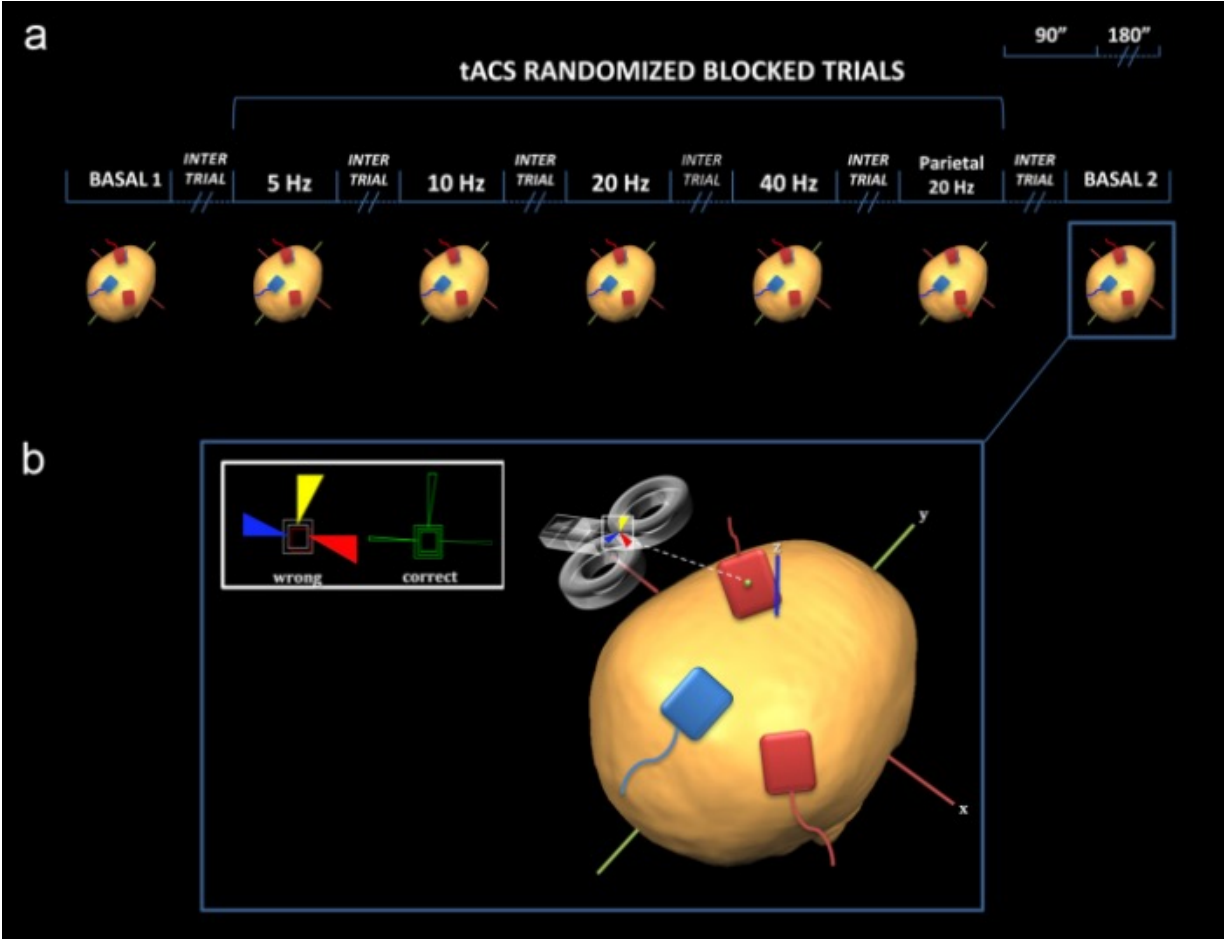




# Courtesy of Ruairidh McLennan Battleday

