STICHTING
HERSENSTIMULATIE

4th BeNe BRAIN STIMULATION CONFERENCE

13-14 November
Maastricht
2025

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CONFERENCE
Date: 13-14 November 2025
Location: Crowne Plaza, Ruiterij 1, Maastricht, the Netherlands

We are honored to welcome you to Crowne Plaza, located on the banks of the Maas river. The historic sights of Maastricht's old city center, including picturesque squares lined with cafés, are a short walk away, as is the Bonnefanten Museum, which exhibits art from medieval times to the present day.

Parking
Parking is available at Crowne Plaza for guests of the hotel, for a fee. Other parking options include:

- Parking Oud Wyck - Wycker Grachtstraat 31, 6221 CZ Maastricht
- Q-park Plein 1922 - Sonnevillelunet, 6221 JP Maastricht

Public transport
The venue is a ten-minute walk from Maastricht Central Station.
The closest bus stop is ‘Centre Céramique’, which is a five-minute walk from the venue. The following bus lines stop here: 1, 3, 5, 12, 57, 350.

CONFERENCE DINNER
Date: 13 November 2025
Time: 19:30 PM
Location: Ipanema

Ipanema is located in the Bonnefantenmuseum, at Avenue Céramique 250, Maastricht. It is a ten-minute walk from the conference venue.

Note: preregistration for the conference dinner is required.

BENE BRAIN STIMULATION CONFERENCE

THURSDAY
13 NOVEMBER

AGENDA

Time	Activity
9:00	Registration Opens
9:30	Words of welcome with **Philip van Eijndhoven**

	ROOM 1	ROOM 2
9:45	Keynote 1: **Teresa Schuhmann**	
10:30	Coffee break	
11:00	Symposium 1	Symposium 2
12:30	Lunch	
13:30	Keynote 2: **Hartwig Siebner**	
14:15	Workshop: **Felix Duecker**	Free communications 1
15:00	Coffee break	
15:30	Free communications 2	Symposium 3
17:00	Reception and poster session - until 19:00	

19:30	Conference dinner (preregistration)

BENE BRAIN STIMULATION CONFERENCE

FRIDAY
14 NOVEMBER

AGENDA

Time	Activity
8:45	*Board meeting (Foundation members only)*
9:30	Registration opens

	ROOM 1	ROOM 2
10:00	Keynote 1: **Jean-Pascal Lefaucheur**	
10:45	Coffee break	
11:15	Symposium 4	Symposium 5
12:45	Lunch	
13:45	Free communications 3	Free communications 4
14:30	Coffee break	
15:00	Keynote 4: **Jacinta O'Shea**	
15:45	Closing and poster awards	
16:15	See you next time!	

KEYNOTES

THURSDAY	ROOM 1
TERESA SCHUHMANN: Unraveling Spatial Attention: From Lab Insights to Clinical Innovations in Stroke Rehabilitation	9:45
HARTWIG SIEBER: It takes two to tango: Synergistic Assessment of Causal Brain Dynamics with TMS and EEG	13:30

FRIDAY	ROOM 1
JEAN-PASCAL LEFAUCHEUR: Neuromodulation of Chronic Pain	10:00
JACINTA O'SHEA: Cognitive mechanisms of brain stimulation action in affective disorder	15:00

FREE COMMUNICATIONS

THURSDAY
ROOM 2
14:15

FREE COMMUNICATIONS 1

Tulika Nandi: Ultrasonic stimulation of the lateral geniculate nucleus using a high-precision array
Afra Souki: Effect of Multi-Electrode Transcranial Direct Current Stimulation (ME-tDCS) on Attentional Control: An fMRI Study

FREE COMMUNICATIONS 2

ROOM 1
15:30

Maxine Gorter: The Cognitive Benefits of rTMS: A Meta-Analysis Across Health and Disease
Karel Scheepstra: The effectiveness of rTMS in dysthymia: a chart review.
Mieke Schulte: Acute differential effects of left and right insula inhibition on craving and cognitive control in regular smokers
Duncan Smith: A Pre–Post Protocol Comparison of Three-Point vs Sequential Single-Point rTMS in Obsessive–Compulsive Disorder

FRIDAY
ROOM 1
13:45

FREE COMMUNICATIONS 3

Eveyne Fraats: Increasing empathy for pain with brain stimulation to study prosocial disobedience
Paula Horczak: Assessing tDCS efficacy in reducing negative symptoms in schizophrenia spectrum disorders: A systematic review and meta-analysis

FREE COMMUNICATIONS 4

ROOM 2
13:45

Tulika Nandi: Modulating ventral premotor to primary motor cortex connectivity in chronic subcortical stroke
Agnese Zazio: Immediate TMS-EEG responses uncover local cortical excitability after M1 stimulation

4th
BeNe
BRAIN STIMULATION CONFERENCE

STICHTING HERSENSTIMULATIE

13-14 November
Maastricht

SYMPOSIUMS

THURSDAY

SYMPOSIUM 1: THE SOCIAL-EMOTIONAL CEREBELLUM AND NON-INVASIVE NEUROSTIMULATION
ROOM 1
11:00

Chair: Frank Van Overwalle

Frank Van overwalle: Cerebellar transcranial brain stimulation and dynamic sequences of human social action
Chiara Ferrari: Time course of the involvement of medial and posterolateral cerebellum in emotional processing
Beatriz Catoira: Targeting the cerebellum with tDCS boosts social-emotional processing in autism
Min Qiu: Cerebellar anodal transcranial direct current stimulation (tDCS) improves implicit mentalizing sequence learning: A double-blind sham-controlled study

SYMPOSIUM 2: PERSONALIZING ECT: FROM SYMPTOMS, INFLAMMATION, AND AGE TO IMPROVED DOSING OUTCOMES?
ROOM 2
11:00

Chair: Erik van Exel and Philip van Eijndhoven

Tom Biemans: Differential ECT Response Across Depressive Symptom Profiles
Melissa Zandstra: Vital-Affective Symptom Connectivity Distinguishes Depression Outcomes after Electroconvulsive Therapy: A Cross-Lagged Panel Network Study
Kara Drexler: A Tale of Two Ages: Inflammation's Divergent Role in ECT Outcomes
Julia Meijer: Impact of Titration, Dosage, and pulse-width, across Age on Electroconvulsive Therapy Effectiveness in Depression

SYMPOSIUM 3: MODULATING FUNCTIONAL CONNECTIVITY WITH TRANSCRANIAL ALTERNATING CURRENT STIMULATION
ROOM 2
15:30

Chair: Bettina C. Schwab

Vincent van de Ven: Frequency-Specific Modulation of Hippocampal-Cortical Connectivity and Memory by Parietal Theta tACS
Miles Wischnewski: Reading minds: The effect of tACS on neural synchronization in non-verbal inter-personal communication.
Silvana Huertas-Penen: Effects of Dual-Site tACS Phase Lags on E-Field Dynamics
Marina Fiene: Altering amplitude coupling in resting-state functional networks by amplitude-modulated tES

WORKSHOP: TMS IN PRACTICE: POSITIONING, DOSING, AND TOLERABILITY
With Felix Duecker
ROOM 1
14:15

FRIDAY

SYMPOSIUM 4: TARGETING BETA OSCILLATIONS IN MOTOR CONTROL: FROM MECHANISMS TO MODULATION
ROOM 1
11:15

Chair: Sybren Van Hoornweder

Sybren Van Hoornweder: Targeting beta oscillations in motor control: from mechanisms to modulation
Inge Leunissen: In-phase and anti-phase dual-site beta tACS differentially influence functional connectivity and motor inhibition
Leo Tomasevic: Diving into the beta harmonics of the mu rhythm
Marten Nuyts: The importance of brain state: Insights from transcranial evoked potentials during distinct phases of a motor task

SYMPOSIUM 5: TOWARDS PERSONALIZED RTMS DOSING AND TARGETING

Chair: Odile van den Heuvel

Coen Coomans: Normative mapping of connectomic markers predicting rTMS outcome in OCD
Debby Klooster: Replication and methodological robustness of a depression network relevant to TMS targeting
Hidde Woerdman: Electric Field Modeling Reveals Inter-Target and Inter-Individual Variability in Induced rTMS Dose in OCD
Felix Duecker: E-Field Fingerprints for Target-Based TMS Modeling

ABSTRACTS - Keynotes

Prof. dr. Teresa Schuhmann

Maastricht University

Unraveling Spatial Attention: From Lab Insights to Clinical Innovations in Stroke Rehabilitation

Abstract: Visuospatial attention is a complex cognitive process crucial for various daily activities and the modulation of attention has been explored through diverse neuromodulation techniques, such as transcranial magnetic stimulation (TMS) and transcranial alternating current stimulation (tACS). In this talk, I will present findings from multiple studies from our lab investigating the effects of tACS on visuospatial attention across healthy individuals. Moreover, I will demonstrate how we aimed at translating these fundamental insights into clinical applications. Specifically, we developed a tACS-based treatment for stroke patients suffering from hemispatial neglect and were able to show symptom improvements in this group.

Prof. dr. Hartwig Siebner

Departments of Neurology and Psychiatry, Copenhagen University Hospital

It takes two to tango: Synergistic Assessment of Causal Brain Dynamics with TMS and EEG

Abstract: Causal understanding how the human brain generates complex functions requires methods that can both perturb and record neural dynamics. Transcranial Magnetic Stimulation (TMS) and electroencephalography (EEG) each offer unique advantages: TMS provides a noninvasive means to causally perturb neural circuits, while EEG enables high temporal resolution recording of neural activity across the cortex. When combined, they form a powerful synergistic approach for probing causal brain dynamics in vivo. In this talk, (i) I will highlight how TMS-EEG integration allows researchers to move beyond purely correlational observations and directly map effective connectivity, excitation–inhibition balance, and state-dependent neural responsiveness. (ii) I will discuss methodological advances that enable the recording of immediate EEG responses to TMS. (iii) I will cover how EEG-TMS can be used for temporal neuronavigation of TMS and closed-loop state targeting. Together, the combination of TMS and EEG illustrates that it truly “takes two to tango” in unraveling the causal mechanisms of brain function.

