Neuro-x Institute (INX)
Defitech Chair in Clinical Neuroengineering
https://www.epfl.ch/labs/hummel-lab

PhD position in the project '*non-invasive Deep Brain Stimulation to enhance cognitive functions in Traumatic Brain Injury (nDBS-TBI)*'

The Laboratory of Clinical Neuroengineering, directed by Friedhelm Hummel (https://www.epfl.ch/labs/hummel-lab), has an open position for a PhD student on the topic of noninvasive deep brain stimulation to enhance memory, impaired memory and motivational behavior and symptoms of impaired motivation like apathy and its impact memory. The PhD will focus on impaired memory functions (spatial or associative memory) and motivation, their underlying correlates by multimodal neuroimaging and the enhancement of them by neuromodulation of core deep brain structures like the hippocampus by means of transcranial temporal interference stimulation (tTIS; Hummel & Wessel 2024 Nature Rev Neurology) To address this question multimodal systems neuroscience methods by means of structural and functional magnetic resonance imaging (s/fMRI), and M/EEG combined with virtual reality based tasks and behavioral evaluations will be used.

Project description:

Everybody from teacher to metal welder needs good cognitive functions such as attention, memory, or motivation to perform well in daily life. Traumatic brain injury after accidents is a frequent and disabling disorder leading to significant deficits in such cognitive functions, especially in memory and motivation, even when the trauma was only mild. These deficits have a massive impact on the daily professional and private life of the patients, the relatives, the health system and the economy. Unfortunately, a treatment that can effectively reduce the deficits and restore these functions beyond neuropsychological training does currently not exist. This strongly limits the recovery of the patients on their way back to normal life. Novel, innovative technologies, such as fully *non-invasive deep brain stimulation* (*nDBS*), provide the exciting opportunity to significantly enhance the recovery process of the patients by stimulating key deep brain structures of cognitive functions such as the hippocampus or the striatum without surgery.

We pioneered a disruptive method that allows to target these deep brain structures non-invasively in humans (Wessel, Beanato *et al.* 2023 Nature Neuroscience, Vassiliadis *et al.* 2024 Nature Human Behavior; Vassiliadis *et al.* 2024 JNE; Beanato, Moon *et al.* Science Advances, minor revision, Hummel & Wessel 2024 Nature Reviews Neurology). These findings open exciting novel opportunities for translational neuroscience as a novel innovative treatment strategy for neurological and psychiatric disorders where the hippocampus or the striatum plays a key role in the pathophysiology of the disorder. Specifically, this disruptive technology provides the exciting opportunity to enhance the recovery process of important cognitive functions, such as memory and motivation, in TBI patients. Our aim is to develop a novel treatment strategy for cognitive functions in TBI and translate it towards clinical use.

Here we are interested in specific cognitive functions like associative memory, spatial navigation and motivation that are impacted by TBI, determine their underlying subcortico-cortical network mechanisms and their disruption due to the TBI, and develop and apply nDBS by means of tTIS to ameliorate the symptoms. The present PhD position is dedicated achieving these goals.

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Ph.D position:

Specifically, the project plans to investigate the effects of theta-burst deep brain stimulation by means of tTIS (see e.g., Wessel, Beanato *et al.* 2023 Nature Neuroscience; Violante *et al.* 2023 Nature Neuroscience; Vassiliadis *et al.* 2024 Nature Human Behavior; Beanato, Moon *et al.* minor revision, Science Advances) applied to the hippocampus during spatial navigation and associative memory tasks and to the striatum during motivation-related learning tasks in TBI patients and healthy controls. The PhD will further develop this neurotechnology, add to the better understanding and treatment of impairments in cognitive functions in brain lesioned patients.

The ideal candidate should have a Master's degree (or equivalent degree) in neuroscience, medicine or psychology, computer science or engineering, be strongly motivated with a keen interest in translational systems neuroscience especially brain stimulation, modelling, neuroimaging, ML and AI and neurotechnology. (1) Strong neuromodulation background, especially non-invasive brain stimulation, (2) strong neuroimaging background, especially in MRI and or M/EEG, (3) Strong programming skills in machine learning and modelling or (4) previous research experience in human experimental translational neuroscience is a plus.

Working environment:

The successful applicant will join the EPFL Defitech Chair of Clinical Neuroengineering, which is led by Prof. Friedhelm Hummel and focuses on translational human neuroscience and neuroengineering with a focus on learning and memory in healthy aging and in patients suffering from stroke, traumatic brain injury or dementia. The Lab is based in Geneva's beautiful Campus Biotech, right next to Lake Geneva with a second strategic Lab hub in an hospital environment in Sion in the heart of the beautiful area of Valais. The Ph.D. candidate will be enrolled in the EPFL Ph.D program Neuroscience (EDNE). You will work in an interdisciplinary, international team of researchers.

Start of position:

Spring 2025

Application procedure:

Interested candidates must submit their application to the EDNE doctoral school

(https://www.epfl.ch/education/phd/edne-neuroscience/edne-how-to-apply/)

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