



Joint MD/PhD Fellowships Groningen-Oldenburg

Outline PhD Project

Working title of project	MEMETIS: Memory Enhancement via Transcranial Temporal Interference Stimulation in Parkinson's and Healthy Subjects
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Short Summary of PhD project

Transcranial Temporal Interference Stimulation (tTIS) represents an innovative non-invasive technique developed to stimulate deep-seated brain regions. This method involves the emission of two very-high-frequency signals, meticulously selected to avoid interference with normal brain activity, while slightly differing in frequency (e.g., 2 kHz and 2.1 kHz). These signals precisely overlap within the region of interest (ROI), creating interference that results in the emergence of a specific frequency (e.g., 0.1 kHz), effectively targeting deep brain structures such as the hippocampus. Crucially, tTIS avoids stimulating surrounding cortical regions. The application of tTIS is facilitated through electrodes placed on the participants' scalps, and previous research, including collaborative studies with Oldenburg/Groningen, attests to its effectiveness and safety when applied to human subjects. The project will be a cooperation of the Department of Cognitive Neuropsychiatry at the UMCG in Groningen (Prof. Aleman), the Department of Psychology in Oldenburg (Prof. Herrmann) and the Department of Neurology at the Evangelical Hospital/University of Oldenburg (Prof. Witt) as well as the Department of Biopsychology at the University of Oldenburg (Prof. Thiel).

The primary objective of this research project is to investigate whether tTIS can enhance memory through the stimulation of the hippocampus in both Parkinson's disease (PD) patients and healthy control participants. The central research question seeks to ascertain whether tTIS can improve memory function via hippocampal stimulation in these two distinct groups.

To ensure precise stimulation and assess changes in brain activity, tTIS will be administered within a controlled environment utilizing functional magnetic resonance imaging (fMRI) technology. In the initial phase of the study, tTIS will be employed to stimulate the hippocampus in both PD patients and healthy control participants. The evaluation will include a battery of cognitive and memory-



related tasks, encompassing memory recall exercises and cognitive processing assessments, all while monitoring brain activity using fMRI.

A cross-over research design, comprising real and sham stimulation sessions, will be employed to explore the impact of tTIS on memory function in PD patients and healthy individuals. The comprehensive examination will provide valuable insights into the feasibility, safety, and initial proof of concept for tTIS as a potential treatment to enhance memory in various neurological conditions, particularly those associated with hippocampal function.

PhD Candidate Profile/desired qualifications

MD/PhD candidates should bring a combination of clinical and research expertise and interest, making their role integral to the study's success. Since this is a translational research project, it involves clinical, patient-centred work as well as basic science in the field of programming and neuroscience.

Besides a strong interest in neurology and neuroscience, experience in the following fields is beneficial but not mandatory. Technical proficiency in medical imaging, especially with neuroimaging techniques like fMRI as well as competency in data analysis software like MATLAB or Python is valuable and aligns with the interdisciplinary nature of the project. In general, programming skills are very important for this study but can be learned during the MD/PhD project.

Effective communication skills, both written and verbal, are necessary for conveying findings, collaborating with the research team, and interacting with participants. This is crucial since the project involves different departments with different backgrounds. Attention to detail, adaptability, and a commitment to ethical research conduct are essential.

Working collaboratively within a multidisciplinary team is a core aspect of MD/PhD training. Maintaining high ethical standards and prioritizing patient safety and privacy throughout the research process is of utmost importance.

A genuine passion for neuroscience as well as for neurology and movement disorders, along with a strong work ethic and effective time management, complete the profile of a successful MD/PhD candidate dedicated to advancing medical knowledge in these areas and bridging the gap between research and clinical practice.