THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

UNC SCHOOL OF MEDICINE

Mechanism of Transcranial Alternating Current Stimulation (tACS)

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Neuroscience Center

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Conflicts of Interest

- UNC owns IP related with FF as the lead inventor.
- UNC has determined the absence of a conflict of interest (COI) for the majority of work presented here and has determined a "COI with administrative considerations" for the clinical trials in the Frohlich Lab.
- FF is the founder, chief scientific officer, and majority owner of Pulvinar Neuro LLC. We provide solutions for transcranial current stimulation research.
- I speak with many companies and have received industry funding from Tal Medical (travel + research).
- I frequently travel and give presentations. I typically receive reimbursement and a stipend.

PULVINAR NEURO
NEUROTECHNOLOGY FOR THE FUTURE

NETWORK NEUROSCIENCE

FLAVIO FRÖHLICH

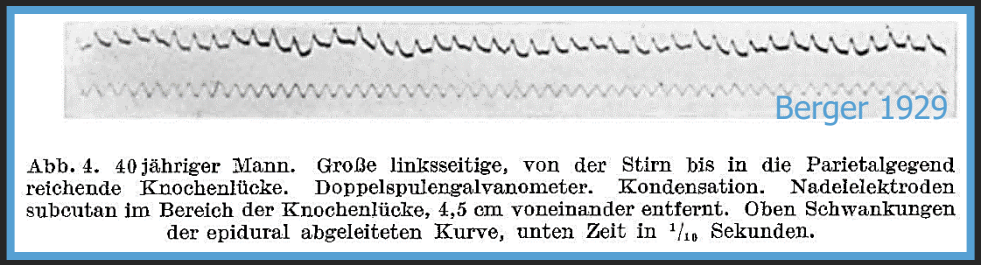
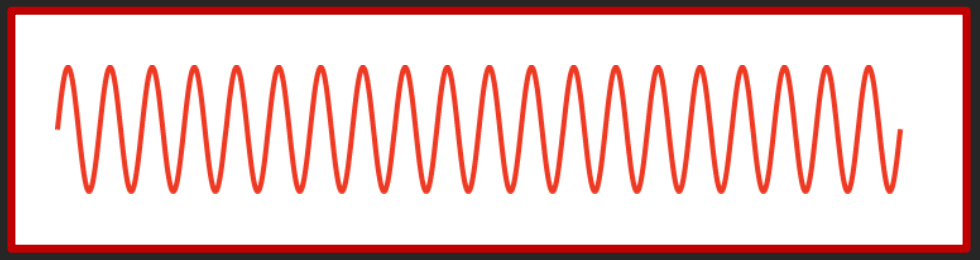


Abb. 4. 40jähriger Mann. Große linksseitige, von der Stirn bis in die Parietalgegend reichende Knochenlücke. Doppelspulengalvanometer. Kondensation. Nadelelektroden subcutan im Bereich der Knochenlücke, 4,5 cm voneinander entfernt. Oben Schwankungen der epidural abgeleiteten Kurve, unten Zeit in $^1/_{10}$ Sekunden.



