

# Exploring the Role of the Prefrontal Cortex in Intentional Forgetting: A Combined HD-tDCS and 7T fMRI Study

Maya Yilmaz <sup>1,2,3</sup>, Raphaela Schöpfer<sup>1,2,3</sup>, Florian Wüthrich<sup>1,3</sup>, Sina Straub <sup>1,3</sup>, Jessica Peter <sup>1,3</sup>

<sup>1</sup> University Hospital of Old Age Psychiatry and Psychotherapy, University of Bern, Bern, Switzerland

<sup>2</sup> Graduate School for Healthy Sciences, Faculty of Medicine, University of Bern, Bern, Switzerland

<sup>3</sup> Translational Imaging Centre, sitem-insel, Bern University Hospital, Bern, Switzerland

## Introduction

Intentional forgetting is an active memory process that supports adaptive cognition and emotion regulation [1]. It is thought to rely on a prefrontal-hippocampal network in which the right dorsolateral prefrontal cortex (DLPFC) exerts top-down inhibitory control over medial temporal structures [2]. Evidence suggests that the ability to suppress unwanted information declines with advancing age [3].

High-definition transcranial direct current stimulation (HD-tDCS) provides a non-invasive method to examine the contribution of the right DLPFC to intentional forgetting. When combined with 7T fMRI, it enables a detailed characterization of the functional neuroanatomy underlying stimulation-induced effects. The current study therefore combines HD-tDCS with 7T fMRI during an item-method directed forgetting task in younger and older healthy adults to examine age-related differences in the neuroanatomical and behavioural mechanisms of intentional forgetting.

## Methods

This ongoing randomized, double-blind, sham-controlled study aims to recruit 110 participants, including younger (20–40 years) and older (60–75 years) healthy adults. Eligibility criteria include fluency in German and the absence of contraindications for MRI or HD-tDCS.

Participants are randomly assigned to receive active or sham HD-tDCS. The stimulation is delivered via an anode over F4 surrounded by four return electrodes. In the sham condition, no sustained current is delivered.

Participants complete an item-method directed forgetting task with positive and negative words during stimulation (1 mA). Task-related fMRI is acquired during encoding as well as during free recall conducted approximately 10 minutes after stimulation. A 24-hour follow-up questionnaire includes free recall and recognition measures. Primary outcomes include directed forgetting performance and task-related BOLD activation in regions of interest. Secondary outcomes include valence-dependent effects on memory performance.

## Expected Results

We expect HD-tDCS over the right DLPFC to increase DLPFC activation and reduce hippocampal activation, thereby supporting intentional forgetting. Older adults are expected to show reduced forgetting success compared with younger adults, reflecting age-related declines in memory control. In addition, stimulation effects on behavioural and neuroimaging measures are expected to be more pronounced in younger than older adults. Furthermore, forgetting success is expected to vary with emotional valence, with negative words being more resistant to forgetting than positive words.

## Conclusions

This study investigates the causal role of the right DLPFC in intentional forgetting across the adult lifespan by combining HD-tDCS with 7T fMRI. By examining younger and older healthy adults, the project aims to clarify how memory-control mechanisms and their neuroanatomical correlates change with age. Findings will contribute to current understanding of prefrontal control over memory, age-related differences in intentional forgetting, and the neural mechanisms underlying adaptive forgetting. In the longer term, this work may inform the development of targeted neuromodulation approaches to support memory control in healthy aging and clinical populations characterized by impairments in adaptive forgetting.

## References

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