

You are kindly invited to the public defense to obtain the degree of

DOCTOR OF PSYCHOLOGY

of **drs. Helen Tobback**

Which will take place on

3 November 2026 at 5:00 p.m. CET

Aula I.0.01 ([Building I](#)) – [VUB Main Campus Brussels](#)

Pleinlaan 2 – 1050 Brussel

Or if you wish to attend online, click here to [join the meeting](#)

TRANSCRANIAL DIRECT CURRENT STIMULATION IN ADDICTION: INVESTIGATING WORKING MECHANISMS, NEURAL MARKERS, AND CLINICAL OUTCOMES

CHAIR

Prof. Dr. Olivier Mairesse (VUB)

PROMOTOR(S)

**Prof. Dr. Kris Baetens (VUB)
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**Prof. Dr. Cleo Crunelle (VUB)
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EXTERN:

**Prof. Dr. Salvatore Campanella (ULB)
Prof. Dr. Marie-Anne Vanderhasselt (Ugent)**

Coming by car? Please [register your licence plate](#) in advance to have access to the campus.

You are also invited to the reception afterwards.

Please confirm your attendance by 25 October by filling out [this form](#).

SUMMARY

Substance use disorders (SUDs) remain among the most treatment-resistant psychiatric conditions, with relapse rates that persist despite the availability of pharmacological and psychosocial interventions. Impaired inhibitory control and heightened salience attribution toward substance-related cues (operationalized as cue-reactivity) are two neurocognitive processes consistently implicated in the onset and persistence of addiction, and both have been linked to dysfunction of the dorsolateral prefrontal cortex (DLPFC). Transcranial direct current stimulation (tDCS), a non-invasive brain stimulation technique using a direct current between electrodes, has been proposed as a mechanism-targeted intervention capable of modulating this circuitry directly. However, the existing literature is marked by substantial inconsistency: reported effects vary widely across studies, ranging from clear clinical benefit to null or even opposite findings. This inconsistency runs alongside wide variation in stimulation montage, dose, population, and outcome measures, leaving open the question of whether, for whom, and under what conditions tDCS might be clinically useful.

This dissertation addressed this gap through five empirical studies and two annexes, integrating clinical, behavioral, and electrophysiological outcome measures, first in healthy adults (Part One) and subsequently in individuals with severe alcohol use disorder (AUD) and SUD (Part Two).

The findings reveal no reliable group-level effect of tDCS on clinical symptoms, inhibitory control or cue-reactivity, regardless of stimulation montage (conventional bilateral or focal high-definition), target (DLPFC or cerebellum), dose (single or multiple sessions), or population (healthy controls, AUD, SUD) tested. Against this consistent pattern, several selective effects emerged: multi-session prefrontal stimulation reduces craving specifically among patients with higher baseline craving severity, and cerebellar stimulation interacts with dispositional traits such as impulsivity and reward sensitivity to shape behavioral performance. Independently, early neural markers of cue-reactivity, but not neural markers of inhibitory control, are found to track craving both at baseline and following stimulation in the total sample, indicating that craving and inhibitory control may constitute separable neurocognitive targets rather than a single construct jointly improved by stimulation.

Together, these findings advance current understanding of tDCS in addiction beyond the field's dominant "does it work" framing, by clarifying the specific conditions under which genuine effects emerge: patient selection based on baseline symptom severity, careful choice between craving- and inhibition-focused outcome measures, the interplay of dispositional characteristics (e.g., impulsivity), and outcome measures sensitive enough to detect change in the first place. Rather than supporting tDCS as a one-size-fits-all approach, this work points toward a more targeted, individualized, and mechanistically specific approach for future clinical research and, eventually, clinical application in substance use disorders.

CURRICULUM VITAE

Helen Tobback graduated from KU Leuven (KUL) as a clinical psychologist (adults and elderly) in 2020. After half a year of clinical work at the AZ Sint-Maarten hospital (Mechelen, Belgium), she started as a mandate assistant at the Vrije Universiteit Brussel (VUB), looking for more profound theoretical knowledge and expertise.

As a mandate assistant, she worked on research in addiction and included samples in close collaboration with the Psychiatric Hospital Boechout. Her project investigated neurocognitive and neurophysiological characteristics of patients with severe alcohol and drug addictions and how non-invasive brain stimulation could be used as a possible treatment for this group, marked by a high relapse and dropout rate. In her research, she uses methods like EEG, behavioral measures, and questionnaires in a multidimensional way. In combination with this research, Helen spent six years teaching practical courses in cognitive psychology, general psychology, clinical interventions, and clinical biological psychology to bachelor's and master's students.