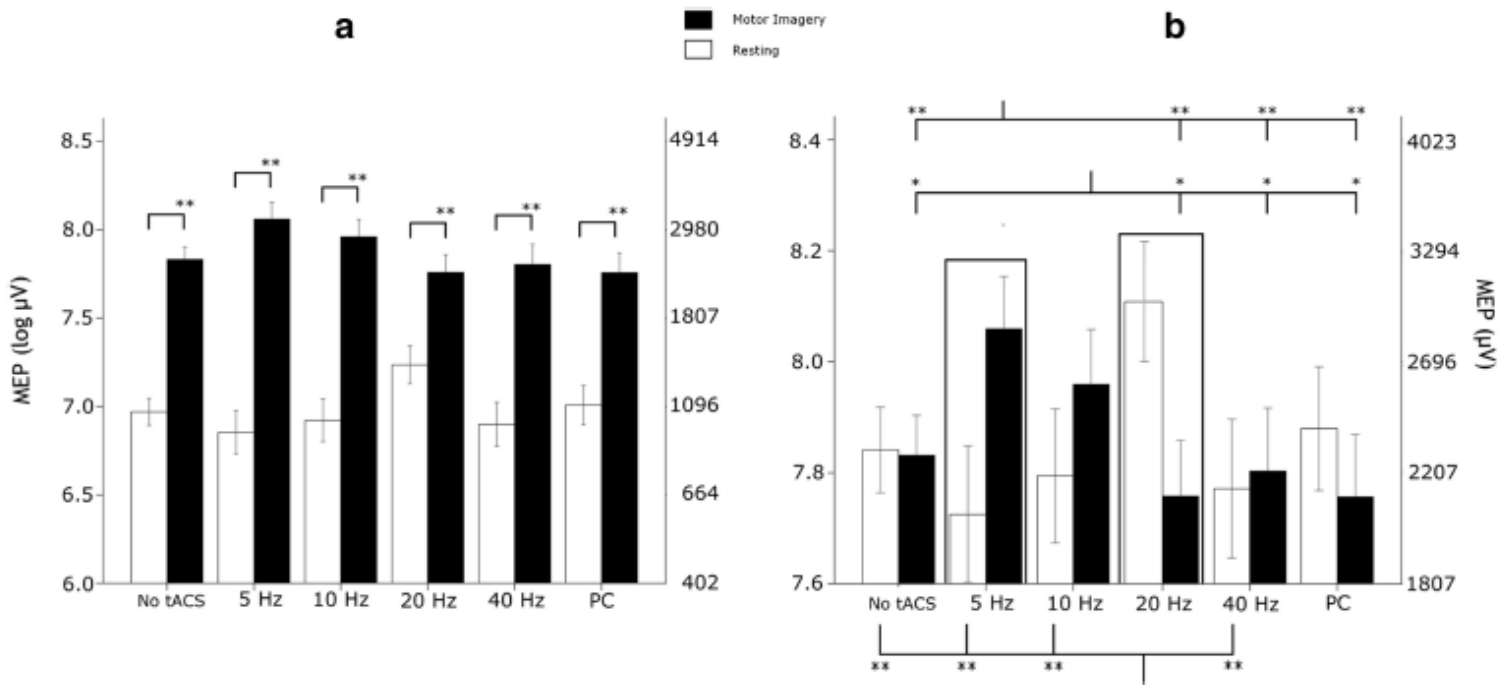
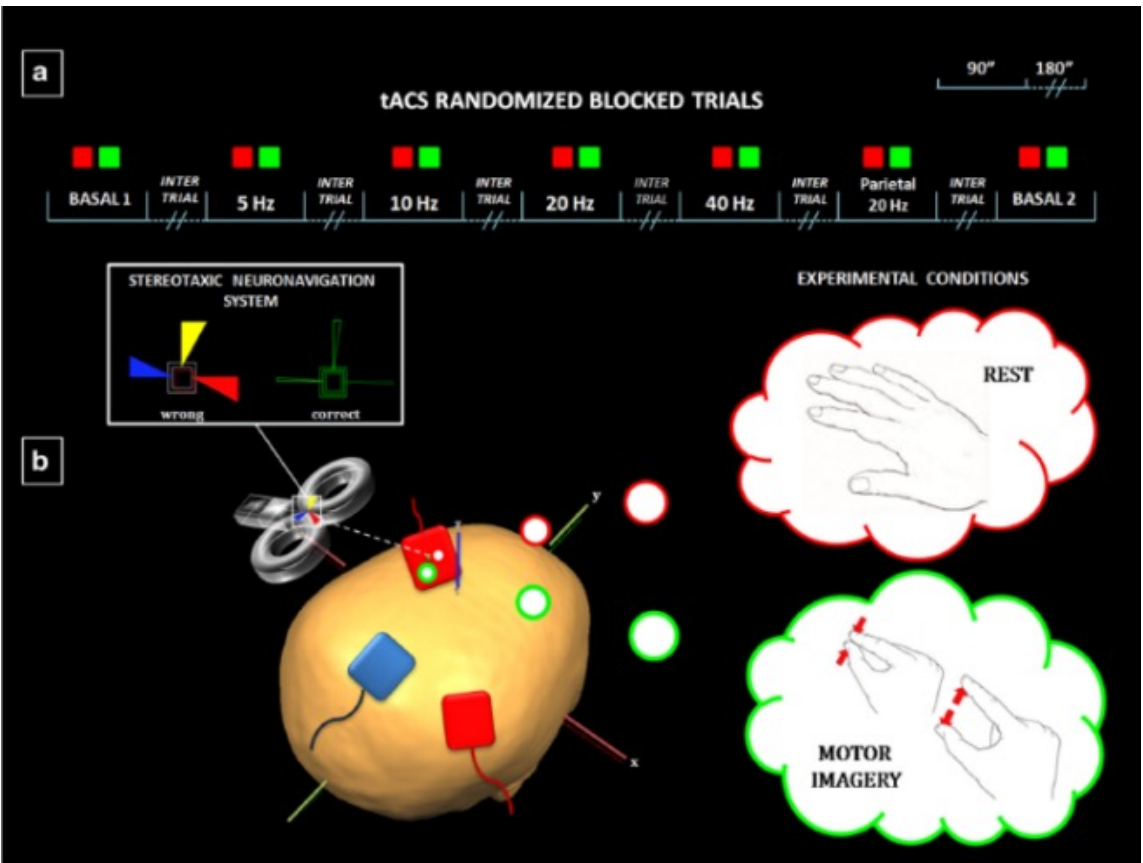