Prof. dr. Jean-Pascal Lefaucheur

Department of Clinical Neurophysiology, UR 4391 (ENT Team), Faculty of Health, Henri Mondor University Hospital, University Paris Est Créteil, Créteil, France

Neuromodulation of Chronic Pain

Abstract: Various non-invasive brain stimulation (NIBS) techniques have demonstrated their efficacy in clinical practice for the treatment of different psychiatric or neurological disorders. The management of chronic pain syndromes is one of the best examples of development and therapeutic success of neuromodulation techniques. In particular, high-frequency repetitive transcranial magnetic stimulation (rTMS) of the precentral gyrus (primary motor cortex) presents a good level of evidence of efficacy in producing analgesic effects in patients suffering from chronic pain. However, the optimal stimulation parameters to be applied remain to be defined for some of them. In this presentation, I will review the principles and mechanisms of action of rTMS to produce analgesic effects, the main technical points to be addressed in the spatial (targeting) and temporal (timing) domains, current and future methodological developments, and the expected results of the use of rTMS for treating chronic pain in clinical practice. In particular, the personalization of rTMS protocols, based on neurophysiological or neuroimaging approaches to assess functional cortical excitability and connectivity, constitutes a significant avenue for improving the therapeutic interest of NIBS. Individual modelling of neural network modulation protocols will optimize the efficacy of NIBS in correcting specific brain dysfunctions presented by each patient.

Prof. dr. Jacinta O'Shea

Department of Psychiatry, University of Oxford

Cognitive mechanisms of brain stimulation action in affective disorder

ABSTRACTS - Free communications

Tulika Nandi

Vrije Universiteit Amsterdam, Faculty of Behavioral and Movement Sciences, Neurocontrol

Ultrasonic stimulation of the lateral geniculate nucleus using a high-precision array

Abstract:

Transcranial ultrasonic stimulation (TUS) is a novel, promising non-invasive brain stimulation technique. The physics of ultrasound makes it possible to overcome the limited focality and deep stimulation capability of electromagnetic techniques. TUS could make deep stimulation available to a large group of patients in whom the risk-benefit ratio does not justify invasive stimulation. Additionally, it opens up the possibility of studying the functions of structures that were previously inaccessible in healthy humans. Despite the theoretical possibilities, currently available TUS devices have several limitations. We developed and validated a novel TUS array which combines several features that are not currently available in any single commercially available device. Specifically, it makes high-precision (high spatial and temporal resolution) deep brain stimulation possible without the need for a stereotactic frame (which breaches the skin) and allows concurrent real-time functional magnetic resonance imaging (fMRI). The aim of this preliminary study was to use this array to demonstrate the neurophysiological effects of stimulating the lateral geniculate nucleus of the thalamus in healthy adults. In experiment one, designed to demonstrate online effects, seven participants viewed a visual checkerboard stimulus while receiving 300 ms TUS pulses applied every 3 s. In experiment two, designed to demonstrate offline effects, four participants received TUS for 80 s (20 ms pulses repeated at 5 Hz). fMRI activity evoked by the checkerboard stimulus was measured before and after TUS. Participants exhibited significantly increased visual cortex activity during online stimulation and decreased visual cortex activity for at least 40 minutes after offline stimulation.

Afra Souki

Department of Psychology, University of Tehran, Tehran, Iran

Effect of Multi-Electrode Transcranial Direct Current Stimulation (ME-tDCS) on Attentional Control: An fMRI Study

Abstract:

Introduction:
Attentional control, the capacity to selectively focus on relevant stimuli while suppressing distractions, is a fundamental cognitive function that underlies higher-order processes. Deficits in attentional control are prevalent across a range of neuropsychological disorders. Non-invasive neuromodulation techniques, such as transcranial direct current stimulation (tDCS), have shown promise in enhancing attentional performance. This study examined the effects of multi-electrode tDCS (ME-tDCS) targeting the frontal cortex on attentional control in adults reporting attention difficulties.

Methods:
In this randomized, triple-blind, sham-controlled trial, 24 adults aged 20–40 years with self-reported attention complaints were enrolled following eligibility screening. Participants were randomly assigned to receive either active or sham stimulation. All participants completed the Attention Network Task (ANT) during functional magnetic resonance imaging (fMRI) both before and after a single session of ME-tDCS targeting the frontal cortex.

Results:

Behavioral analyses showed a trend toward improved performance in the conflict component of the ANT post- versus pre-stimulation in the active group compared with the sham group, whereas no significant time-by-group interactions were observed for the alerting or orienting components. Whole-brain fMRI analyses of the conflict component revealed significant time-by-group interactions in key attentional regions, including the middle frontal gyri (MFG), inferior parietal lobule (IPL), and posterior cerebellum.

Conclusion:

These findings indicate that ME-tDCS targeting the frontal cortex is a safe and potentially effective approach for enhancing attentional control. The intervention appears to modulate activity within key attention-related neural networks, highlighting its promise for addressing attentional deficits in both clinical and subclinical populations.

Maxine Gorter
Amsterdam UMC, Hersentumorencentrum

The Cognitive Benefits of rTMS: A Meta-Analysis Across Health and Disease

Abstract:

Background: Cognitive deficits are common across numerous neurological and psychiatric conditions. Repetitive transcranial magnetic stimulation (rTMS) has emerged as a promising non-invasive neuromodulation technique. However, its efficacy for improving cognitive functioning remains to be established. This study aimed to assess the effectiveness of rTMS in enhancing cognitive functioning through a meta-analysis.

Materials and Methods: A PRISMA systematic search was conducted to identify randomized controlled trials comparing active versus sham (placebo) rTMS, with cognitive outcomes reported as either primary or secondary endpoints in individuals with psychiatric/neurological conditions or healthy volunteers. A random-effects meta-analysis was performed to estimate the effect sizes of rTMS on global cognition, cognitive screeners (MMSE/MoCA) and specific cognitive domains, including attention, memory, information processing speed, working memory, executive function, language, and social cognition.

Results: A total of 108 studies were included, comprising 4265 participants (2173 active, 2092 sham). Active rTMS was associated with a statistically significant improvement in overall cognitive functioning compared to sham, with a pooled effect size of Hedges' g = 0.27 (95% CI: 0.22–0.31). Significant cognitive improvements were observed across all domains, with small-to-moderate effect sizes (Hedges'g range: 0.15-0.79). The strongest evidence for beneficial effects of rTMS was found for executive functioning (g = 0.15, 95% CI: 0.07-0.24), language (g = 0.36, 95% CI: 0.27-0.44), and memory functioning (g = 0.29, 95% CI: 0.18-0.40). However, substantial heterogeneity in effect sizes was observed across studies (I^2= 10.3-92.6%), indicating that a proportion of the variability in results is likely due to differences in study populations, treatment protocols, or cognitive outcomes.

Conclusion: This meta-analysis supports the transdiagnostic efficacy of rTMS for cognitive improvement, with small to moderate effects observed across a broad spectrum of populations and cognitive domains. These findings highlight the clinical utility of rTMS as a cognitive intervention and underscore the need for standardized stimulation protocols and cognitive outcome assessments.

Karel Scheepstra

Amsterdam, UMC, department of Psychiatry

The effectiveness of rTMS in dysthymia: a chart review

Abstract:

Aim: To evaluate the effectiveness of rTMS in persistent depressive disorder [PDD, formerly dysthymia].
Methods: A retrospective chart review. Patients diagnosed with PDD or treatment resistant depression [TRD] in accordance to the DSM-5 were eligible for inclusion. Protocols: 3-5 times a week a 1 Hz protocol over the right dorsolateral prefrontal cortex [dlPFC], a 10 Hz protocol over the left dlPFC or a bilateral protocol. The dlPFC was targeted with the Beam F3 method. Primary outcomes: mean Hamilton Depression Rating Scale [HDRS-17] and inventory of depressive symptomology – self rating [IDS-SR] scores, response and remission rates. Mixed-effects models and unpaired Welch t-test were used.

Results: 14 patients with PDD and 45 patients with TRD were treated with rTMS and included in this study. In PDD, IDS-SR at T-0 was 41.2 [SD=11.0], at T-1 40.2 [SD=11.4] and at T-end 39.5 [SD=13.7], [mixed-effects models; $p=0.63$, $F=0.4$]. In TRD, IDS-SR at T-0 was 45.2 [SD=10.3], at T-1 35.7 [SD=13.1] and at T-end 30.5 [SD=14.7], [mixed-effects model; $p<0.0001$, $F=48.5$]. Response and remission rates based on the IDS-SR in PDD was 0.0% [0/13]. In MDD, 31.8% [14/44] responded and 18.2% [8/44] remitted based on the IDS-SR. Δ mean IDS-SR of PDD and MDD at T-end versus T-0 was 12.6 [SD=2.7], Welch t-test was $t=4.6$, $df=32.5$, $p<0.0001$*. At T1 versus T0 mean ΔIDS-SR was 10.0 [SD=2.4], Welch t-test was $t=4.2$, $df=31.5$, $p=0.0002$*.

Conclusions: These results indicate that rTMS is not effective in treating PDD, however a first randomized controlled trial is warranted to draw definitive conclusions on the effectiveness of rTMS in PDD.

Mieke Schulte
Erasmus University Rotterdam

Acute differential effects of left and right insula inhibition on craving and cognitive control in regular smokers

Abstract:

There is an urgent need for more effective treatment for smoking cessation. The insula is associated with several addiction-related cognitive processes, of which there appears to be functional lateralization. This project aimed to investigate acute effects of unilateral insula inhibition on craving and cognitive control in regular cigarette smokers, using a unique H8 TMS coil. In a double-blind randomized sham-controlled trial, using a single-session, cross-over design, 54 regular smokers (53.7%F, 23.3(3.2)y/o) were randomized to undergo sham and active continuous Theta Burst Stimulation (cTBS) of the left or the right insula (3 50Hz bursts, delivered at 5Hz for 20 sec, 80% active motor threshold). Craving and cognitive control were assessed after both stimulation conditions by a cue exposure task (CET) and a stop signal task, respectively, in counterbalanced order, during which heartrate variability (HRV) was recorded simultaneously. There were no acute effects of stimulation condition (active vs sham) or stimulation side (left vs right) on cognitive control, craving, or HRV during any phase of the CET (p's>.05). Potential explanations include TMS target specificity, cognitive functions potentially being unaffected in this sample of smokers, and stress induced by the first stimulation session overshadowing any TMS effects (regardless of stimulation condition). Nevertheless, cTBS targeting the insula appeared to be a feasible stimulation protocol, as 98% completed both stimulation conditions, thereby providing valuable input on an RCT that is being prepared to investigate 13-session intervention effects of cTBS of the insula in heavy smokers. Future research could benefit from familiarizing participants more before stimulation.