Transcranial Alternating Current Stimulation

VERTICAL INTEGRATION

Patients

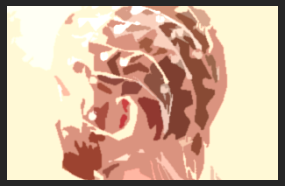
COMPLEXITY

TRACTABILITY

Model Systems

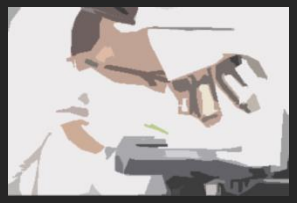
Clinical Trials

Brain Stimulation,
Human Neurophysiology



In vivo (Animal)
Electrophysiology

In vitro (Animal)
Electrophysiology



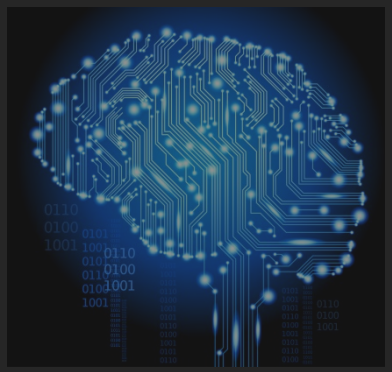
Computer Simulations

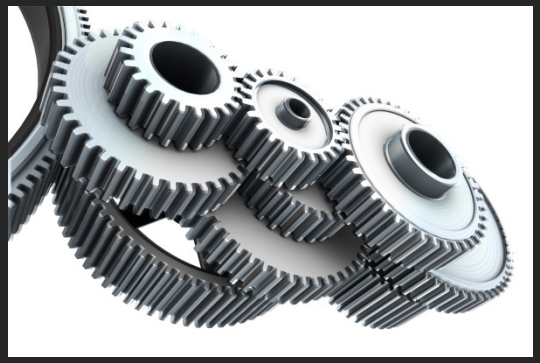
RATIONAL DESIGN

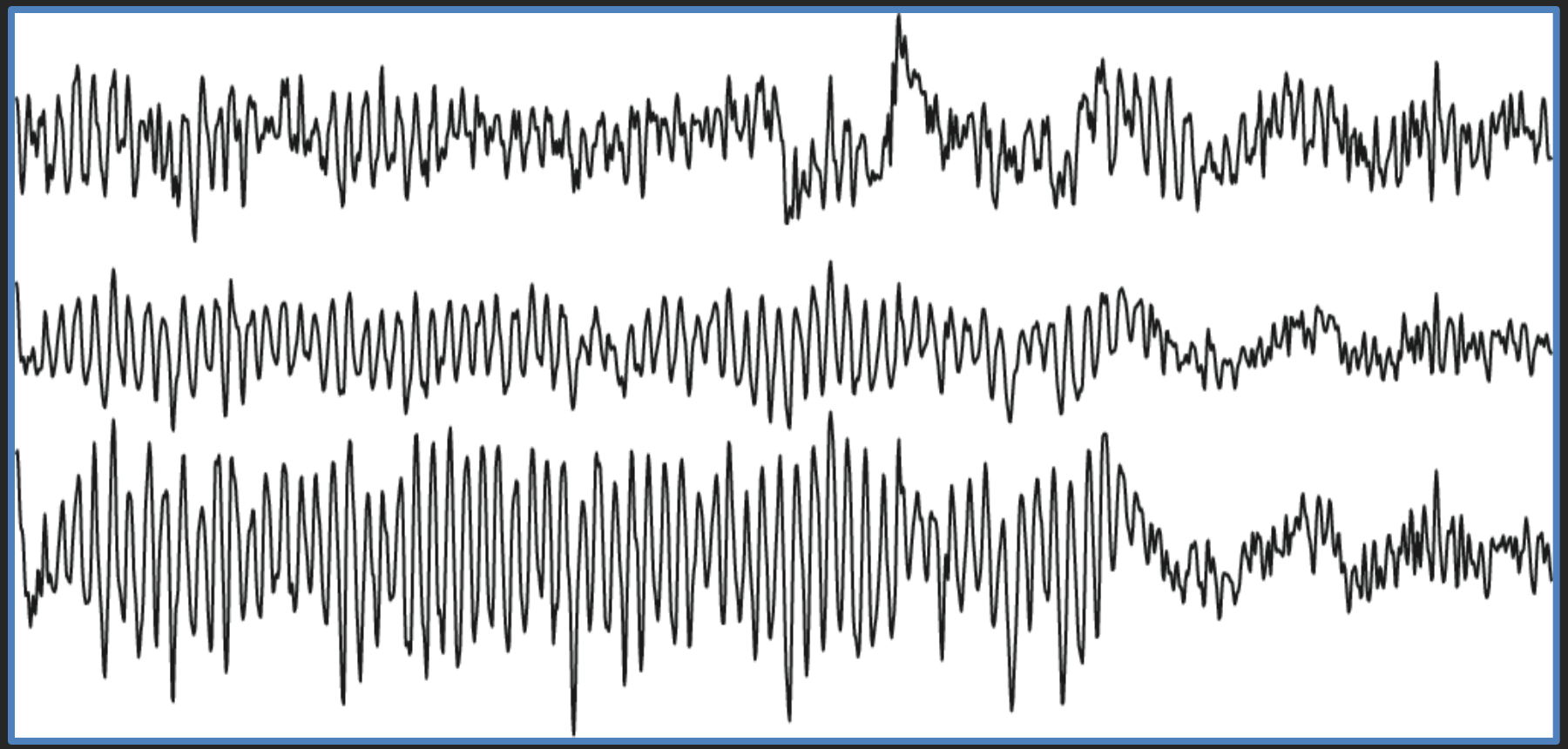
Target Identification

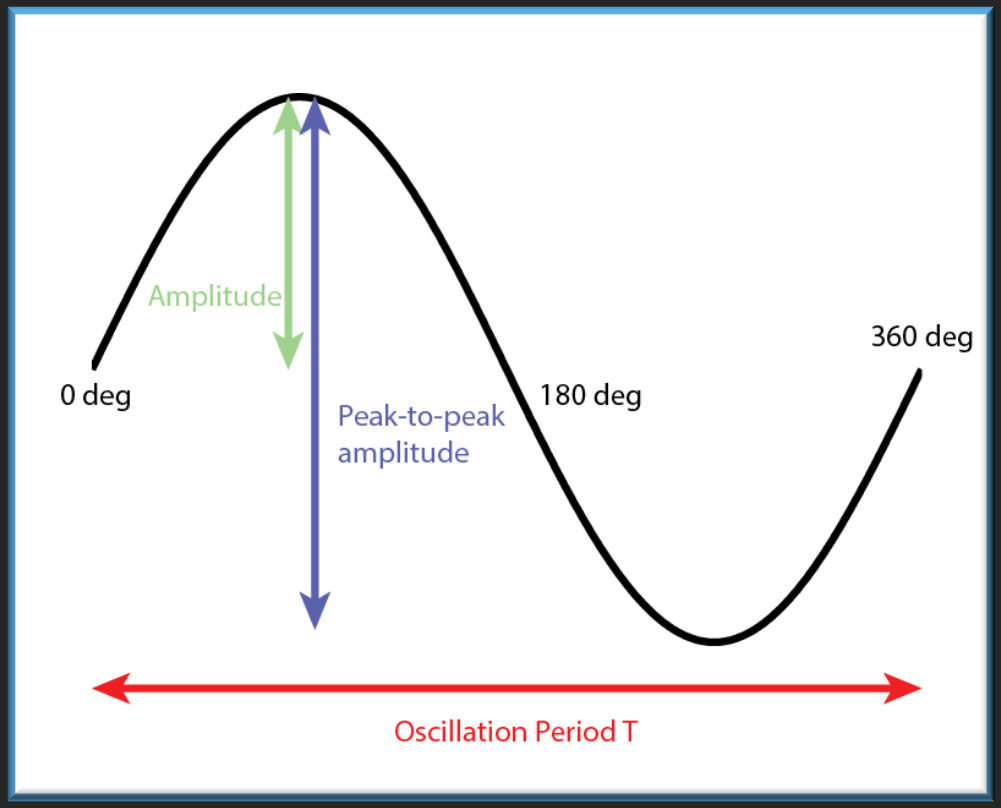
Target Engagement

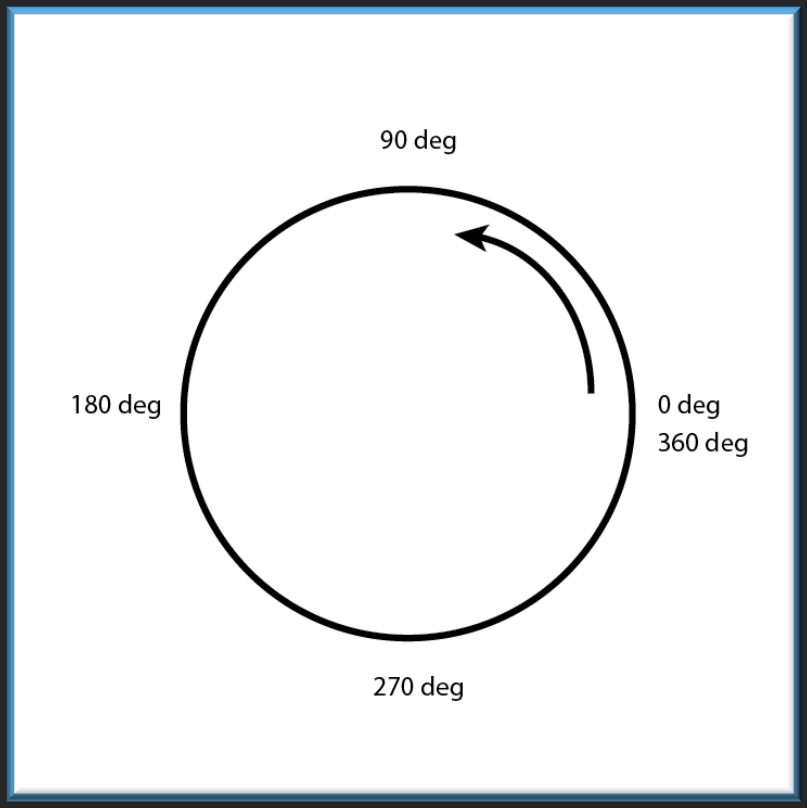
Target Validation





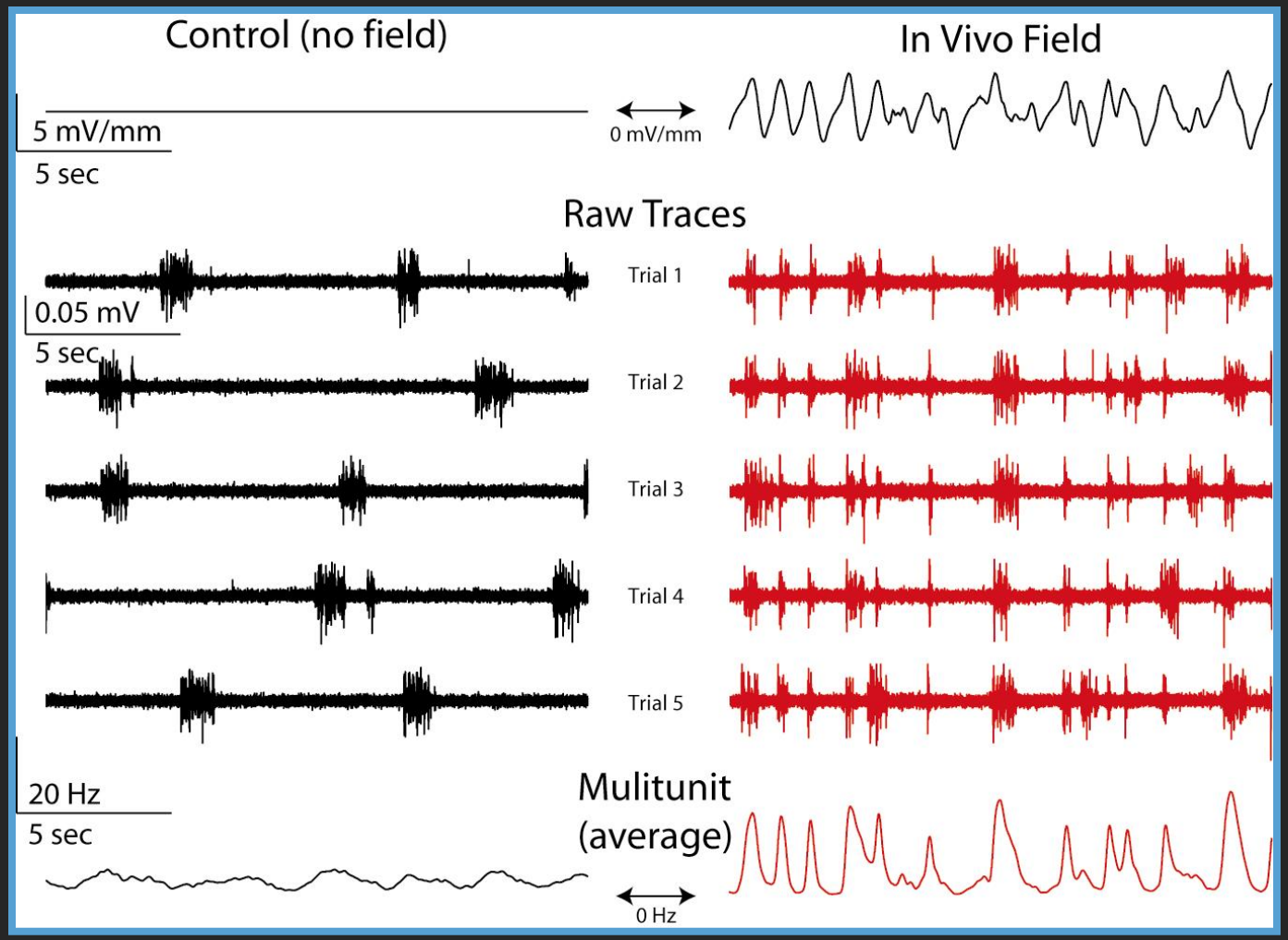




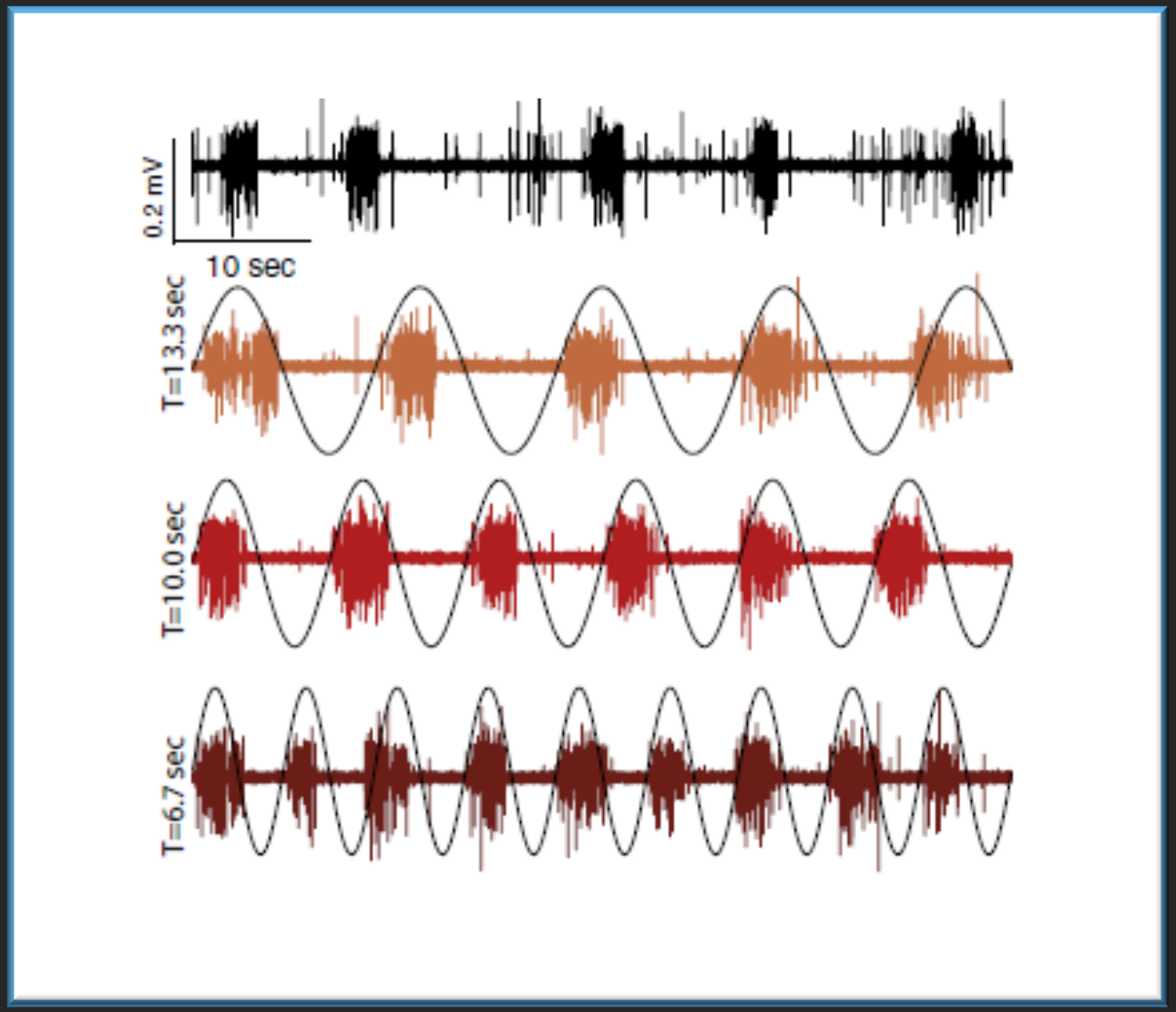


Caution: Most tACS literature refers to the peak-to-peak amplitude as amplitude.