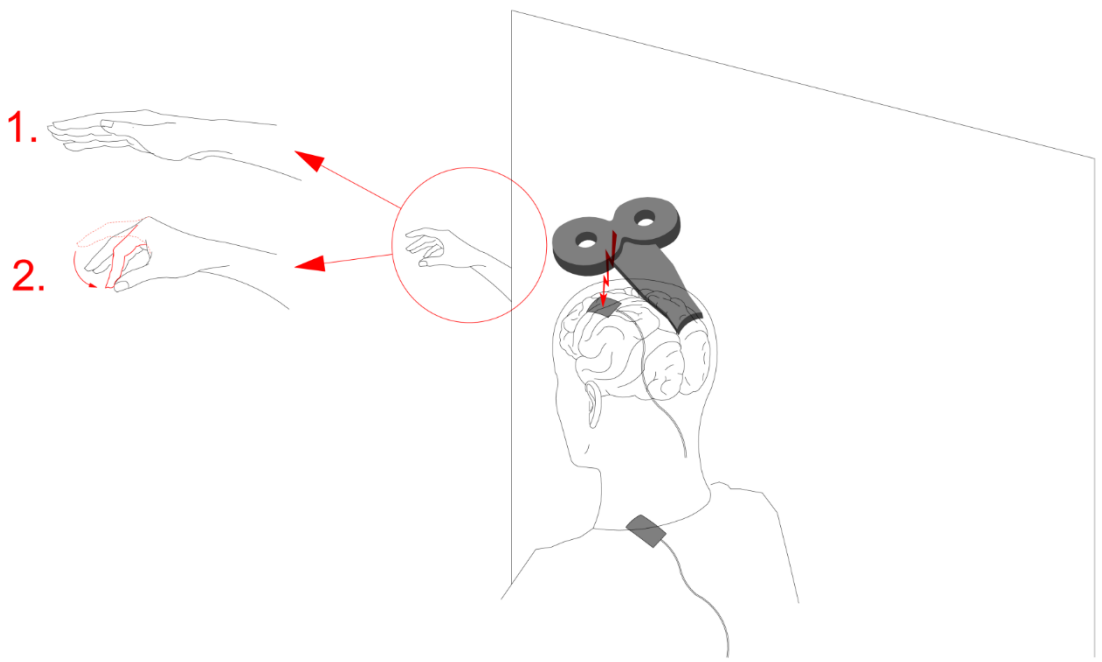


*Feurra et al., 2011.*

*Shpektor et al., 2017.*

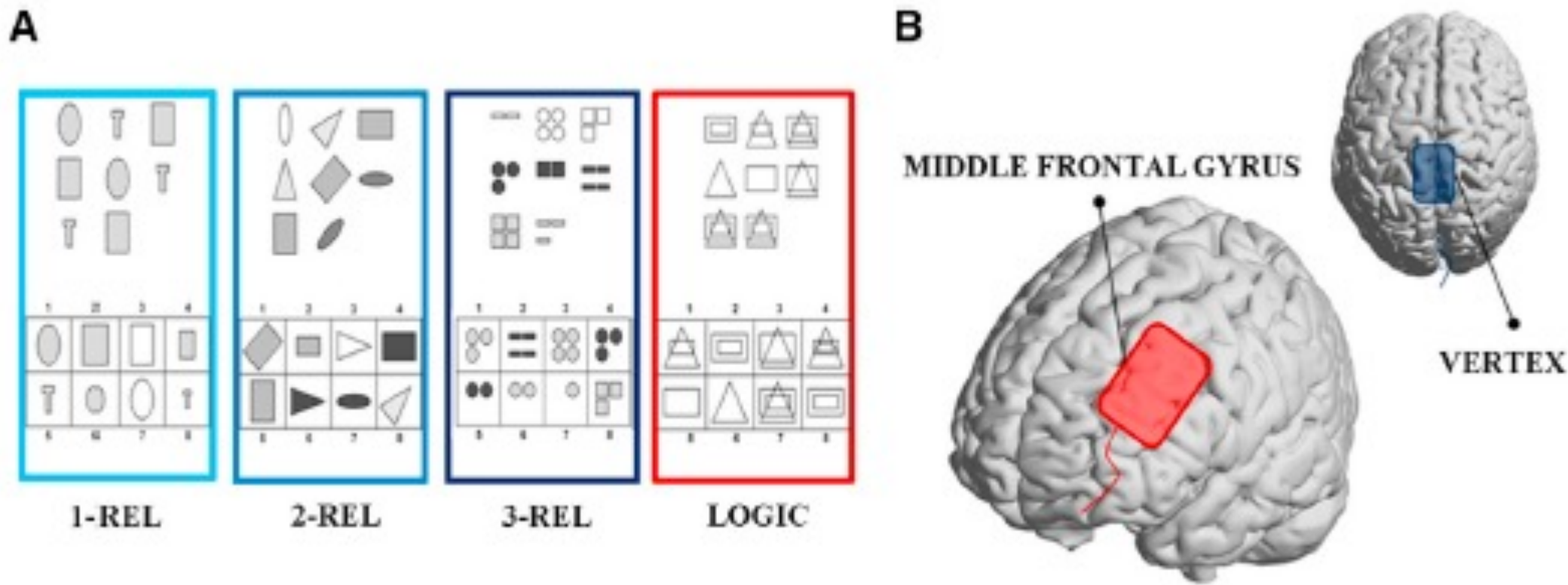


*Feurra et al., 2013.*

