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Modulating cognition: The effects of non-invasive brain stimulation

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Introduction: Cognitive abilities are crucial in everyday life, including working memory, planning, decision-making, and learning. Despite its importance, we do not fully understand the brain mechanisms behind cognition. In two studies (your internship would focus on one of those), we will focus on the role of neural oscillations and the vagus nerve in cognitive performance.

The vagus nerve is a cranial nerve and a key component of the parasympathetic nervous system, which plays a crucial role in autonomic regulation, but also influences cognitive functions through its impact on brain regions like the prefrontal cortex. To test the causal role of the vagus nerve in cognition, its activity can be non-invasively modulated using transcutaneous vagus nerve stimulation (tVNS; Hiltz, 2022). A change in any cognitive function (working memory, learning, etc.) would imply that the vagus nerve is causally involved in said function.

Alternatively, from electroencephalography (EEG), we have correlational evidence that neural oscillations (such as theta and alpha) relate to cognition. To test the causal relationship between oscillations and cognition, transcranial alternating current stimulation (tACS) can be used (Wischnewski et al., 2023). Again, any changes in cognitive functioning that result from tACS would indicate that a particular oscillation causally relates to a specific function.

What to expect: In this internship, you will learn all aspects of human behavioral experiments. That involves setting up the experiment, collecting data, and analyzing. Dr. Miles Wischnewski will provide guidance and supervision. The primary methodology, besides the behavioral experiment, will be non-invasive brain stimulation. As such, some basic interest in neuroscience/neurophysiology would be required. If the experiment is successful, the goal is to prepare a research article for publication. Note: There is no financial compensation for this internship.

What you will learn:

- Design an experiment
- Program a task in Matlab (Psychtoolbox) or Python (PsychoPy/OpenSesame) (prior knowledge is helpful, but not required).
- Perform tVNS/tACS experiments
- Analyse behavioral and neurophysiological data (prior knowledge is helpful, but not required).
- Write a scientific article

Location: The internship and the study will occur at the University of Groningen in the Netherlands. Groningen is a beautiful small city in the north of the Netherlands with a lot of history. There is a lot of rain, so be prepared for that. The experiments will take place at the Department of Experimental Psychology, which is part of the Faculty of Behavioral and Social Sciences. Note, in the Netherlands, nobody speaks French, so a decent level of English is required!

References:
Hiltz, M.J. (2022). Transcutaneous vagus nerve stimulation - A brief introduction and overview. Autonomic Neuroscience, 103038.

Wischnewski, M., Alekseichuk, I., Opitz, A. (2023). Neurocognitive, physiological, and biophysical effects of transcranial alternating current stimulation. Trends in Cognitive Sciences, 27(2), 189-205