Duncan Smith
Smart rTMS Ltd.

A Pre–Post Protocol Comparison of Three-Point vs Sequential Single-Point rTMS in Obsessive–Compulsive Disorder

Abstract:

Background: This study compared the tolerability, safety, and efficacy of a three-point stimulation protocol (3PP; Stubbeman et al., 2024) with a sequential single-point protocol (SSPP) for obsessive–compulsive disorder (OCD) in routine clinical practice.

Methods: Twenty consecutive OCD patients received either SSPP (n=10) or 3PP (n=10) treatment. SSPP involved cTBS at F4 and 1 Hz at FCz, or 1 Hz at FP1 (if no response by session 5). 3PP involved iTBS at F3, 1 Hz at FCz–Fz, and 1 Hz at FP2. Patients were assessed using Y-BOCS and PHQ-9. Inclusion criteria were baseline Y-BOCS ≥14 and at least one completed stimulation. Outcome data were collected at session 30 (last observation carried forward for dropouts). Side effects and dropout reasons were qualitatively coded from clinical notes by two independent researchers using a coding protocol.

Results: Baseline demographic and clinical variables did not differ significantly between groups. Mean Y-BOCS reduction was similar (3PP: –5.0; SSPP: –6.2; $p = .764$). Remission occurred in 1/10 (3PP) and 2/10 (SSPP). No serious adverse events were reported. Local side effects (scalp discomfort, muscle twitching) were significantly more frequent with 3PP (90%) compared to SSPP (40%) ($p = .027$). Headache and fatigue incidence did not significantly differ between protocols. Dropout rate was lower in the 3PP group (3 vs 8; $p = .025$). No dropouts were attributed to side effect intolerability.

Conclusion: Three-point stimulation showed a favourable tolerability profile with fewer dropouts and no loss in efficacy. These findings support continued clinical use and further investigation in larger controlled trials.

Evelyne Fraats
Ghent University

Increasing Empathy for Pain with Brain Stimulation to Study Prosocial Disobedience

Abstract:

The tragedies of World War II demonstrate that many of the most horrendous acts are committed in the name of obedience. While the phenomenon of resisting immoral commands despite pressure to comply is recognised, the cognitive mechanisms driving such prosocial disobedience remain poorly understood. Prior research suggests empathy for pain is a key neurobiological factor which is downregulated under coercive conditions. Causally manipulating empathy for pain using non-invasive neuromodulation enables direct study of its effects on prosocial disobedience. To do this, we first determined the optimal concurrent electroencephalogram (EEG)-transcranial direct current stimulation (tDCS) set-up to target empathy for pain.

Through computational modelling, we discovered two high-definition (HD)-tDCS 4x1 electrode configurations that effectively target the primary or secondary somatosensory cortex, which are areas of the neural network underlying empathy for pain. In conjunction with one established 4 x 1 HD-tDCS setup, we performed a concurrent EEG-tDCS experiment to evaluate how stimulation modulated empathy for pain across these three configurations. While participants observed painful stimuli applied to another real person's hand, we analysed modulations in the late event-related potentials (ERP) amplitude, which serve as a marker for empathy towards pain. We observed modulation of empathy for pain for some electrode configurations and will present the most effective configuration and its behavioural and neural effects on empathy for pain.

Through this study, we established the most effective non-invasive neuromodulation method to influence empathy for pain. This represents an important first step toward utilising this modulation in the upcoming study designed to causally investigate how empathy for pain influences prosocial disobedience, ultimately facilitating the development of targeted interventions aimed at reducing blind compliance to authority.

Paula Horczak
Ghent University

Assessing tDCS efficacy in reducing negative symptoms in schizophrenia spectrum disorders: A systematic review and meta-analysis

Abstract:

Background: Negative symptoms in schizophrenia spectrum disorders (SSDs) are linked to poor functioning and reduced quality of life. Due to the limited efficacy of current treatments, transcranial direct current stimulation (tDCS) has been investigated as a potential adjunctive intervention, though findings have been mixed to date. This meta-analysis aims to evaluate the efficacy of tDCS in reducing negative symptoms in individuals with SSDs.

Methods: A systematic review and meta-analysis were conducted on randomized controlled trials comparing active tDCS with sham stimulation in individuals diagnosed with SSDs. Standardized mean differences (SMDs) were calculated, and subgroup and moderation analyses were performed to explore potential sources of heterogeneity.

Results: Overall, tDCS significantly reduced negative symptoms compared to sham stimulation, with moderate heterogeneity across studies. Subgroup analyses indicated greater efficacy in trials that exclusively included participants with a schizophrenia diagnosis (SMD = -0.51), and in studies where negative symptoms were the explicit target of the intervention (SMD = -0.80). Stimulation targeting the left dorsolateral prefrontal cortex (lDLPFC) was significantly associated with symptom reduction (SMD = -0.30). No significant effects were observed at follow-up, suggesting limited durability of treatment effects in the absence of maintenance sessions. tDCS was well tolerated and demonstrated a favorable safety profile.

Conclusion: tDCS shows significant efficacy in reducing negative symptoms of SSDs as an adjunct to pharmacotherapy, particularly when protocols specifically target these symptoms and the anode is positioned over the lDLPFC. Future research should investigate strategies to enhance and sustain long-term treatment effects, as well as explore individual characteristics to optimize and personalize interventions.

Tulika Nandi

Vrije Universiteit Amsterdam, Faculty of Behavioral and Movement Sciences, Neurocontrol

Modulating ventral premotor to primary motor cortex connectivity in chronic subcortical stroke

Abstract:

The ventral premotor cortex (PMv) is crucial for sensorimotor transformations during reach-to-grasp movements. In healthy adults, PMv can inhibit or facilitate the primary motor cortex (M1), depending on the specific behavioural context. Limited evidence also shows that modulation of PMv-M1 connectivity improves motor function. Little is known about PMv function and PMv-M1 connectivity after stroke. It is hypothesized that, like the dorsal premotor cortex, PMv may contribute to recovery after strokes affecting the M1 or its output pathways. The primary aim of this study was to determine the effect of PMv-M1 paired associative stimulation (PAS) on PMv-M1 connectivity in patients with subcortical strokes affecting M1 output pathways. We recruited eight chronic stroke patients (age: 60 ± 13 years; 3 females) and fourteen healthy controls (age: 60 ± 9.7 years; 6 females). Each participant received three transcranial magnetic stimulation (TMS) PAS sessions in counterbalanced order: 1) ipsilesional PMv – ipsilesional M1, 8ms interstimulus interval (ISI); 2) contralesional PMv – ipsilesional M1, 8ms ISI; 3) ipsilesional PMv – ipsilesional M1, 500 ms ISI (sham). 90 pairs of stimuli were applied at 0.1 Hz. Before and after each PAS session, PMv-M1 connectivity was measured using the same stimulation locations and ISIs as the respective PAS session, while participants performed a reach-to-grasp task. The motor evoked potential elicited by single pulse M1 stimulation was compared to that elicited by paired pulse PMv-M1 stimulation to estimate PMv-M1 connectivity. We are analysing the data to examine the effects of PAS, and differences between sessions and between patients and controls.

Agnese Zazio

IRCCS Istituto Centro San Giovanni di Dio Fatebenefratelli (Brescia, Italy)

Immediate TMS-EEG responses uncover local cortical excitability after M1 stimulation

Abstract:

Background: Concurrent transcranial magnetic stimulation and electroencephalography (TMS-EEG) is widely employed to assess cortical excitability of large-scale brain networks, but its use to probe local excitability has been limited, mainly due to technical constraints. A recent study (Beck et al., 2024) revealed immediate TMS-evoked potentials (i-TEPs), occurring within 6 ms after stimulation. We aimed to investigate whether these immediate responses reflect genuine cortical activity and to clarify their functional significance.

Methods: Twenty-eight healthy participants underwent TMS-EEG during stimulation of the primary motor cortex (M1). Minimal preprocessing was applied to extract i-TEPs and immediate TMS-related power (i-TRP), isolating high-frequency components potentially contributing to early responses. We assessed the association between i-TRP and motor-evoked potential (MEP) amplitude, performed source localization of i-TEPs, and conducted a control experiment involving stimulation of a lateral site to evaluate muscle artifact contributions.

Results: Our results confirmed the presence of i-TEPs consistent with existing evidence. Moreover, the present study provided additional key findings. First, the i-TRP revealed two prominent frequency peaks—one in the 600–800 Hz range and another between 100–200 Hz—with the higher frequency positively associated with MEP amplitude across current directions. Second, source analysis localized i-TEPs to the precentral gyrus of the stimulated hemisphere. Third, the pattern observed following the control stimulation eliciting a muscle response was clearly distinguishable from both i-TEPs and i-TRP over M1.

Discussion/conclusion: Our findings converge to indicate that immediate EEG responses to M1 stimulation are physiological in origin and reflect local excitability of the motor cortex.

ABSTRACTS - Symposia

The social emotional cerebellum and non-invasive neurostimulation

Chair: Frank van Overwalle

Summary:
For a long time, the human cerebellum was considered to be mainly involved in motor coordination. Several decades ago, however, it was recognized that the cerebellum was also supporting human cognition and affect, and during the last decade more evidence demonstrated that the posterior cerebellar Crus is essential for human social cognition, in particular for the temporal coordination of social action sequences.
The topic of this symposium is how non-invasive stimulation of the posterior cerebellum can increase social functioning and performance of social and emotional functions.

Frank Van Overwalle
Vrije Universiteit Brussel, Faculty of Psychology

Cerebellar transcranial brain stimulation and dynamic sequences of human social action

Abstract:

This talk gives a brief overview of evidence on humans during the last decade which shows the strong involvement of the cerebellar Crus in a plethora of human social and emotional sequencing functions, as well as recent attempts to improve social functioning with non-invasive stimulation using transcranial direct current stimulation (tDCS) and transcranial magnetic stimulation (TMS). In addition, he will showcase recent experiments using tDCS on social sequencing tasks, showing successful as well as failed attempts to improving social temporal functioning.