Today’s Theory

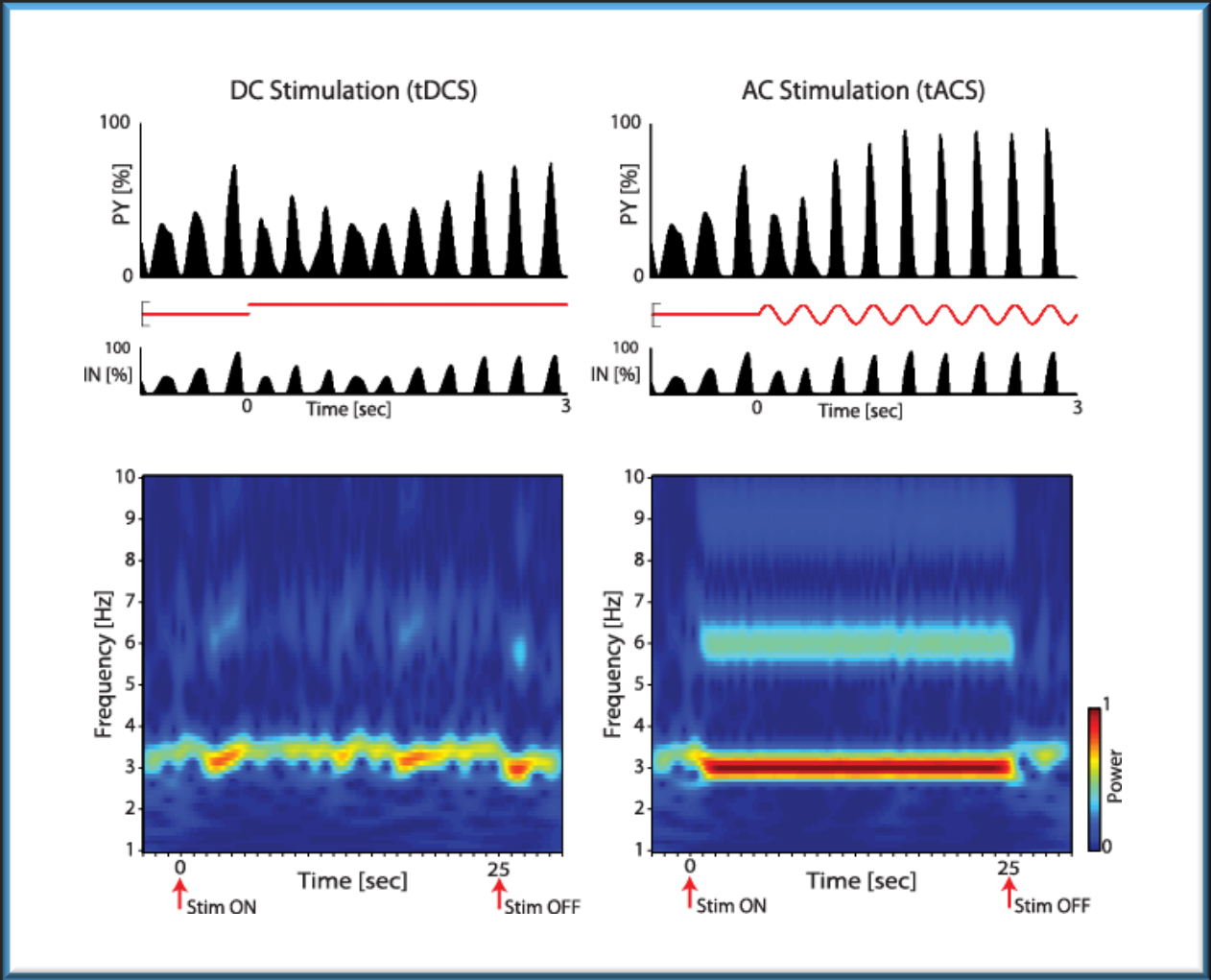


Frohlich and McCormick, 2010

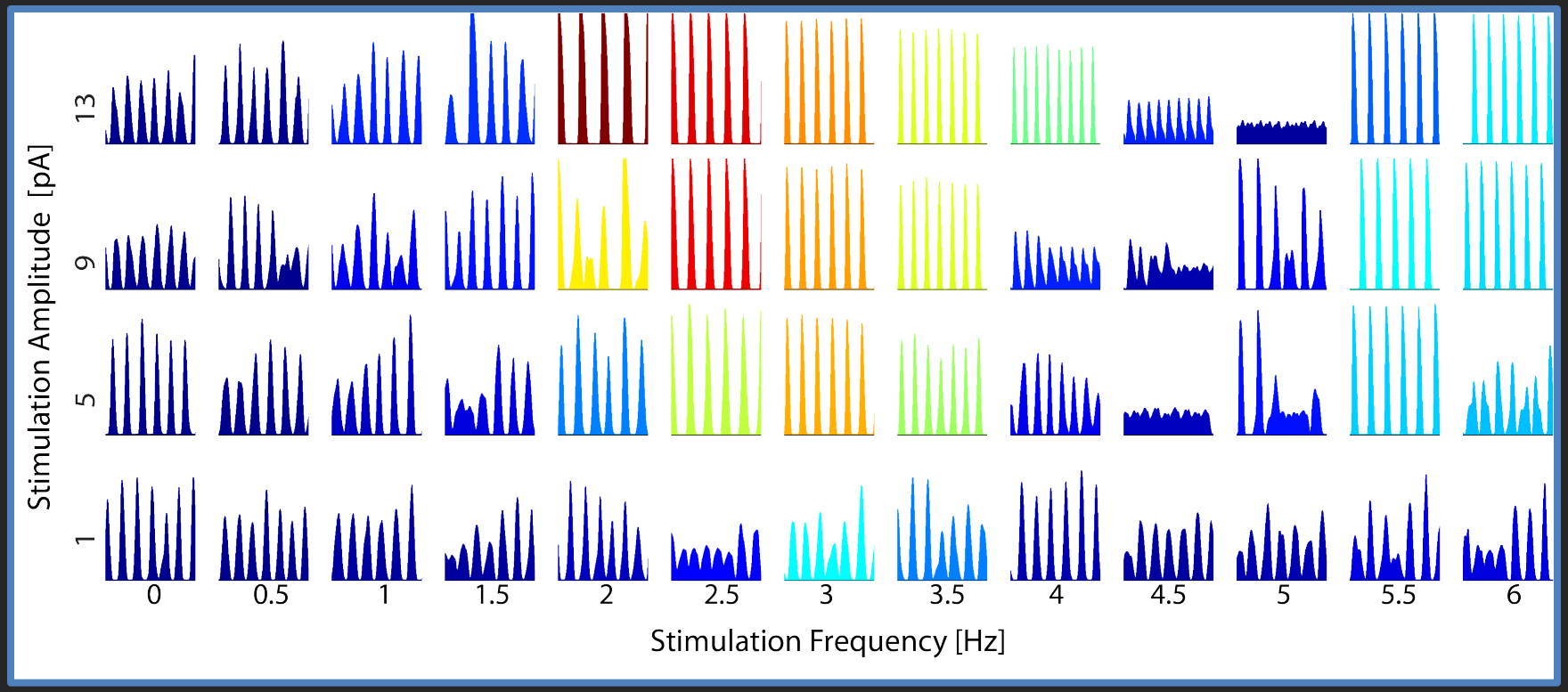


Frohlich and McCormick, 2010

AC/DC

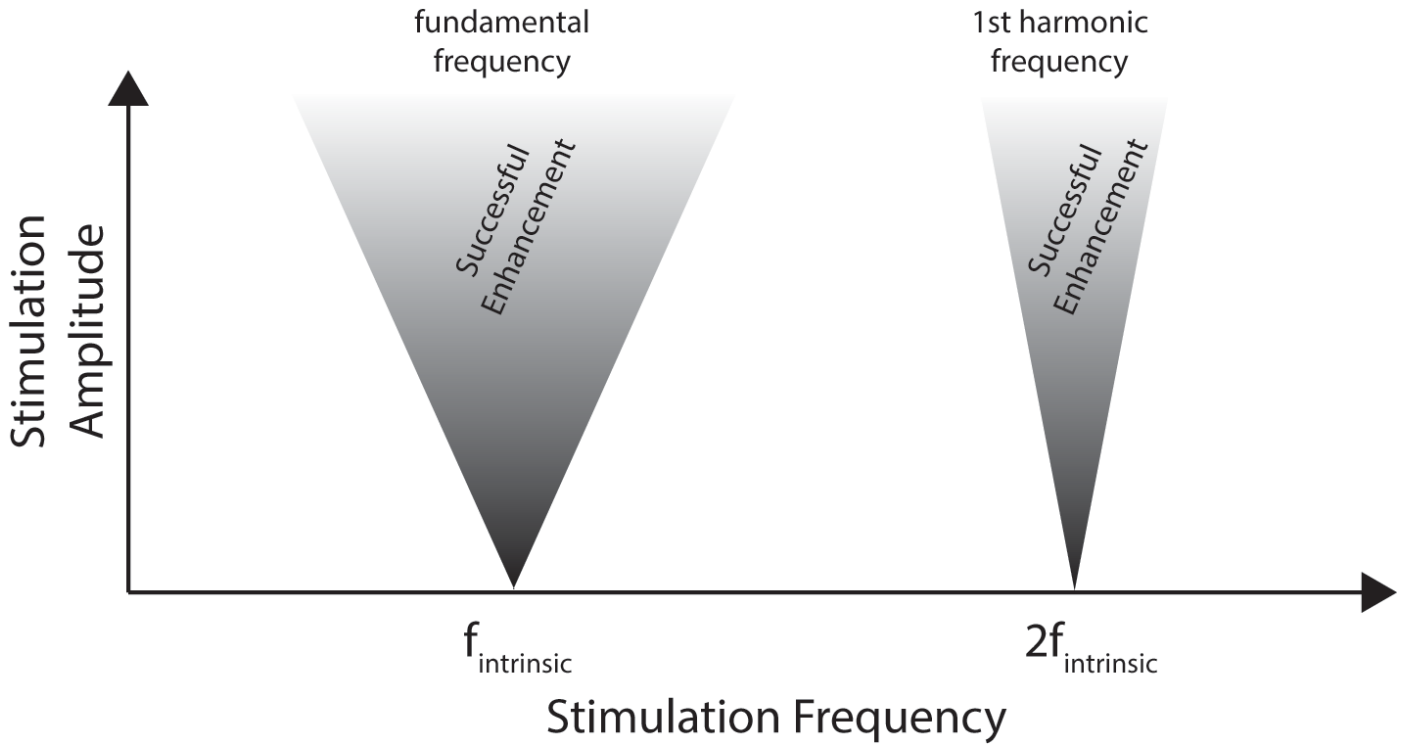


Ali et al. 2013

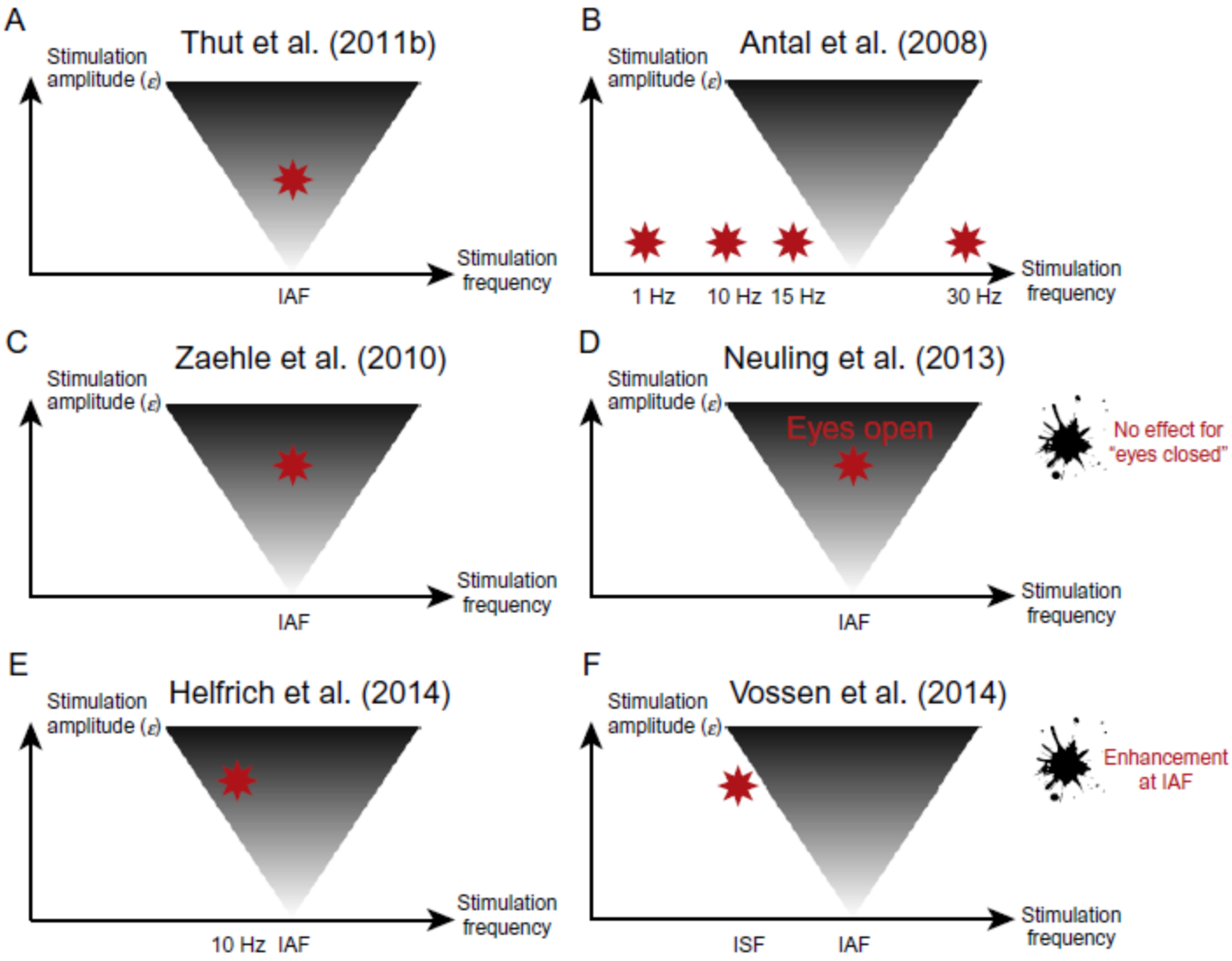