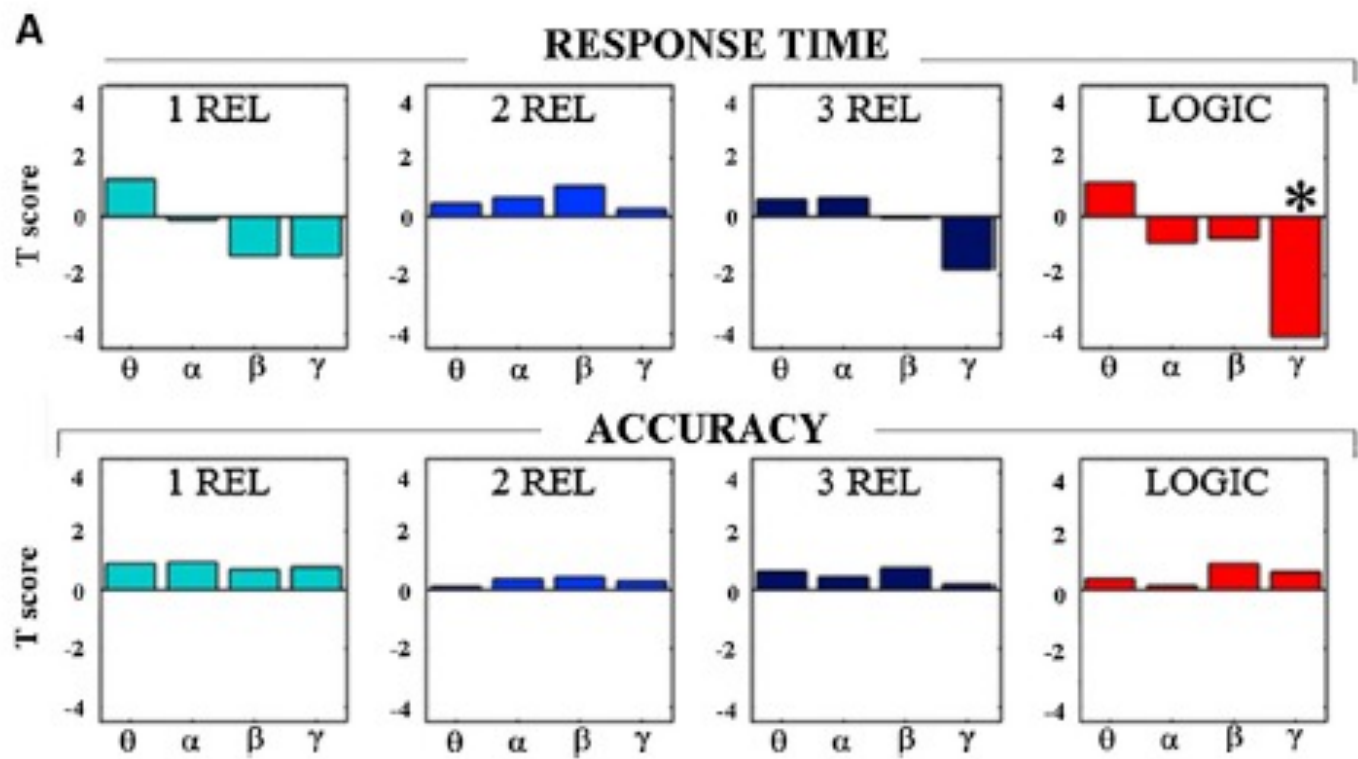


*Feurra et al. 2019*

	$\theta$	$\alpha$	$\beta$	$\gamma$	S
AO					
R					