Chiara Ferrari

Department of Humanities, University of Pavia, Pavia, Italy & IRCCS Mondino Foundation, Pavia, Italy

Time course of the involvement of medial and posterolateral cerebellum in emotional processing

Abstract:

The posterior cerebellum is a recently discovered node of the social brain. However, its anatomy makes it difficult to apply traditional approaches to investigate the temporal aspects of brain processing in humans; therefore, nothing is known about the time course of the contribution of this region to social processes. To overcome this gap, we ran a series of experiments in which we systematically investigated the time course of the causal involvement of the medial and posterolateral cerebellum in an emotional discrimination task by employing a chronometric transcranial magnetic stimulation (TMS) approach. We revealed that when perceiving emotional faces, the medial posterior cerebellum is recruited in the initial stages of emotional processing, while the posterolateral cerebellum is recruited at a later stage. Furthermore, we found that the involvement of the posterolateral cerebellum in emotional processing is asymmetric: only the left (but not the right) posterolateral cerebellum is causally recruited in this socioemotional task. Our findings provide critical evidence about the cerebellum's contribution in supporting human emotional and social behavior.

Beatriz Catoira

Vrije Universiteit Brussel - Universiteit Gent

Targeting the cerebellum with tDCS boosts social-emotional processing in autism

Abstract:

Autism is a neurodevelopmental condition that affects multiple domains of social cognition, including the recognition of emotional facial expressions. This ability is crucial for effective communication, yet current interventions are limited and often rely on prolonged compensatory training. Recent evidence implicates the cerebellum (particularly Crus II) in social and emotional processing. In this study, we investigated whether cerebellar transcranial direct current stimulation (tDCS) could enhance emotion recognition in autistic adults using a within-participant, sham-controlled design. A total of 100 participants (40 with an autism diagnosis, 20 with high autistic traits, and 40 neurotypical controls) underwent both anodal and

sham cerebellar tDCS in separate sessions, administered during resting-state fMRI. Following stimulation, participants completed an emotion recognition task during task-based fMRI. Behaviorally, anodal stimulation improved reaction times for anger in the ASD group compared to fear and neutral expressions, suggesting selective facilitation for recognizing negative emotions. Preliminary fMRI analyses revealed group-dependent modulation of social brain regions: in autistic participants, cerebellar tDCS led to increased activation in areas involved in emotion and social processing, including the temporoparietal junction and inferior frontal gyrus. These effects were absent or reversed in neurotypical participants. Together, these findings support a modulatory role of the cerebellum in emotion recognition and offer promising evidence for targeted neuromodulation as a potential tool to address social difficulties in autism.

Min Qui
Vrije Universiteit Brussel

Cerebellar anodal transcranial direct current stimulation (tDCS) improves implicit mentalizing sequence learning: A double-blind sham-controlled study

Abstract:

An increasing number of studies have revealed that the posterior cerebellum plays a vital role in mentalizing by identifying and learning social action sequences which render social interaction more fluent, coordinated and predictable. An implicit social sequencing task, the Belief serial response time (SRT) task, was administered during and 30 minutes after targeting the cerebellum with anodal transcranial direct current stimulation (tDCS). In a previous study, anodal tDCS targeting the posterior cerebellum (i.e., 2 mA for 20 min, electrode 2 cm below the inion) did not show significant improvement in response times. We reasoned that the familiar and overlearned nature of attributing social beliefs resulted in a ceiling effect, and thus left very little margin for improvement on the task. Therefore, the current study developed a more complex and less predictive version of the Belief SRT task, and again examined the effect of anodal cerebellar tDCS. Using a double-blind sham-controlled protocol, 60 participants received either anodal tDCS or sham tDCS using the same stimulation protocol. Results showed that participants receiving anodal tDCS responded faster when the sequence of actions was repeated as opposed to totally randomized, while those receiving sham tDCS did not show a significant change. These findings suggest a positive effect of anodal cerebellar tDCS on implicit mentalizing sequence learning, supporting a causal role of the cerebellum in this learning process. This holds promise for treating clinical populations with limited social and sequencing capacities (e.g., autism) with anodal tDCS.

Personalizing ECT: from symptoms, inflammation, and age to improved dosing outcomes?

Chairs: Eric van Exel and Philip van Eijndhoven

Summary:

Our symposium on Electroconvulsive Therapy (ECT) aims to provide a framework for understanding ECT efficacy and improving personalized treatment approaches. We will discuss how different symptom profiles, such as suicidality and severe vital depression effect treatment outcome. Furthermore, the role of inflammation will be examined, revealing its divergent impact on ECT efficacy across age groups, where it predicts poorer outcomes in younger patients but better outcomes in the elderly. Finally we will delve into the technical aspects of ECT, emphasizing the importance of accurate dosing protocols. Findings suggests that higher-than-intended dosing, often due to inaccurate titration, significantly reduces remission rates, highlighting the need for tailored, age-specific dosing strategies to enhance ECT effectiveness.

Tom Biemans

Radboud UMC, Department of psychiatry

Differential ECT Response Across Depressive Symptom Profiles

Abstract:

Background: Unipolar depression is a multifaceted syndrome, where patients with varying clinical representations, or symptom profiles, can share the same diagnosis. These patients not only differ in their clinical characteristics but also in the way they respond to different treatment modalities (2-5), each with its own mechanism of action. In order to better tailor ECT treatment to the patients who will benefit the most, the current study examines the relationship between the treatment effect of ECT and different symptom profiles of depression.

Methods: A latent profile analysis (LPA) based on the Hamilton Depression Rating Scale (HDRS-17) by baseline was performed using the ‘Dutch ECT Cohort’ database (n = 372). In order to investigate the relationship between the treatment effect of ECT and the different symptom profiles, the data was analyzed using chi square tests and mixed models.

Results: Four different symptom profiles of depression were identified using LPA: “Core Mood-Depression”, “Anxious Depression”, “Vital Depression – Mild”, and “Vital Depression - Severe”. Significant differences were found between the profiles on overall treatment effect, total percentage change and response rates. Even when controlling for baseline depression severity, the profile “Vital Depression - Severe” showed the greatest effect of ECT treatment and the profile “Core Mood-Depression” showed the smallest effect. No differences were seen in remission rates between the profiles.

Conclusion: Symptom profiles of depression respond differently to ECT-treatment. The results of this study provide evidence for using symptom profiles as a clinical tool for a more personalized treatment approach.

Melissa Zandstra

University Medical Centre Utrecht, Department of psychiatry

Vital-Affective Symptom Connectivity Distinguishes Depression Outcomes after Electroconvulsive Therapy: A Cross-Lagged Panel Network Study

Abstract:

Background: Electroconvulsive therapy (ECT) is an effective treatment for depression, but the underlying mechanisms of its therapeutic change are not fully understood. Investigating how symptoms interact during treatment may offer crucial insights beyond simply reducing symptoms.

Aim: This study aimed to investigate baseline depressive symptom interactions before ECT, analyze temporal symptom interactions during ECT, and compare these networks between patients who achieved remission and those who did not.

Methods: A cross-sectional and longitudinal network analysis was conducted using data from the Dutch ECT Cohort (DEC), collected between 2001 and 2020. Data analysis took place from May 2024 to January 2025. The study was set across twelve psychiatric centers in the Netherlands. Participants included adults with major depressive disorder or bipolar disorder who received ECT, while those with schizophrenia, schizoaffective disorder, or major neurological illnesses were excluded. Remission was defined as a post-ECT 17-item Hamilton Depression Rating Scale (HDRS-17) score ≤7 or Montgomery-Åsberg Depression Rating Scale (MADRS) ≤9. Out of 2,057 eligible patients, 857 with available weekly depression scores were included. Patients received twice-weekly ECT following Dutch guidelines. Seven core depressive symptoms were harmonized from baseline and weekly follow-up HDRS-17 and MADRS scores. Baseline symptom networks were estimated using the EBICglasso algorithm to compare

network structure, global strength, and expected influence (EI). Temporal symptom interactions were modeled using Cross-Lagged Panel Network (CLPN) analyses, quantifying in- and out-prediction values. Network similarities were quantified using Jaccard indices and edge weight correlations.

Results: A total of 857 patients were included in the analysis (65.2% female, mean age 61.34 ± 15.48 years), with 413 achieving remission. Baseline symptom networks did not show significant differences between outcome groups in network structure (M=0.12,p=.60), global strength (S=0.21,p=.40), or EI. In the full sample, decreases in suicidal thoughts most strongly predicted subsequent improvements in other symptoms (R2=0.008). Longitudinal networks differed between outcome groups (Jaccard=0.25, r=0.16). Remitters displayed integrated networks connecting affective and vital symptoms, whereas non-remitters exhibited fragmented subnetworks.

Conclusion: Suicidal ideation emerged as a key predictor of subsequent symptom improvement in other depressive symptoms, potentially acting as a catalyst for recovery and warranting further investigation through targeted intervention research. Remitters demonstrated integrated networks with strong vital-affective symptom connections, while non-remitters showed a pronounced disconnection between these domains. This distinction suggests that symptom integration is a critical mechanism underlying successful ECT response, offering a novel framework for understanding treatment efficacy beyond mere symptom reduction.

Kara Drexler
GGZinGeest, Amsterdam

A Tale of Two Ages: Inflammation's Divergent Role in ECT Outcomes

Abstract:

Background: Psychotic features and older age are amongst established clinical predictors of favorable ECT outcomes, yet the mechanisms underlying these associations remain unclear. This study aims to explore whether low-grade inflammation is associated with ECT efficacy in elderly patients and those with psychotic features.

Methods: Baseline CRP levels, age, and psychotic features were examined as predictors of treatment outcome, measured by post-treatment Montgomery-Åsberg Depression Rating Scale (MADRS) scores (post-MADRS) and remission status (MADRS ≤10), in patients with major depression receiving ECT. Patients were stratified into three age groups (≤50, 51-70, and ≥71 years) to assess age-related differences in effect. Low-grade inflammation was defined as CRP levels between 3 - 10 mg/L.

Results: A total of 257 patients (mean age 61.2 years) were included in the analyses. Age (β -0.14, p 0.004) and duration of the current episode (β 0.07, p 0.004) emerged as significant predictors of ECT efficacy, whereas psychotic features did not (β -2.32, p 0.105). When stratified by age, baseline CRP levels significantly predicted post-MADRS scores in the youngest (≤50 years) (β 4.75, p 0.021) and oldest (≥71 years) (β -2.53, p 0.026) age groups. ANOVA with Bonferroni correction confirmed significant CRP differences across age groups, and linear regression analyses showed CRP levels significantly increased with age (β 0.02, $p < 0.001$). Psychotic features did not significantly alter the relationship between inflammation and ECT outcome.