Ali et al. 2013

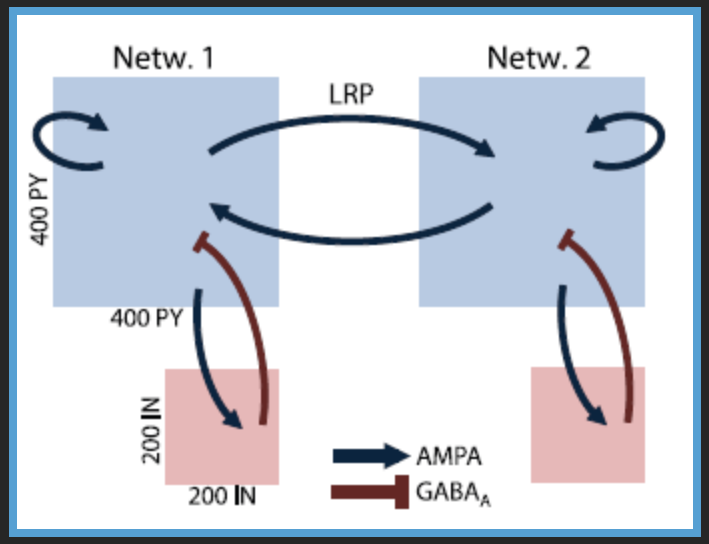
ARNOLD TONGUE

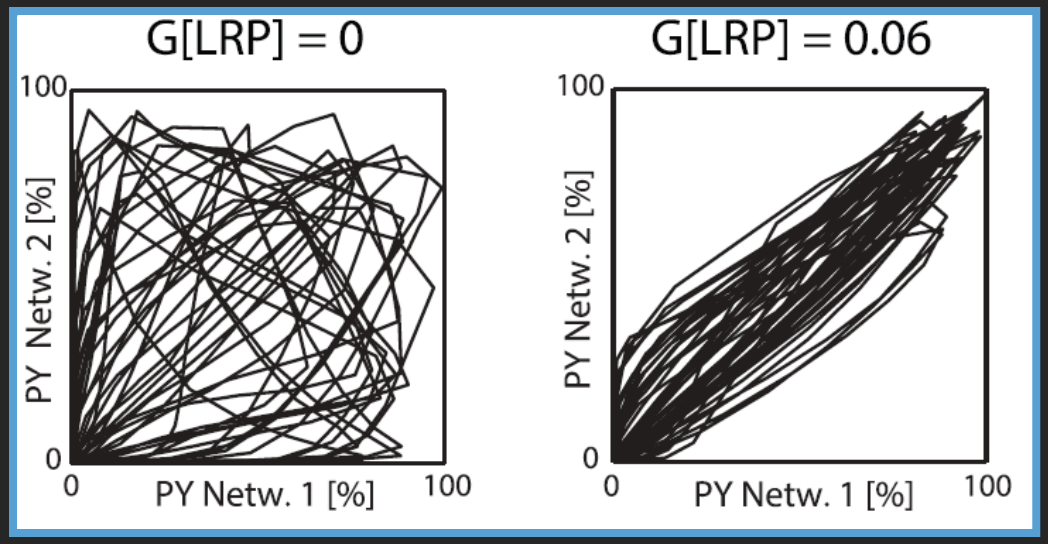


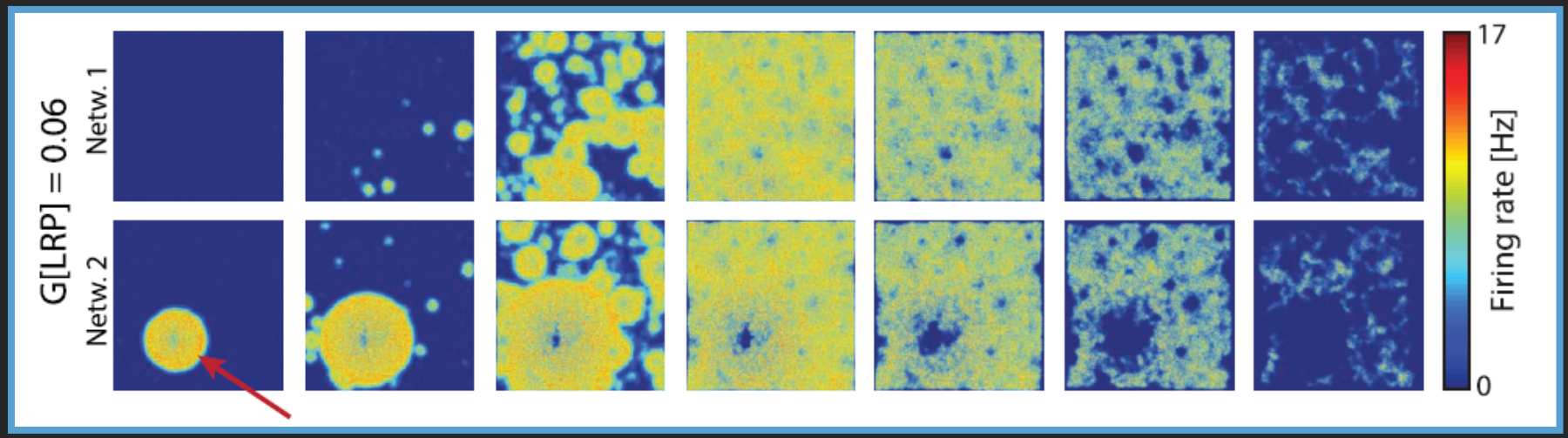
Frohlich 2014



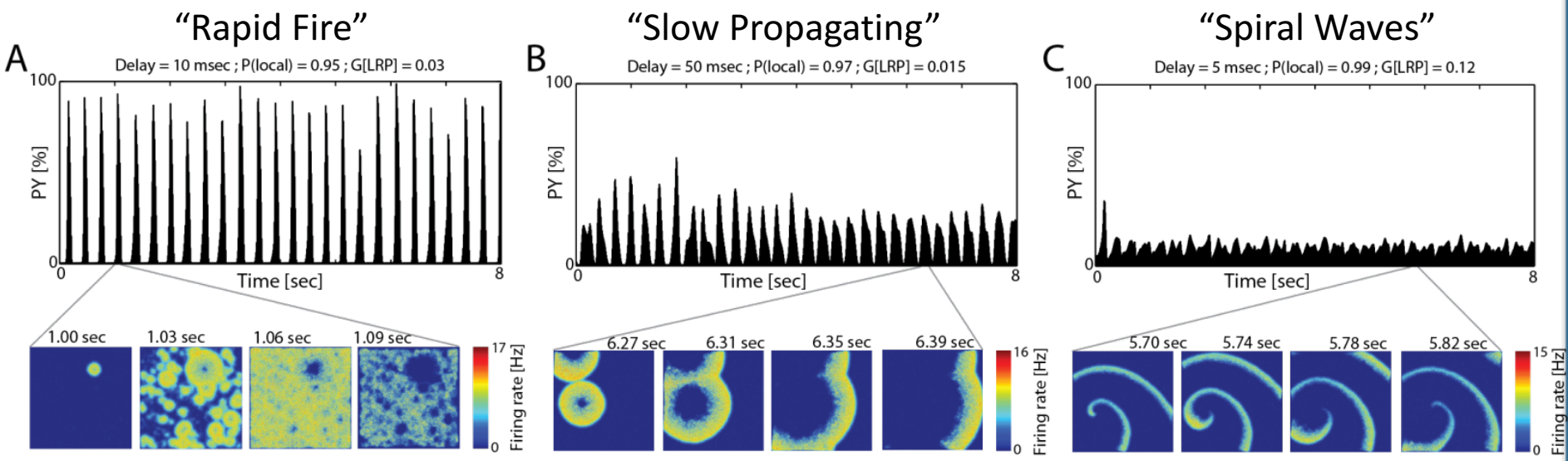
Frohlich 2014



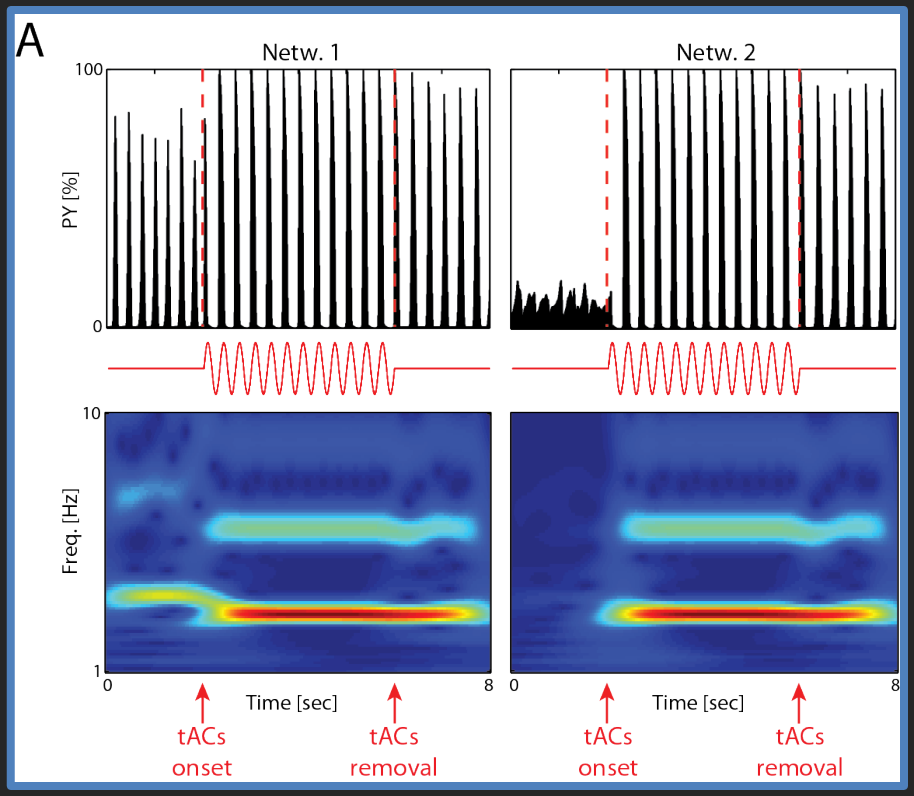