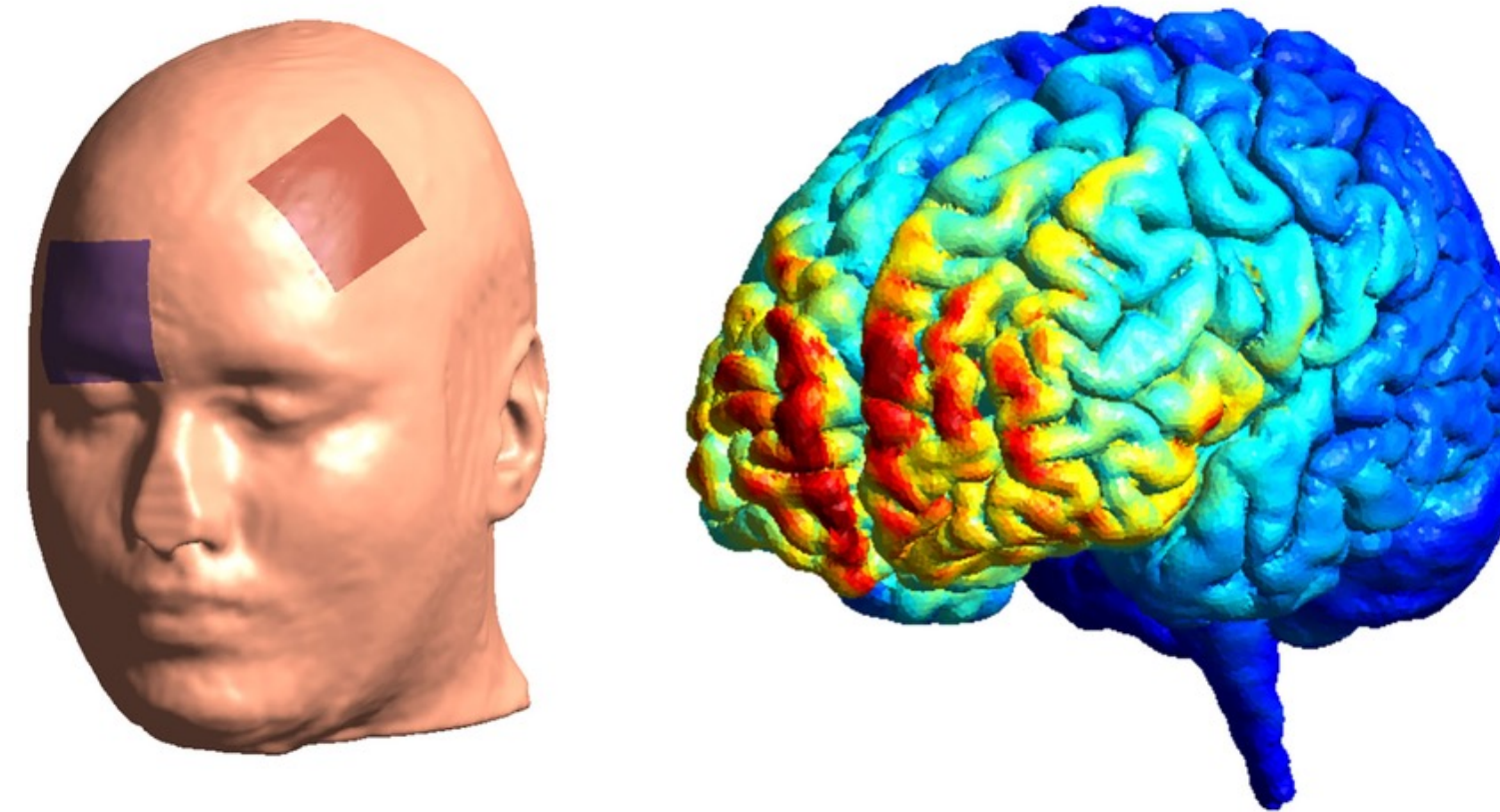
*Santarnecchi et al., 2013.*



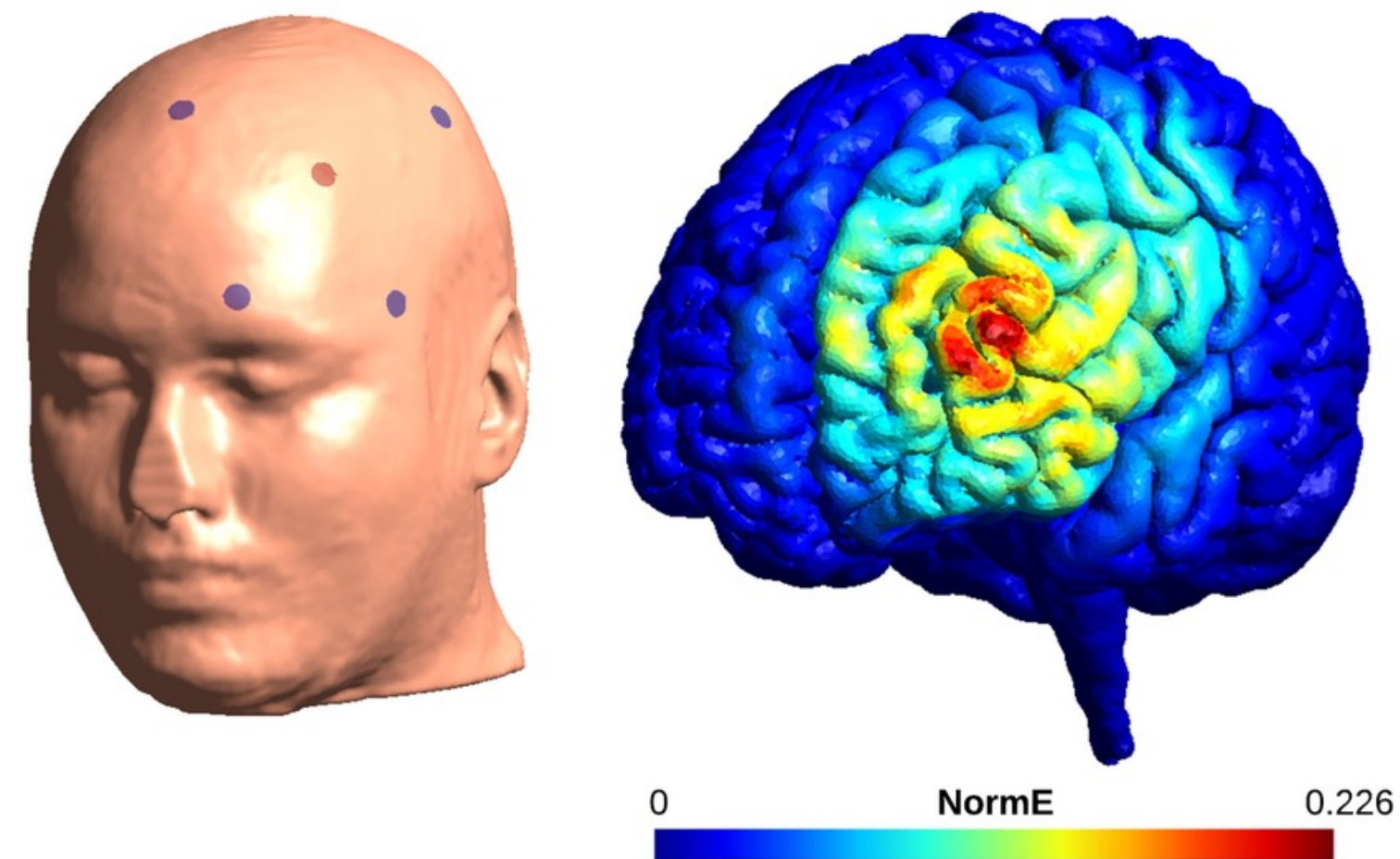


# High Definition VS Conventional tDCS

Conventional tDCS