Conclusion: Low-grade inflammation appears to differentially impact ECT outcomes across age groups, predicting poorer outcomes in younger and better outcomes in elderly patients with major depression, but not for psychotic versus non-psychotic features. Furthermore, our study highlights an age-dependent increase of CRP levels, which has implications for future research exploring the role of inflammatory markers on treatment response in major depression.

Julia Meijer

Amsterdam UMC, Department of psychiatry

Impact of Titration, Dosage, and pulse-width, across Age on Electroconvulsive Therapy Effectiveness in Depression

Abstract:

Background: Although electroconvulsive therapy (ECT) effectively treats major depressive disorder (MDD), remission rates vary widely, and the impact of ECT stimulus parameters remains unclear. This study investigated how different titration protocols influence dosage, and how different dosages affect remission, including age-dependent differences.

Methods: This retrospective cohort study used data from the Dutch ECT Consortium, with 409 patients treated with right unilateral ECT (median age [IQR], 63 [50-73] years). Patients were categorized based on dosing factor—defined as the administered dose relative to individual seizure threshold (ST)—into three groups: 6×ST, 8×ST (accurate titration), and >8×ST (inaccurate titration). Remission was defined as a Montgomery-Åsberg Depression Rating Scale (MADRS) score ≤10 and analyzed using multivariable regression.

Results: Among 409 patients, 204 were treated using titration protocols starting at 25.2 or 50.4 mC while using pulse widths of 0.3 or 0.5 ms. In 92% of these cases, a seizure was induced at the first step, suggesting the titration protocol substantially overestimated the ST, resulting in higher-than-intended dosing factors (>8xST). Remission rates were lower in the >8xST group (45.5%) compared to 6xST (61.5%; $\chi^2 1=6.50$, P=.01) and 8xST (71.4%; $\chi^2 1=20.60$, P<.001). In

patients aged 55 and older, 8xST was associated with higher remission likelihood than 6xST (OR=2.51; 95%CI=1.05-6.04, P=.04).

Conclusion: Higher-than-intended dosing (>8xST), resulting from inaccurate titration protocols using shorter pulse widths, was linked to a substantial reduction in remission. Patients over 55 showed better outcomes with 8xST than 6xST, highlighting the potential importance of age-specific dosing. Improving titration accuracy and tailoring dosing protocols may significantly enhance ECT effectiveness.

Modulating Functional Connectivity With Transcranial Alternating Current Stimulation

Chair: Bettina C. Schwab

Summary:

This symposium explores the emerging role of transcranial alternating current stimulation (tACS) in modulating functional connectivity in large-scale brain networks. The talks involve a wide range of methods such as EEG, fMRI and computational modeling, but also diverse mechanisms, including phase coupling, amplitude coupling, and state- and frequency-specific effects.

First, speaker 1 will present evidence that theta-range tACS over the inferior parietal cortex can modulate hippocampal-cortical connectivity in a frequency- and state-dependent manner. Using behavioral and fMRI data, the study highlights the selective impact of slower theta frequencies on memory-related processes and resting-state connectivity. Second, speaker 2 will present a study that investigated whether alpha-tACS over the right temporoparietal junction enhances interpersonal neural synchrony during social interaction. Results suggest that tACS can improve non-verbal communication efficiency, shedding light on the oscillatory mechanisms underlying social cognition. Third, speaker 3 will show how phase lags of dual-site tACS influence electric field characteristics. Finite element modeling revealed that phase configuration significantly affects field magnitude, directionality, and spatial extent, emphasizing the importance of biophysical modeling for precise neuromodulation. Finally, the closing talk by speaker 4 presents evidence that amplitude-modulated tACS in the beta band can selectively disrupt amplitude coupling without affecting phase coupling or power. This supports the functional relevance of amplitude coupling as an independent communication channel in the brain.

Together, these studies underscore the precision and complexity of tACS as a tool for causally probing functional connectivity, offering valuable insights into both fundamental brain dynamics and potential therapeutic applications.

Vincent Van de Ven

Department of Cognitive Neuroscience, Faculty of Psychology and Neuroscience, Maastricht University, The Netherlands

Frequency-Specific Modulation of Hippocampal-Cortical Connectivity and Memory by Parietal Theta tACS

Abstract:

Transcranial alternating current stimulation (tACS) offers a low-cost non-invasive means to modulate large-scale brain networks in the human brain. We investigated if tACS delivered over inferior parietal cortex can modulate hippocampal-cortical connectivity in a frequency- and state-dependent manner. We used a concentric electrode setup that provided more focal stimulation than the more commonly used rectangular electrodes distributed over large scalp distances. The parietal location of stimulation was because of its strong hippocampal anatomical and functional connectivity. Previous behavioral studies showed that 6 Hz tACS, compared to sham, decreased associative recognition performance without affecting perceptual recognition, pointing to a functional sensitivity of modulating associative memory processes that are related to hippocampal-cortical interactions. Furthermore, 3 Hz—but not 8 Hz—theta stimulation improved temporal memory accuracy, consistent with the hypothesis that slower hippocampal theta rhythms support associative memory processing more than faster theta. In a novel simultaneous tACS-functional magnetic resonance imaging study, we found that 5 Hz tACS, but not higher frequencies, selectively enhanced hippocampal-parietal cortical connectivity during resting-states, but not when participants performed an attentional task.

These findings provide converging evidence that theta tACS can selectively influence behaviorally relevant hippocampal-cortical connectivity, depending on both stimulation frequency and cognitive context. However, it remains unclear if these changes resulted from broader network entrainment or local hippocampal activity changes. Ongoing work aims to disentangle these mechanisms. In sum, our findings underscore the potential of frequency- and state-specific tACS as a tool for probing and modulating hippocampal function in both basic research and clinical applications.

Miles Wischnewski

Department of Psychology, University of Groningen, The Netherlands

Reading minds: The effect of tACS on neural synchronization in non-verbal inter-personal communication.

Abstract:

Humans are highly social creatures who use communication to interact. Social decision-making, the evaluation and integration of social cues with self and others' interests, is crucial in all forms of interaction. Studies suggest a key role for the alpha band in temporo-parietal regions and the right temporoparietal junction (rTPJ) in social decision-making. Moreover, existing research indicates that increased interpersonal neural synchronisation (INS) leads to increased social

connectedness. To date, research has not addressed whether modulation of neural oscillations will increase interpersonal synchrony between subjects. Transcranial alternating current stimulation (tACS) is a form of non-invasive (electric) brain stimulation that 'entrains' ongoing neural oscillations, thereby allowing for studying the causal relation between alpha in rTPJ in social interaction. The current study investigates the effects of tACS on INS in N=40 healthy volunteers. Each session involves two participants, one from whom EEG is recorded and one receiving (sham-) tACS at 10 Hz and 2 mA intensity. During stimulation, participants perform the Tacit Communication Game, which involves establishing a non-verbally communicating strategy between participants to relay the location and orientation of a stimulus. We present results on the modulatory effect of tACS on task performance (i.e., a modulation in communication efficiency) and an exploration of the effects of tACS in INS. The results of our study provide direct evidence for the importance of alpha oscillations in rTPJ during social interactions.

Silvana Huertas-Penen
Biomedical Signal and Systems, University of Twente, The Netherlands

Effects of Dual-Site tACS Phase Lags on E-Field Dynamics

Abstract:

1. Introduction: Dual-site transcranial alternating current stimulation (ds-tACS) influences neural interaction by simultaneously applying electric currents to two scalp regions [1]. It can modulate synchronisation between the stimulated regions, depending on the phase lag between currents [2]. To selectively modulate connectivity, E-field characteristics should remain consistent across phase lags.

2. Objectives: This study assessed how phase lags of ds-tACS influence key E-field characteristics such as magnitude, distribution, directionality, and effective area of stimulation [3], when targeting the primary motor cortices (M1s). We also investigated how different high-definition montages affect these characteristics.

3. Methods: We performed individualised finite element simulations in SimNIBS [4] using 18 MRI-derived head models [5]. E-field characteristics-including magnitude, distribution, and directionality-were analysed across eight equidistant phase lags and multiple montages previously used for M1 stimulation. We quantified how these E-field characteristics in the target region changed with the phase lag conditions.

4. Results: E-field characteristics in the stimulated areas significantly depended on the phase lag across all examined montages. High inter-individual variability was observed, particularly in the E-field directionality.

5. Conclusion: Our findings highlight the importance of considering phase-lag-dependent variations in the E-field characteristics when interpreting ds-tACS studies. Unintended neuromodulatory effects may occur alongside desired connectivity modulation, complicating the interpretation of functional connectivity. This study also suggests the potential for individualised montages to achieve the intended E-field directionality in the targeted regions.

Marina Fiene

Department of Neurophysiology and Pathophysiology, University Medical Center Hamburg-Eppendorf, Germany

Altering amplitude coupling in resting-state functional networks by amplitude-modulated tES

Abstract:

Background: Intrinsic functional coupling of neural signals is fundamental to integrative information processing and adaptive behavior. Current theoretical frameworks propose that large-scale network coordination relies not only on phase coupling but also on the slower co-modulation of oscillatory amplitudes, referred to as amplitude coupling. While phase-based mechanisms have been extensively studied, the functional relevance of amplitude coupling remains insufficiently understood.
Methods: In this study, we sought to experimentally manipulate amplitude coupling by targeting the temporal co-modulation of beta-band oscillation amplitudes – a frequency range central to the organization of resting-state networks. To this end, 28 participants received amplitude-modulated transcranial alternating current stimulation (AM-tACS) over bilateral parieto-occipital cortices. Stimulation was applied in the beta range, with signal envelopes being either highly coherent or incoherent between hemispheres.
Results: Our results reveal that incoherent AM-tACS significantly reduced amplitude coupling compared to the coherent condition. This modulatory effect was specific to the beta frequency band and spatially restricted to the targeted parieto-occipital cortex. The change in amplitude coupling was not accompanied by changes in oscillatory power or phase coupling.
Conclusion: These findings provide causal evidence that slow amplitude co-modulation can be selectively modulated by non-invasive brain stimulation. The isolated change in amplitude coupling, independent of phase coupling, supports its role as a distinct mode of large-scale neural communication. Together, these results highlight the potential of using AM-tACS to selectively target amplitude coupling and investigate its role in both cognitive function and dysfunction.