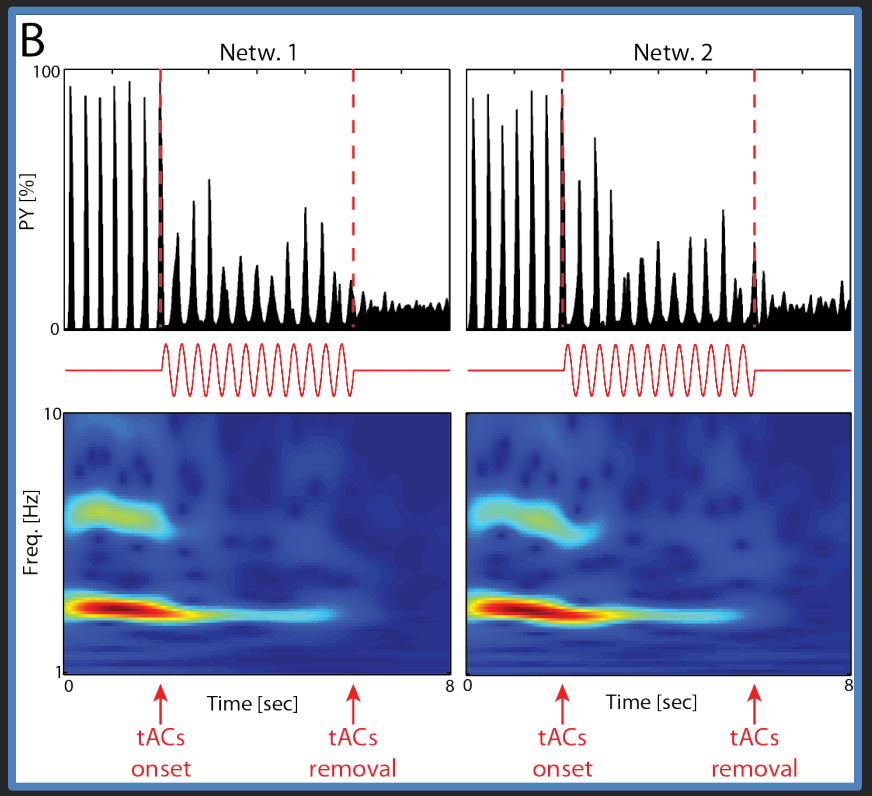


Kutchko and Frohlich 2013

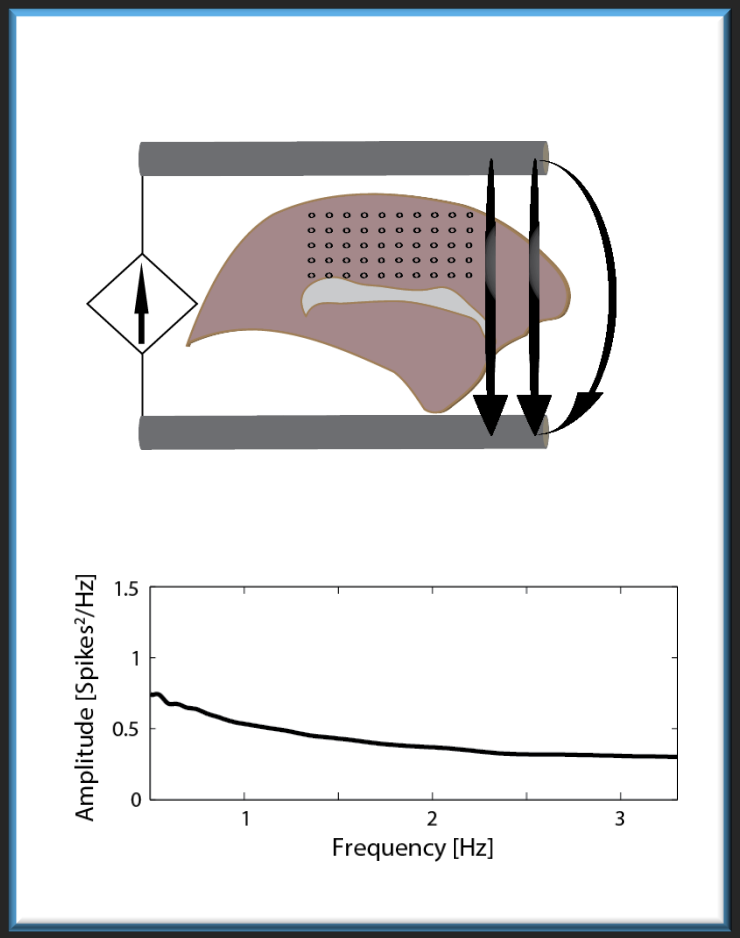


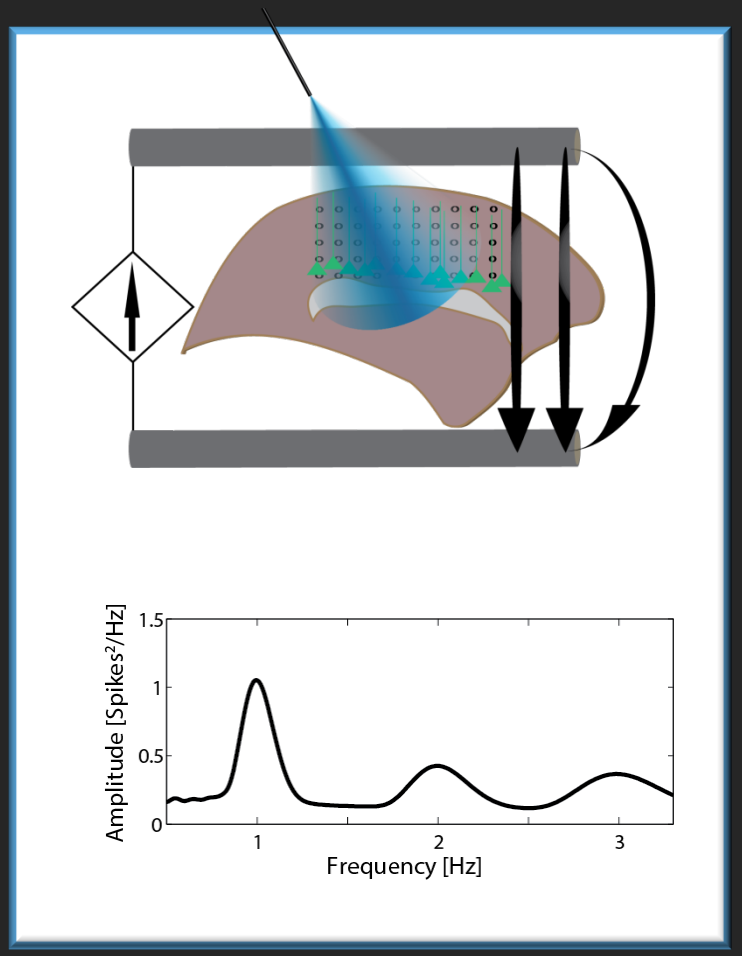
Kutchko and Frohlich 2013



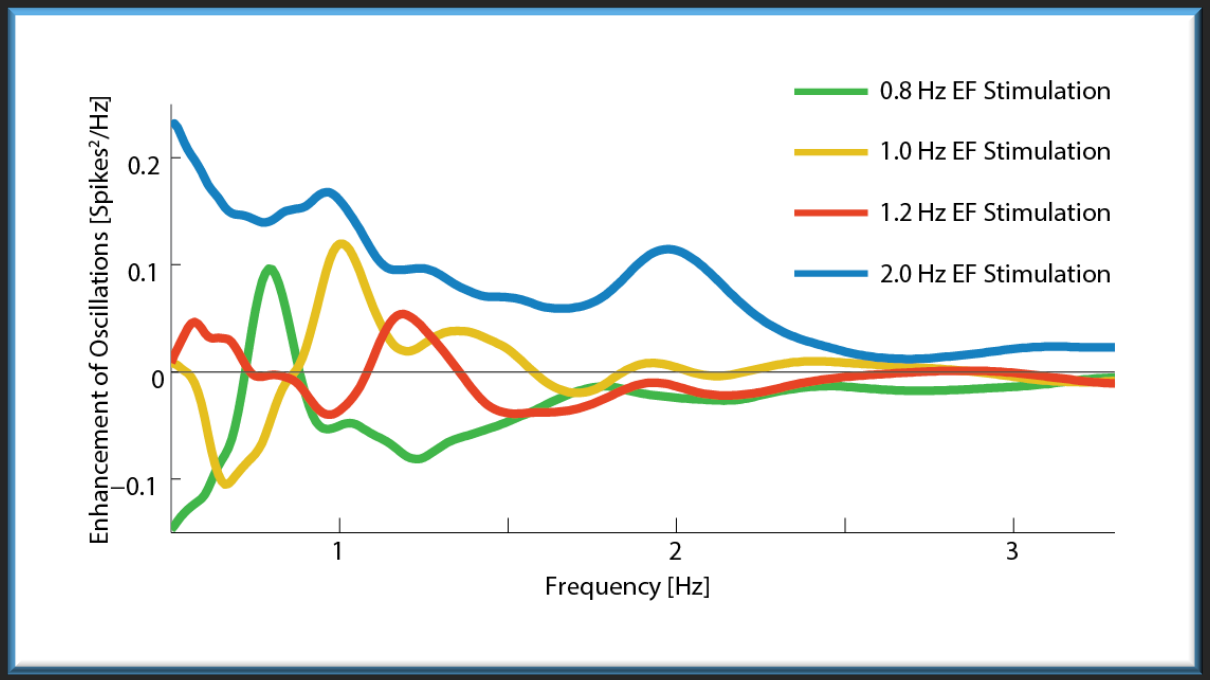


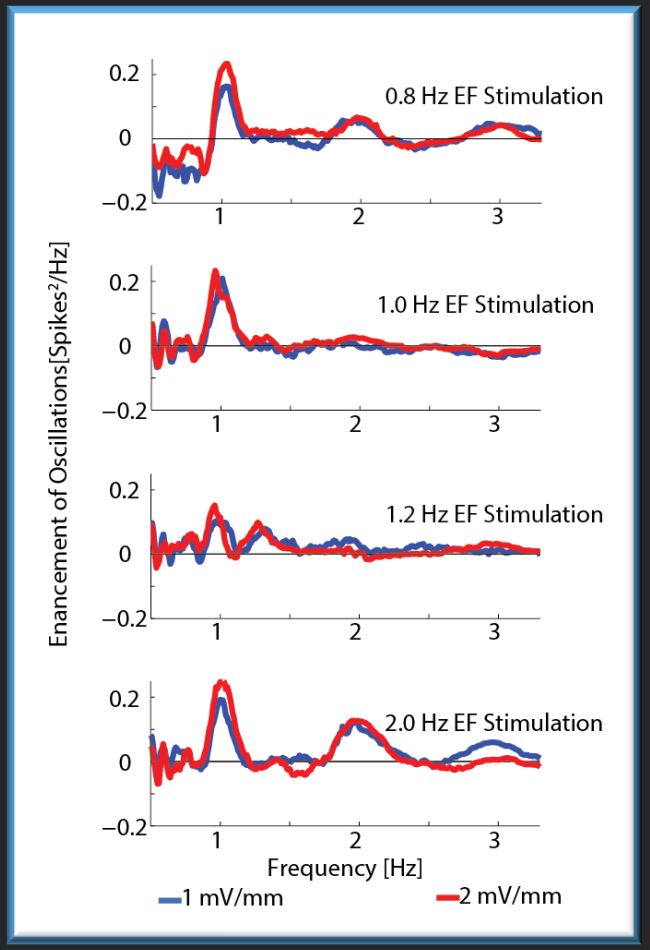