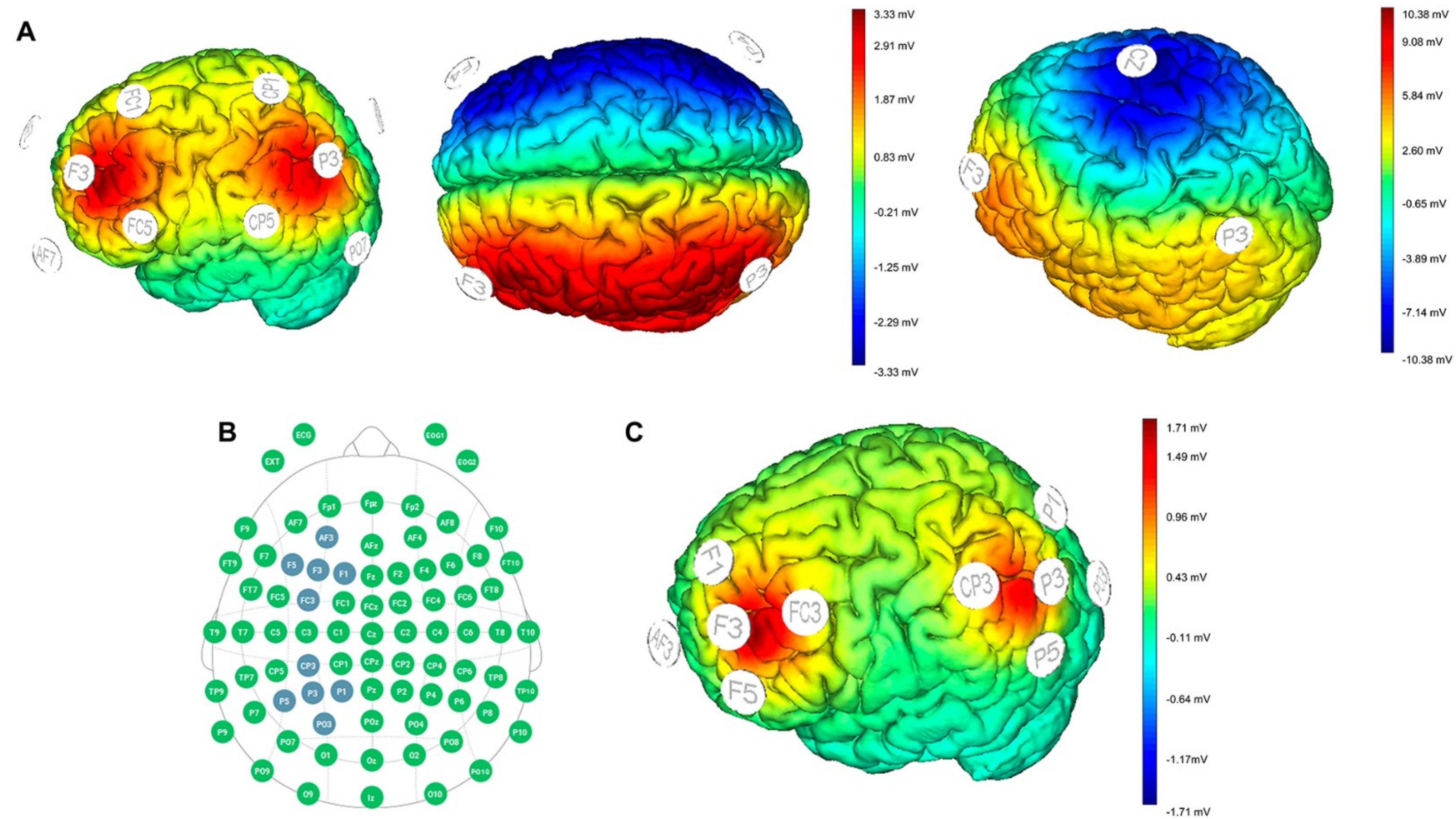


HD-tDCS

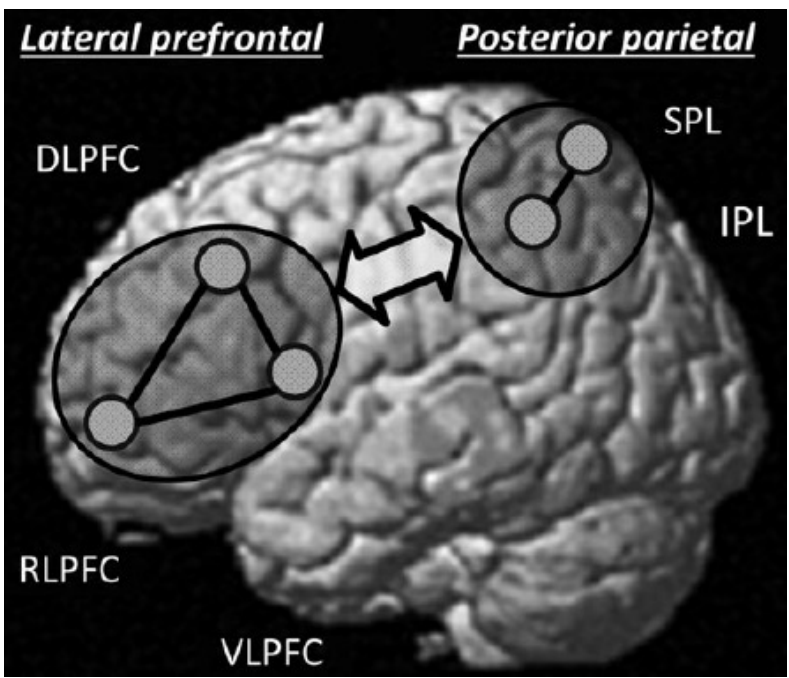




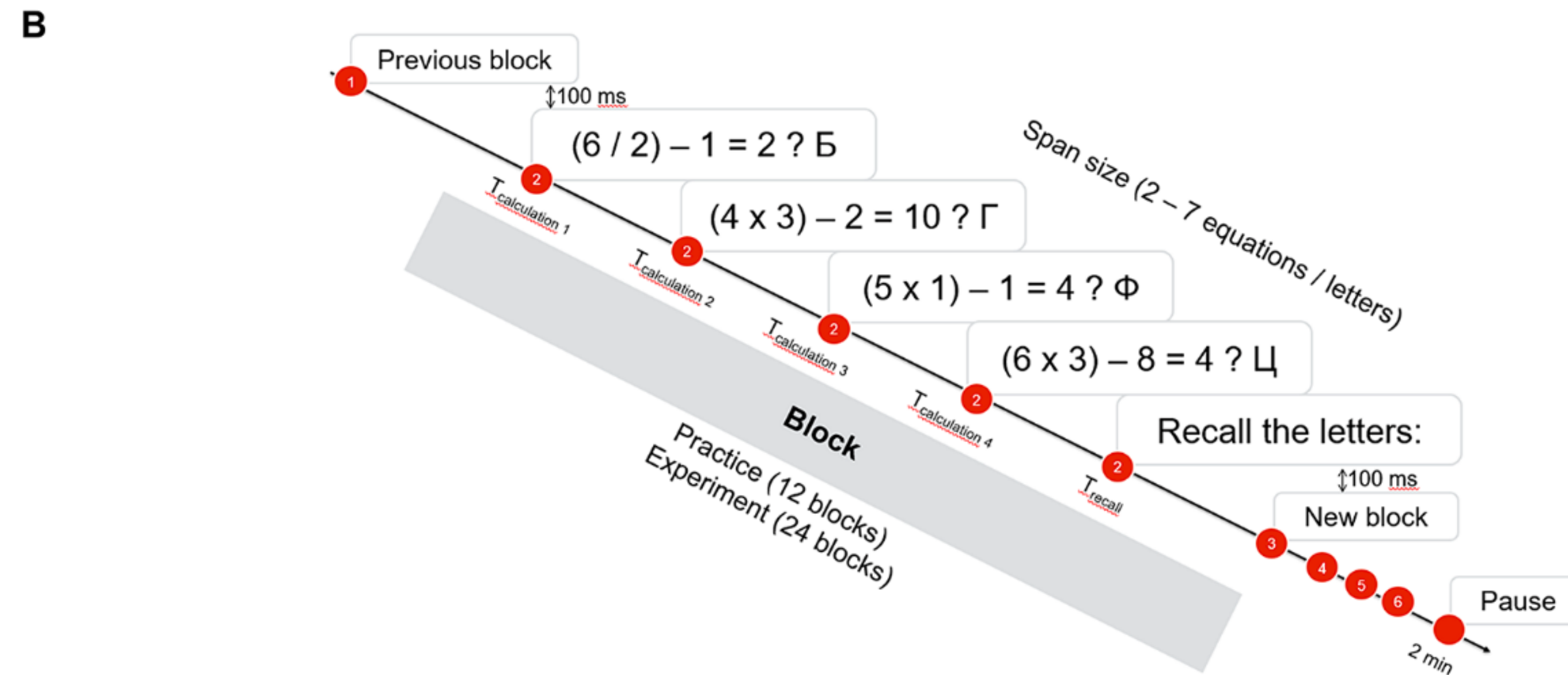
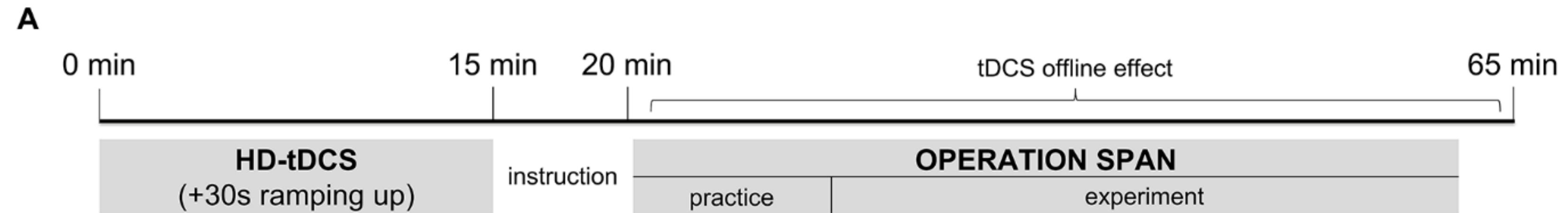
# Fronto-parietal brain network plays a crucial role in working memory capacity during complex cognitive task