Targeting Beta Oscillations In Motor Control: From Mechanisms To Modulation

Chair: Sybren Van Hoornweder

Summary:

Beta-band oscillations (13–30 Hz) are critical in regulating sensorimotor functions, yet their precise functional role remains under investigation. This symposium brings together recent advancements in non-invasive brain stimulation (NIBS) and neurophysiological monitoring to explore how beta activity contributes to motor inhibition, excitability, and performance. Speakers will present findings from electroencephalography (EEG), transcranial magnetic stimulation (TMS), and transcranial alternating current stimulation (tACS) studies, ranging from dual-site stimulation and phase-specific effects to individualized protocols and brain-state-dependent stimulation. The symposium highlights emerging noninvasive brain stimulation strategies for targeting beta oscillations, and informs future interventions in motor rehabilitation and neurological disorders.

Sybren Van Hoornweder

REVAL - Rehabilitation Research Center, Faculty of Rehabilitation Sciences, University of Hasselt, Diepenbeek, Belgium

Targeting beta oscillations in motor control: from mechanisms to modulation

Abstract:

Background. Beta-band desynchronization (13–30 Hz) is a hallmark of sensorimotor activation, yet its functional role across different motor states remains debated. Previous work from our group hints at a functionally polymorphic role, where the amount of desynchronization during motor planning, but not execution, relates to motor performance. While this is suggestive of MRβD as a potential marker of motor performance, causal evidence is lacking. Here, we investigated whether modulating MRβD via individualized beta-band transcranial alternating current stimulation (β-tACS) enhances bimanual motor control in healthy adults.

Methods. In a double-blind, sham-controlled, crossover design, 36 participants received three tACS interventions (fixed 20 Hz β-tACS, individualized β-tACS, and sham) over the right sensorimotor cortex across three days. EEG and bimanual tracking task (BTT) performance were assessed before, during, and after stimulation. Individualized β-tACS was matched to each

participant's peak MRβD frequency during motor planning. EEG data were analyzed using spatiotemporal cluster-based permutation tests with underlying linear mixed models.

Results. Individualized β-tACS significantly improved online and offline BTT performance compared to fixed β-tACS. It also enhanced MRβD online during motor planning. No significant offline MRβD effects were observed. Stronger MRβD increased during planning were associated with greater performance gains. Over sessions, both MRβD and motor performance enhanced.

Discussion/Conclusion. These findings provide causal evidence that MRβD plays a functionally polymorphic, state-dependent role in motor control. Personalized β-tACS emerges as a promising tool to enhance sensorimotor function by targeting MRβD.

Inge Leunissen

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In-phase and anti-phase dual-site beta tACS differentially influence functional connectivity and motor inhibition

Abstract:

Background: Inhibitory control relies on coordinated beta-band activity within a fronto-basal ganglia network, which implements inhibition via downstream effects on (pre)motor areas. In this study, we employed dual-site transcranial alternating current stimulation (tACS) targeting the right inferior frontal gyrus (rIFG) and primary motor cortex (M1) to directly manipulate phase relationships in the beta band and assess their effects on both functional connectivity and motor inhibition.

Methods: Fifty-two healthy participants received in-phase, anti-phase and sham stimulation on rIFG and left M1 while performing a stop-signal task. Concurrently we measured brain activity with EEG (session 1) and fMRI (session 2).

Results: The results revealed that beta connectivity between rIFG and lM1 increased following in-phase but decreased after anti-phase stimulation. Although no direct modulation of task performance was observed, the greater connectivity increase between the targets during in-phase stimulation was predictive of faster inhibitory performance. In contrast, greater connectivity decreases during anti-phase stimulation were related to faster go responses, suggesting a shift towards less inhibition on the motor system. Preliminary fMRI results show that anti-phase dual-site tACS resulted in increased activity of the motor inhibition network.

Conclusion: These findings provide evidence that dual-site beta-tACS can both enhance and impair inhibitory control depending on phase alignment, highlighting its potential as a non-invasive intervention for disorders marked by impaired inhibition.

Leo Tomasevic

Department of Psychiatry and Psychotherapy, University of Regensburg, Regensburg, Germany; - Department of Human Sciences, Institute of Psychology, University of the Bundeswehr Munich, Neubiberg, Germany

Diving into the beta harmonics of the mu rhythm

Abstract:

Background. The mu rhythm is a sensorimotor cortex rhythm centered around 8–13 Hz. Because the mu rhythm waveform is non-sinusoidal, it often exhibits energy at harmonic frequencies, primarily the second harmonic in the beta range (13–30 Hz). In this study, we aimed to investigate whether these harmonics reflect hidden beta activity or are simply nonlinear components of the mu rhythm waveform itself.

Methods. EEG-informed TMS responses were recorded in 20 subjects as motor evoked potentials (MEPs). Single-pulse TMS was delivered over the primary motor cortex targeting the first dorsal interosseous muscle representation at 110% of the resting motor threshold. At each of 20 different phases of the mu rhythm—equally spaced across the 100 ms period—30 stimuli were randomly distributed. For each phase, the 30 MEPs were analyzed to identify patterns of phase-dependent excitability or inhibition.

Results. MEP amplitudes showed phase-dependent excitability, with facilitation more pronounced near the negative mu peak and inhibition near the positive peak. However, no additional modulation was observed at higher frequencies nested within the mu rhythm period.

Discussion/Conclusion. In this study, we found no evidence of cortical excitability modulation linked to frequencies faster than the mu rhythm but nested within it. We failed to falsify the hypothesis that beta-range harmonics are byproducts of the mu rhythm's waveform shape rather than separate physiological rhythms. Therefore, in EEG analyses, it is important to recognize these harmonics to avoid misinterpreting them as independent beta-band activity.

Marten Nuyts

REVAL - Rehabilitation Research Center, Faculty of Rehabilitation Sciences, University of Hasselt, Diepenbeek, Belgium

The importance of brain state: Insights from transcranial evoked potentials during distinct phases of a motor task

Abstract:

Background. There has been a growing interest in neuroimaging and electrophysiology guided non-invasive brain stimulation approaches. While recent work has highlighted the importance of phase, this study aims to extend current EEG-guided approaches by considering event-related power changes in the beta band. Using TMS-EEG, we investigated the effect of task state on direct measures of cortical excitability.

Methods. Twenty-five healthy young adults received single biphasic TMS pulses over the left primary motor cortex (M1) at 110% of resting motor threshold. Stimulation was delivered and individualized in three task-related states: (1) rest; (2) peak beta desynchronization; and (3) peak beta resynchronization. Transcranial evoked potentials (TEPs) were recorded using 61-channel EEG at a 25 kHz sampling rate.

Results. Preliminary analyses suggest a state-dependent modulation of TEPs. Specifically, both early and late evoked activity decreased during a state of desynchronization compared to resynchronization and rest. More in-depth analysis and statistics are currently being conducted.

Discussion/conclusion. These preliminary results highlight the importance of brain state when applying stimulation. Although the approach focuses on single-pulse TMS over M1, it can be extended to both rhythmic TMS and other task-relevant cortical regions, such as those involved in cognition.

Towards personalized rTMS dosing and targeting

Chair: Odile van den Heuvel

Summary:

Can we improve rTMS treatment effects for psychiatric conditions? This symposium explores personalised methods to assess and improve rTMS protocols. Advances in functional connectivity mapping and electric field modeling offer new opportunities to individualize treatment protocols. This symposium brings together computational approaches addressing these topics, aiming to improve mechanistic understanding and inform the development of more effective rTMS treatment.

Coen Coomans

Team Neuropsychiatry, department of Anatomy and Neuroscience; department of Psychiatry, Amsterdam UMC, Amsterdam, the Netherlands

Normative mapping of connectomic markers predicting rTMS outcome in OCD

Abstract:

Background. In depression, inter-individual differences in the optimal cortical target of repetitive transcranial magnetic stimulation (rTMS) are described based on its connection to the relevant circuit related to therapeutic outcome. In obsessive-compulsive disorder (OCD), this relation has not been described.

Aim. To identify circuits or regions for which resting-state functional connectivity (FC) with the rTMS stimulated target is related to therapeutic outcome in OCD patients.

Methods. Resting state fMRI (rsfMRI) data from the global OCD study (N=479)[1], and clinical data and rsfMRI from the TIPICCO trial [2] were used. In TIPICCO, OCD patients received 10Hz stimulation over the pre-SMA (N=21, 110% MT), DLPFC (N=19, 110% MT), or vertex as control (N=19, 110% MT). Normative connectivity networks of the targeted brain regions were constructed by aggregating whole-brain, seed-based connectivity maps from the global OCD study data, using the stimulation sites from TIPICCO as seeds. In the TIPICCO data, patient-specific FC between the rTMS-target and the corresponding normative stimulated network was statistically related to treatment outcome.

Results. FC of DLPFC rTMS targets with the positively coupled normative network was positively correlated with symptom change ($r=0.48$, $p<0.05$), driven by frontoparietal- and frontotemporal connections. In the pre-SMA, FC of rTMS-targets with the negatively coupled normative network was negatively correlated with symptom change ($r=-0.48$, $p<0.05$), driven by negative connectivity with the precuneus and inferior parietal cortex. FC in the vertex condition showed no relation with treatment outcome.

Conclusion. We present functional circuits associated with OCD symptom reduction when stimulated with rTMS.

Debby Klooster

Electromagnetics for Care and Cure lab, Department of Electrical Engineering, Eindhoven University of Technology, Eindhoven, the Netherlands; Epilepsy center Kempenhaeghe, Department of Clinical Physics, Heeze, the Netherlands; Ghent Experimental Psychiatry Lab, Department of Head and Skin, Ghent University, Ghent, Belgium

Replication and methodological robustness of a depression network relevant to TMS targeting

Abstract:

The efficacy of repetitive transcranial magnetic stimulation (rTMS) for major depressive disorder (MDD) is largely depends on coil placement. Traditionally, the optimal target within the left dorsolateral prefrontal cortex (DLPFC) was thought to be the site mostly anti-correlated with the subgenual anterior cingulate cortex. However, recent evidence suggests that connectivity with a broader "depression network" may better predict clinical outcomes (1).

This study aimed to replicate the depression network using data from 40 participants in a clinical trial at Ghent University Hospital, all treated with accelerated intermittent theta burst stimulation (aiTBS) (2). Subjects received five daily iTBS sessions across four consecutive days, targeting the left DLPFC at 110% of the resting motor threshold. Individual functional connectivity maps were computed using a normative connectome and a circular seed placed beneath the coil center. Depression networks were generated by correlating connectivity values with clinical response in every voxel.

As secondary objective, we explored the impact of electric field (e-field) modeling on the resulting networks. Seed regions were derived from e-field simulations thresholded at 91%, 95%, and 99% of peak intensity.