Kutchko and Frohlich 2013



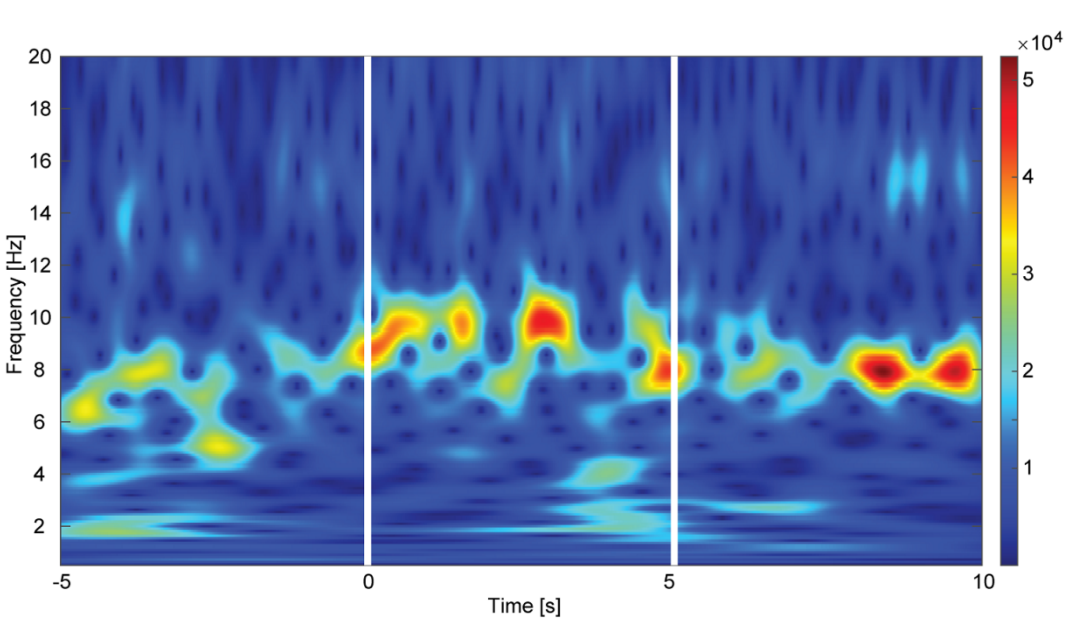


Schmidt et al. 2015

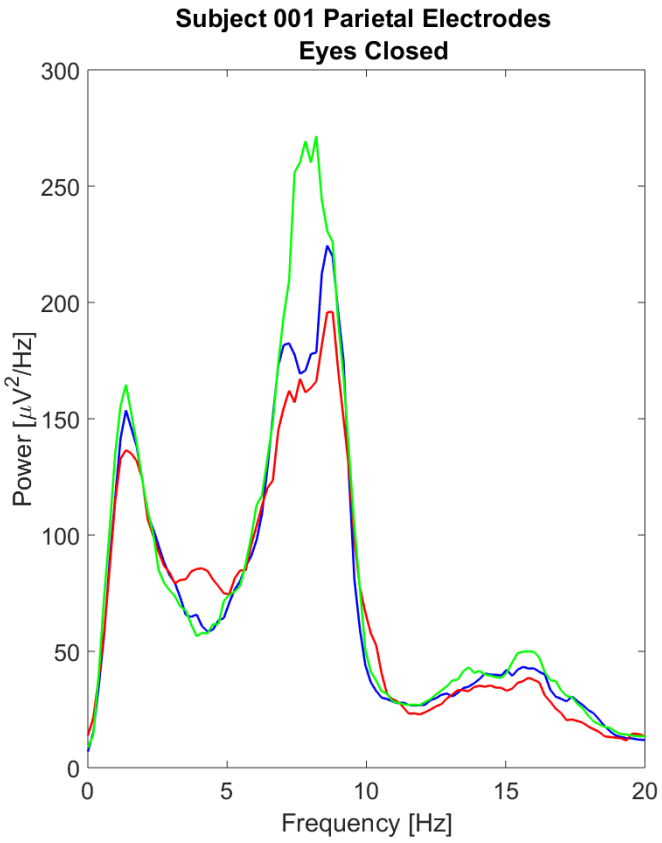


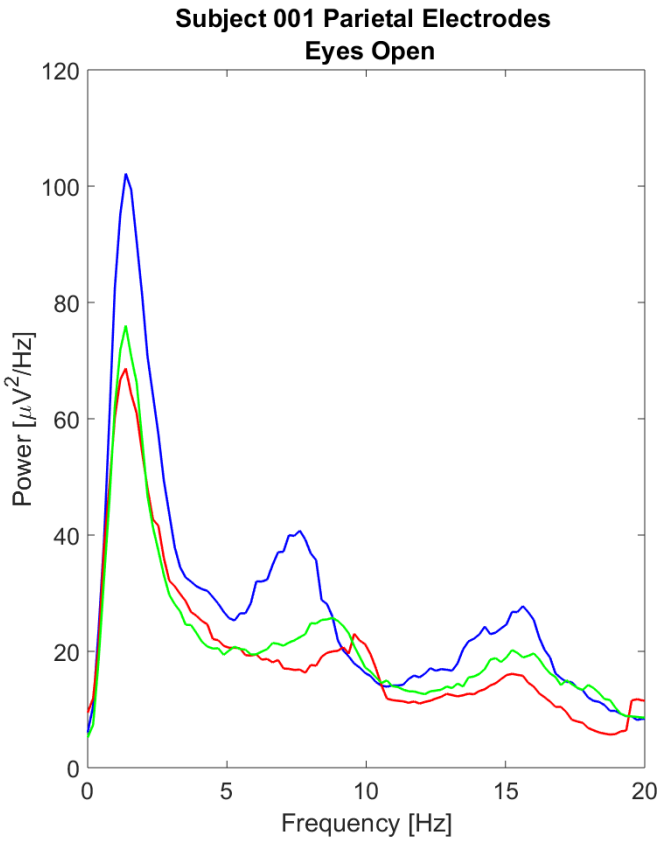


Schmidt et al. 2015



Alagapan et al. 2016

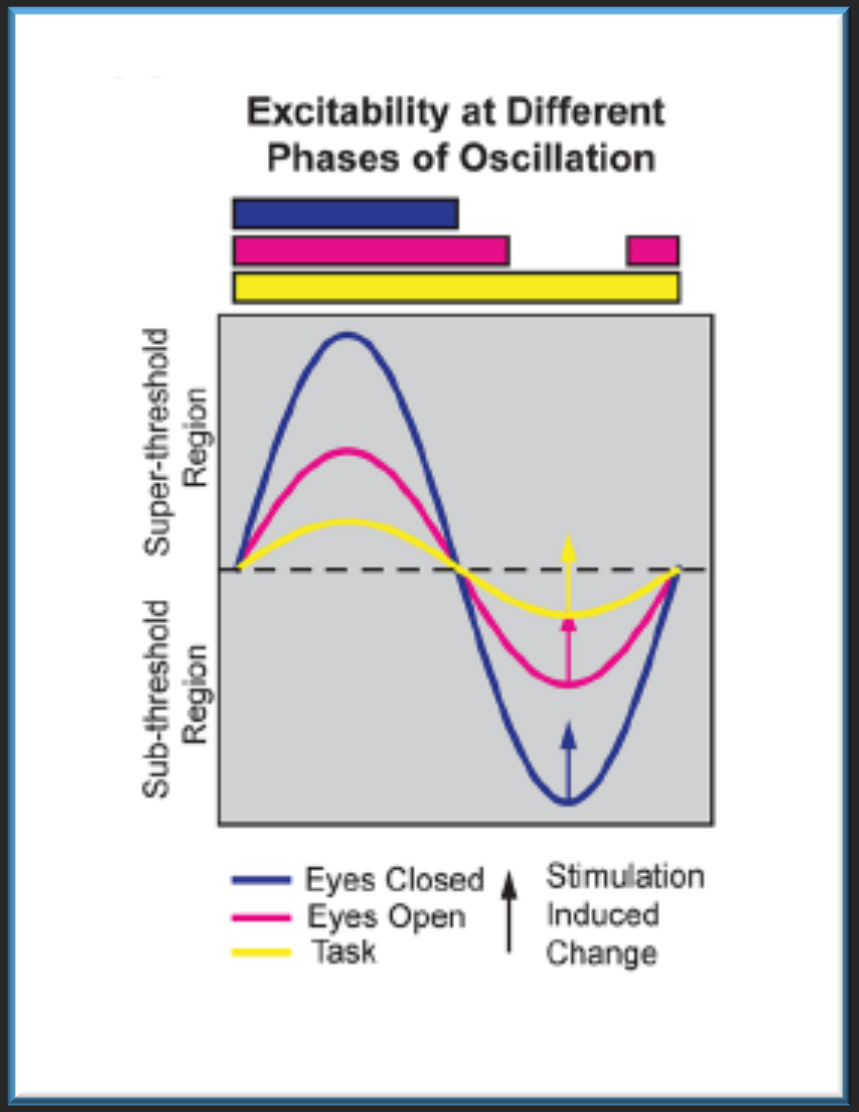




"Eyes Closed"

Visual Working Memory Task

Alagapan et al. 2016



Alagapan et al. 2016

1. Outlasting effects
2. Arnold tongue beyond model
3. Interacting oscillators
4. State-dependence
5. Waveform modifiers

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