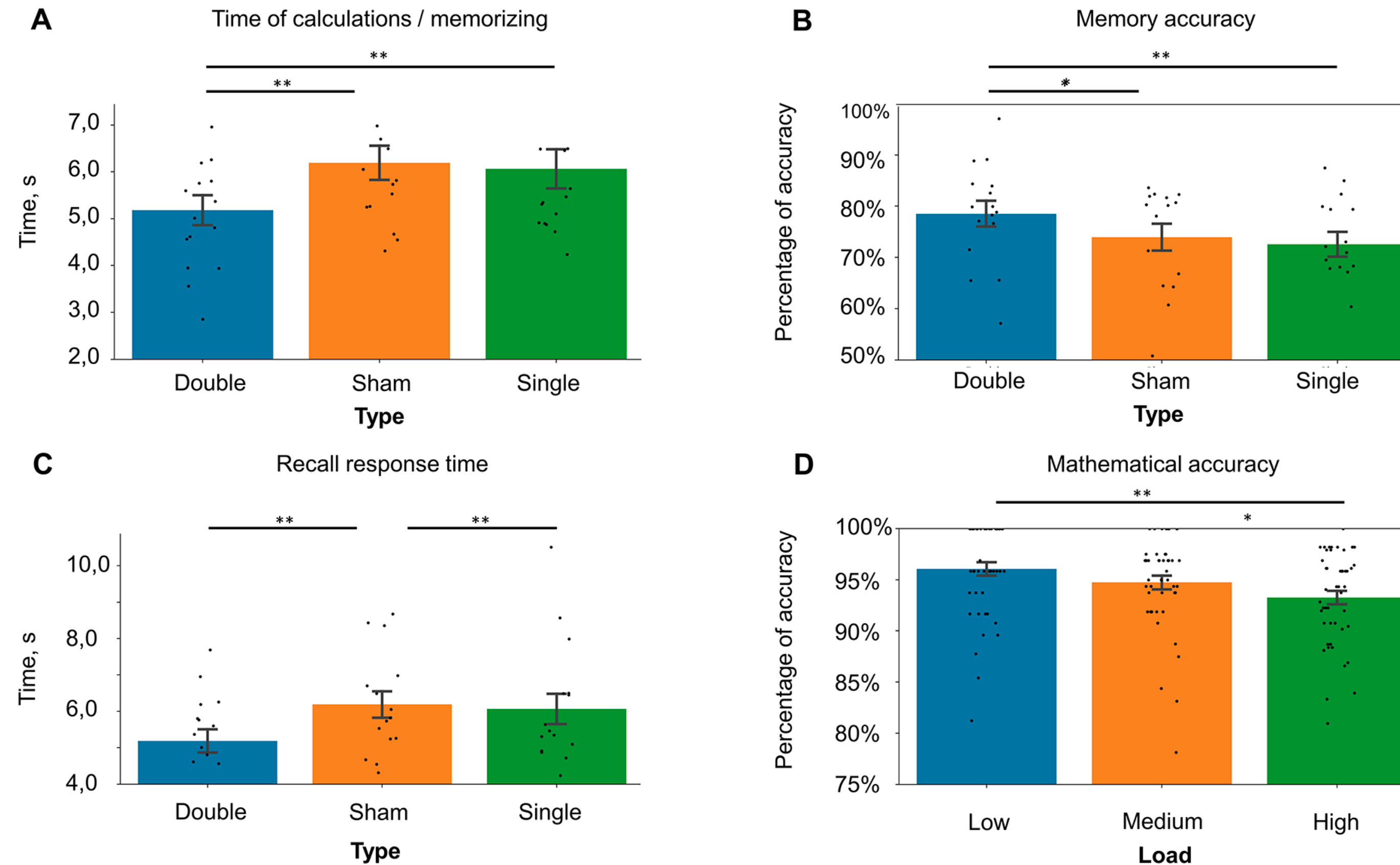


Otstanov et al. 2024









The results emphasize the differential contributions of the Frontal Parietal Network (FPN) and underscore the significance of boosting network synchronization for Working Memory (WM) performance during complex WM tasks.

Overall, this study highlights the novelty and effectiveness of concomitant stimulation of the FPN in enhancing WM performance.





NATIONAL RESEARCH  
UNIVERSITY



Nikita  
Otstanov  
(PhD  
student)

Higher  
School of  
Economics



Carlos  
Nieto-Doval  
(PhD  
student)

Higher  
School of  
Economics



Giulia Galli  
PsY, PhD

Kingston  
University  
of London



Matteo  
Feurra  
PsY, PhD

Higher  
School of  
Economics





# Thanks for your attention

**mfeurra@hse.ru**  
**matfeu@gmail.com**