The depression network derived using the circular seed closely resembled the reference network (spatial correlation = 0.67). Networks generated using e-field-derived seeds showed strong internal consistency, and high similarity to the circular-seed networks (mean spatial correlation = 0.86).

Despite these similarities, further research is needed to determine whether different seed definitions lead to the same optimal TMS targets. Future work will also assess how connectivity to these depression networks correlates with clinical outcomes.

Hidde Woerdman

Alzheimer Center, Department of Neurology, Amsterdam UMC, Amsterdam, the Netherlands

Electric Field Modeling Reveals Inter-Target and Inter-Individual Variability in Induced rTMS Dose in OCD

Abstract:

Background: In a recent randomized trial, repetitive transcranial magnetic stimulation (rTMS) was combined with exposure therapy for patients with treatment-resistant obsessive-compulsive disorder (OCD). Participants received high-frequency rTMS targeting the left dorsolateral prefrontal cortex (DLPFC), the left pre-supplementary motor area (preSMA), or vertex (control). This study reexamines resting motor threshold (RMT)-based dosing across targets using electric field (E-field) modeling.

Methods: We modeled E-fields in 57 OCD patients using personalized task-fMRI-based target coordinates. Simulations were conducted using intensities that matched the actual stimulation doses used in the clinical trial: 100% RMT over the primary motor cortex (M1), 110% RMT over the DLPFC and preSMA, and 60% over the vertex. E-fields were quantified within a 1 cm sphere centered on each target.

Results: The average E-field was highest for DLPFC (72.5 ± 15.4 V/m), followed by M1 (71.7 ± 13.0 V/m), preSMA (40.1 ± 7.4 V/m), and vertex (26.7 ± 6.2 V/m). When expressed as a percentage of the M1 E-field at 100% RMT, DLPFC, preSMA, and vertex reached 105.9 ± 20.2%, 54.4 ± 8.7%, and 38.4 ± 9.0%, respectively. PreSMA and vertex E-fields were significantly lower than M1 ($p < 0.001$), while DLPFC did not differ significantly ($p = 0.834$).

Discussion/Conclusion: E-field modeling revealed substantial variability in delivered stimulation across targets and individuals. Although DLPFC stimulation averaged motor-equivalent intensity, many individuals received subthreshold E-fields. PreSMA showed considerably lower

values, suggesting that RMT-based protocols may underdose deeper or medial targets. Furthermore, the consistently low—but nonzero—E-fields at the vertex challenge its validity as a control condition in rTMS trials.

Felix Duecker

Department of Cognitive Neuroscience, Faculty of Psychology and Neuroscience, Maastricht University, The Netherlands

E-Field Fingerprints for Target-Based TMS Modeling

Abstract:

Background. Interest in modeling of transcranial magnetic stimulation (TMS)-induced electric fields (E-fields) has grown substantially, driven by advanced simulation tools such as simNIBS. However, common practices often reduce these complex, spatially detailed simulations to single-coordinate measures or basic summary statistics within small spherical regions beneath the coil. This oversimplification limits our ability to describe how TMS-induced E-fields are distributed across anatomically or functionally defined brain regions.

Methods. To address this, we introduce the “E-field fingerprint”, a computational framework that quantifies multiple E-field attributes (including mean and peak strength, depth, specificity, effectiveness, and homogeneity) within explicitly defined target regions. Crucially, these regions reflect the intended stimulation targets specified by the researcher (e.g., fMRI-based clusters), which may not coincide with the site directly beneath the coil. Our approach uses mesh-based simulations (via simNIBS) and evaluates the resulting E-fields within these researcher-defined brain regions, shifting the analytical focus from the coil’s location to the actual area of intended modulation.

Results. We illustrate the framework’s versatility through three scenarios: comparing focal figure-8 versus broad double-cone coils at identical scalp positions; contrasting scalp-based BeamF3 with individualized resting-state fMRI-guided targets; and exploring how adjustments in stimulation intensity or coil geometry can compensate for suboptimal targeting. This final case highlights how practical trade-offs between coil placement, geometry, and intensity can be used to optimize E-field characteristics, even under clinical constraints.

Conclusion. The E-field fingerprint offers a comprehensive, spatially precise, and adaptable tool for characterizing, comparing, and optimizing TMS protocols across both research and clinical domains.

ABSTRACTS - Posters

Poster nr 1

Praveen James

Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum, India

NEUROMODULATORY EFFECT OF YOGA ON PAIRED ASSOCIATIVE STIMULATION INDUCED NEUROPLASTICITY IN HEALTHY INDIVIDUALS.

Introduction: Yoga involves the practice of postures, regulated breathing, and meditation. The positive effects of yoga on wellness, mobility, mood, fatigue, muscle strength, and quality of life are now well established. Paired associative stimulation (PAS) is a non-invasive technique that can induce neuroplasticity in the human motor cortex. No study has tested the neuro-modulatory effect of yoga, in comparison to aerobic exercise, on motor cortex plasticity, a function considered necessary for motor learning and efficient motor performance.

Materials / Methods: 42 healthy volunteers were recruited who were non-practitioners of Yoga. On Day 1, each subject underwent paired associative stimulation (PAS) using Transcranial Magnetic Stimulation to assess their baseline motor cortex plasticity. The subjects were then randomized to three groups: a yoga group, an aerobic exercise group, and a non-exercise group who did not practice any specific exercise besides routine activities. The yoga and aerobic groups received training from a trained instructor for the 1st week. After one week, subjects continued the regimen at home for at least 30 minutes a day, 5 days a week, for the next 12 weeks. All subjects underwent PAS reassessment at 4 weeks and at 12 weeks.

Results: It was found that 12 weeks of daily yoga or aerobic training, enhanced in healthy volunteers, the responsiveness of the primary motor cortex (M1) to plastic interventions. At 4 weeks, the yoga group had significantly more PAS effect than the 2 other groups. At 12 weeks, the yoga and the aerobic groups had more PAS effect than the no-intervention group.

Discussion: For the first time, we show that yoga training is faster than aerobic training to drive the change in plastic responsiveness. After 4 weeks of daily training, the yoga practitioners have already reached the plateau of the neuromodulatory effect while this was not achieved for the aerobic practitioners.

Conclusion: In this study, we establish that yoga is, in a way, better than aerobic exercises in driving plastic changes, especially in the human motor cortex. The practice of Yoga may help learn new motor tasks faster and perform them in an efficient manner.

Poster nr 2

Marloes Wurkum

Department of Psychiatry, Radboud University Medical Center, Nijmegen, The Netherlands & Donders Institute for Brain Cognition and Behavior, Centre for Medical Neuroscience, Nijmegen, The Netherlands

Enhancing effect of dual interventions in the treatment of depression: a study protocol for a randomized comparison with conventional TMS

Background: Repetitive transcranial magnetic stimulation (rTMS) is an effective treatment for depression, however not every patient responds sufficiently. Recent developments have focused on combining rTMS with additional interventions to enhance its effectiveness. These combination strategies may produce synergistic effects instead of additive effects, possibly because the state-dependent effects of rTMS interact with the effects of the adjuvant intervention. Cognitive control training (CCT) activates the same neural circuit as rTMS and has been shown to have antidepressant effects. As rTMS is a time-consuming treatment, augmenting rTMS with CCT could be a time-efficient and cost-effective solution to increase the therapeutic response of rTMS. This study aims to investigate whether the combination of rTMS augmented with CCT is more (cost-)effective in reducing depressive symptoms than rTMS alone.

Methods: In this multicenter clinical trial 132 adult patients with major depressive disorder (MDD) will be randomized to either rTMS augmented with CCT or rTMS with a placebo task. The trial consists of eight weeks of blinded treatment (30 rTMS sessions), after which patients will be followed up until one year. The primary endpoint is change in depressive severity, assessed with the Hamilton Depression Rating Scale (HDRS-17) during eight weeks of treatment. Secondary outcomes include an economic evaluation, and response and remission after treatment as well as during follow-up.

Discussion: The present study aims to improve the effectiveness of rTMS in a cost-effective way by augmenting rTMS with CCT. The findings may support more cost-effective, tailored interventions for the treatment of depression.

Poster nr 3

Viona Wijnen

PsyQ / Erasmus University Rotterdam, The Netherlands

Psychophysiological and behavioral succes indices of rTMS treatment

Background: Repetitive transcranial magnetic stimulation (rTMS) of the DLPFC has shown high efficacy in treating major depressive disorder (MDD). However, little is known about the neurocognitive mechanisms involved. This study explores whether reward processing, cognitive performance, resting-state EEG, HRV, and EDA are related to the effectiveness of rTMS combined with psychotherapy. The main aim is to predict who may or may not benefit from treatment.

Methods: This is a prospective, within-subject longitudinal outcome study starting in August 2025. Participants are adults with MDD who have not responded to at least two evidence-based therapies. All patients are enrolled in the Intensive Specialist Program (ISP) at PsyQ, The Netherlands. Treatments follow a TAU model. Patients receive either combined rTMS + psychotherapy or psychotherapy alone. Behavioral and neurophysiological data (rest and task-based) will be collected at three time points. The main outcome is a QIDS score ≤ 5. Profiles across modalities aim to identify treatment-related biotypes.

Preliminary results are expected in November 2025. We anticipate that distinct profiles in baseline HRV, resting EEG, and cognitive task performance will predict treatment response. Specifically, higher pre-treatment parasympathetic activity and stronger reward processing signals may be associated with better outcomes in the rTMS + PT group. First results might already give small insight in neurocognitive profile differences between fast, slow and non-responders.

Discussion: This research may pave the way for personalized treatment selection based on biotype classification, improving efficiency and long-term remission rates in treatment-resistant depression.

Poster nr 4

Laura Luyten

KU Leuven, Belgium

Preregistering your brain stimulation research: Why (not)?

Background: Although more and more common in some fields of research, preregistration has not yet or barely been adopted in many others, including that of brain stimulation. Completely unknown or highly unwanted – the reasons for this are diverse. Nevertheless, there are solid scientific arguments for taking this approach. Clinical trials already require (limited) registration for about 20 years, but preclinical research and observational patient studies are often not preregistered.

Methods/Results: Drawing on almost a decade of experience with preregistration, I will share my insights and discuss the drawbacks and hurdles, as well as the merits of preregistration. I will illustrate the approach with recent publications about my own deep brain stimulation research in rats and psychiatric patients.

