

# Kognisyonun Ritimleri

Citation for published version (APA):

Aktürk, T. (2022). Kognisyonun Ritimleri: Bellek performansları üzerinde ölçülebilir etki ile nöral osilasyonları modüle etmek için transkraniyal alternatif akım uyarımının kullanılması . [ Maastricht University, Istanbul Medipol University]. Istanbul Medipol University. <https://doi.org/10.26481/dis.20221213ta>

## Document status and date:

Published: 01/01/2022

## DOI:

[10.26481/dis.20221213ta](https://doi.org/10.26481/dis.20221213ta)

## Document Version:

Publisher's PDF, also known as Version of record

## Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

## General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

[www.umlib.nl/taverne-license](http://www.umlib.nl/taverne-license)

## Take down policy

If you believe that this document breaches copyright please contact us at:

[repository@maastrichtuniversity.nl](mailto:repository@maastrichtuniversity.nl)

providing details and we will investigate your claim.

## GENERAL SUMMARY

In a series of studies we here aim to test and modulate the functional relationship between brain oscillations and cognitive processes, induce cognitive after effect of electroencephalography (EEG)-informed individualized transcranial alternating current stimulation (tACS) in the context of memory and learning, and investigate the therapeutic potential of noninvasive neuromodulation techniques in patients suffering from cognitive impairments associated with pathological alterations in oscillatory brain activity. To this end, we recorded EEG in both, healthy and diseased human participants during the performance of various cognitive tasks. In the first study, we revealed that event-related delta and theta oscillations play a specific functional role for the optimization of cognitive performance with both differentially contributing to different encoding strategies during the digit span-backward working memory task. Namely, delta responses evoked by items in each series matched the 'serial position curve', with higher delta power being present during the first and last items as compared to items presented in the middle of a series. Theta responses, in contrast, rather resembled a neural correlate of a chunking pattern. This EEG study contributed to our understanding of the neural oscillatory mechanisms underlying multiple item encoding, directly informing recent efforts towards memory enhancement through targeted oscillation-based neuromodulation. In a next step, we then used tACS to experimentally modulate these oscillatory activities and assess the induced effect on brain oscillations and memory performance. We could show that theta tACS applied at the individual peak frequency of theta (ITF) most effectively modulated spontaneous oscillatory theta activity but had not measurable effect on memory performance. In contrast, tACS stimulation applied slightly below this individual peak theta frequency showed to be better capable to improve memory performance. Importantly, this beneficial cognitive effect of tACS applied at a slightly lower frequency than ITF was observed to persist even after stimulation and was associated with tACS-induced changes in EEG frontal-parietal connectivity. Finally, in a clinical study on patients suffering from Parkinson's Disease with mild cognitive impairment (PD-MCI), impaired anterior-posterior functional connectivity caused by abnormal EEG delta-theta oscillations was revealed during a visual oddball task. Collectively, these studies highlight the importance of delta-theta oscillations for cognitive processing in the domain of memory, and demonstrate that these oscillations can be effectively modulated using tACS leading to measurable cognitive enhancements that persisted even after tACS stimulation was discontinued (tACS cognitive after effects). We also revealed

pathologically altered functional connectivity patterns within theta-delta oscillations to be associated with cognitive impairment in PD-MCI patients. The results of this thesis may therefore pave the way for developing new neuromodulation-based treatment approaches for improving cognitive deficits in patients suffering from disorders with underlying oscillatory deterioration patterns.