Conclusion: This poster aims to provide an informal opportunity for discussing the pros and cons of preregistration in brain stimulation research. Depending on the visitor's background, I can give pointers to start using preregistration or we can discuss more specific issues that they might be struggling with if they already (considered to) use it.

Poster nr 5

Hanieh Ghaempanah

Vrije Universiteit Brussel

Quantifying the Effect of Different Brain Tissue Segmentation Pipelines on The Simulated tDCS Electrical Field Strength and Focality

Background: Accurate electric-field modeling for transcranial direct-current stimulation (tDCS) relies on tissue segmentation, and is especially sensitive to how cerebrospinal fluid (CSF) is labelled. We assessed the impact of two CSF segmentation approaches on tDCS simulation results.

Methods: T1-weighted MRIs from 47 healthy adults (26–69 years) were processed with (i) the default CHARM pipeline and (ii) the same pipeline but substituting its CSF mask with one from a commercial pipeline optimized for grey and white matter volumetry. Using SimNIBS 4.1, we ran a 1 mA frontal montage (anode F3, cathode F4, 5×5 cm electrodes, 4 mm thick). From cortical grey matter, the E 99.9 % peak (E99) and the volume experiencing ≥ 75 % of that peak were extracted. Paired differences failed normality (Shapiro–Wilk), so we applied the Wilcoxon signed-rank test and report p-values and effect sizes (r).

Results: The second segmentation resulted in larger CSF volume. E99 changed minimally, from 0.236 ± 0.058 V/m (CHARM) to 0.224 ± 0.041 V/m (commercial software), median Δ=-0.004 V/m (p=0.071, r=0.29). In contrast, focality was more strongly affected: the volume of cortex experiencing ≥ 75 % of the peak decreased from 10.9 ± 2.3 cm^3 to 6.43 ± 2.34 cm^3 (median Δ=-4.16 cm^3, ≈ 39, p = 3.6 $\times 10^{-14}$) with a large effect size (r = 0.87).

Conclusion: As expected, the segmentation with the larger CSF volume, results in a larger spread of the electrical current. This results in lower focality, whereas the strength of the electrical field remains similar.

Poster nr 6

Rick voncken

MHeNS

Boosting associative memory in elderly by entraining theta-gamma coupling with transcranial alternating current stimulation.

Background: Mild Cognitive Impairment (MCI) represents an intermediate stage between healthy ageing and Alzheimer`s disease (AD), characterized by cognitive decline. A significant proportion of individuals with MCI progress to AD, emphasizing the need for novel therapeutic strategies. Disruption of theta-gamma coupling, a neural mechanism essential for memory consolidation, has been implicated in this progression.

Hypothesis and Objectives: This study hypothesizes that non-invasive brain stimulation (NIBS) like theta-gamma coupled transcranial alternating current stimulation (TGc-tACS) can “tune up” endogenous brain oscillations by frequency synchronization. This effect will result in re-established neural spiking, restored functional coupling, improved cognitive performance and enhanced brain metabolic profiles. The primary aim is to evaluate whether TGc-tACS enhances neurochemical and neurophysiological conditions in brain regions involved in cognitive processing, like the hippocampus and the prefrontal cortex.

Methods: A within-subject design will be used with 30 healthy, ageing participants (≥55 years old), who will undergo active and sham TGc-tACS during resting-state and a working memory task (using a face-and-scene task). During both stages, a 7T Magnetic Resonance (MR) system will be used to acquire anatomical, functional Imaging (fMRI) and metabolic Spectroscopy (MRS) data. fMRI will assess connectivity along with neural synchrony, while MR Spectroscopy will quantify concentrations of neurochemicals such as choline, GABA and glutamate/glutamine.

Discussion: The expected outcomes include improved theta-gamma coupling, increased connectivity within the hippocampal-prefrontal network, and altered metabolite concentrations associated with neural plasticity and excitation-inhibition balance.

Conclusion: This study aims to advance non-pharmacological therapies for MCI and AD by combining brain stimulation with cutting-edge neuroimaging.

Poster nr 7

Oscar Magnusson

Maastricht University

Assessing Neural Entrainment Dynamics During Transcranial Alternating Current Stimulation with EEG

Neural entrainment—the synchronization of neural oscillations to rhythmic external input—is thought to play an important role in how the brain processes and predicts environmental rhythms. Entrainment can arise not only from natural stimuli, but also from artificial sources, such as transcranial alternating current stimulation (tACS). Because tACS artifacts are much larger than EEG signals, studies have relied on after-effects, which offer limited insights into entrainment dynamics due to rapid post-stimulation decay.

The Kuramoto coupling model provides a framework for assessing how neural oscillations entrain to ongoing stimulation. According to the Kuramoto model, when stimulus intensity and frequency offset are insufficient for full entrainment, tACS will pull and push the frequency of the intrinsic oscillator. Shifts in intrinsic instantaneous frequency provide a way to assess entrainment dynamics without relying on the direct measurement of the stimulation frequency, which is masked by the tACS artifact in EEG recordings.

We recorded EEG from 35 participants while delivering amplitude-modulated tACS (220 Hz carrier) at four intensities (0.8-3.2 mV peak-to-peak) and frequency offsets of ±1.5 Hz and ±2.5 Hz relative to each participant's individual alpha frequency. We employed spatial source separation filters to suppress the stimulation artifact and isolate cortical signals during tACS. Our analysis focuses on testing the Kuramoto model's prediction, which follows an Arnold Tongue pattern: distinct pushing/pulling patterns of the instantaneous frequency depending on the stimulation intensity and frequency offsets. We anticipate that these entrainment effects should decay towards the natural intrinsic frequency once stimulation ceases.

Poster nr 8

Sofie Salden

Department of Morphology, Imaging, Orthopedics, Rehabilitation, and Nutrition, Faculty of Veterinary Medicine, Ghent University; Department of Head and Skin, Ghent Experimental Psychiatry (GHEP) Lab, Ghent University

Time-dependent modulation of monoaminergic metabolites by accelerated rTMS in healthy and anxious dogs

Background: Accelerated repetitive Transcranial Magnetic Stimulation (arTMS) is an emerging modality in both human and veterinary medicine. While previous studies have demonstrated brain changes and behavioral improvements in healthy and patient dogs, the effects of arTMS on neurotransmitter level remains poorly understood.

Methods: This study examined the impact of accelerated high-frequency rTMS (aHF-rTMS) on cerebrospinal fluid (CSF) metabolites, focusing on dopaminergic (DOPAC, HVA) and serotonergic (5-HIAA) markers, in healthy dogs and dogs with anxiety-related disorders. A total of 79 dogs were included, consisting of 59 healthy controls and 20 anxious patients.

Results: Using generalized linear mixed-effects models, our results revealed a significant group effect, with patient dogs consistently showing lower baseline levels of all three metabolites (DOPAC, HVA, and 5-HIAA) compared to healthy control dogs, supporting a neurochemical basis for anxiety in dogs. Furthermore, arTMS primarily influenced CSF metabolites after just one day of active stimulation, compared to sham or four days of stimulation.

Discussion: These results suggests that a shorter duration may have a more immediate impact, with prolonged treatment possibly leading to homeostatic adjustments in the brain. These findings show that arTMS affects neurotransmitter pathways in a time-dependent manner but also highlight the importance of baseline neurochemical differences when evaluating treatment outcomes. While preliminary, our results suggest that rTMS has a time-dependent effect on neurotransmitter dynamics in dogs and may hold translational value for its potential use in treating anxiety-related disorders in both veterinary and human contexts.

Poster nr 9

Imke de Wijs

Department of Psychiatry, Radboud university medical center, Nijmegen, The Netherlands

Combining Behavioral Activation and rTMS in Late-Life Depression: a Study Protocol for a Randomized Controlled Trial

Background: Late-life depression (LLD) is common in older adults and associated with reduced quality of life, cognitive decline, elevated mortality risk, and increased healthcare costs. Despite available pharmacological and psychotherapeutic treatments, response rates remain suboptimal, highlighting the need for alternatives. Repetitive transcranial magnetic stimulation (rTMS) has demonstrated efficacy in treating LLD, but remission rates are limited. Behavioral activation (BA), a structured intervention increasing engagement in rewarding activities, may enhance rTMS effects. Combining rTMS and psychotherapy may produce synergistic effects by modulating partially overlapping fronto-limbic and fronto-striatal circuits involved in emotion regulation and reward processing through distinct mechanisms.

Methods: This multicenter, single-blind, randomized controlled trial will assess the (cost-)effectiveness of combining BA with low-frequency rTMS targeting the right dorsolateral prefrontal cortex (DLPFC) in individuals aged 60 and older with treatment-resistant LLD. A total of 148 participants will be randomized to receive either rTMS with BA (active condition) or rTMS with placebo (control condition) over six weeks. The primary objective is to determine whether combined treatment leads to greater symptom reduction and superior cost-effectiveness compared to rTMS with placebo. Secondary outcomes include relapse prevention, quality of life, treatment acceptability, behavioral engagement, and changes in anhedonia, apathy, and cognitive symptoms. We hypothesize that the combined intervention is more effective in reducing depressive symptoms and more cost-effective.

Discussion: This trial will explore the synergistic effect of combining rTMS and BA in LLD. Findings may advance understanding of psychotherapy-assisted rTMS and provide practical insights for integrating psychotherapy into routine rTMS care for older adults.

Poster nr 10

Christophe Lafosse

RevArte Rehabilitation Hospital and KU Leuven

Analgesic effect of tailored bilateral sequential rTMS on treatment-resistant phantom upper limb pain

Phantom limb pain (PLP) is regarded as a difficult to treat neuropathic pain condition. In this case-study we investigated the analgesic effect of repetitive transcranial magnetic stimulation over the primary motor cortex (M1-rTMS) for treating PLP. A 59-yr-old man, had an accident two years ago, followed by a total surgical amputation of the right arm. Since then he experienced a severe treatment-resistant phantom limb pain. We applied 30 M1-rTMS sessions spread over 9 weeks. During each session we applied alternating high-frequency rTMS stimulation (2970 pulses) over M1 of the contralateral hemisphere to the amputated limb and low-frequency rTMS stimulation (600 pulses) over right ipsilateral M1. The treatment period was followed by a maintenance period of one session per week during 6 following weeks. Analgesic effects were assessed daily at different time moments based on a patient-reported remote clinical real-time monitoring of VAS pain score. The McGill Pain Questionnaire Dutch Language Version (MPQ-DLV) was obtained after each block of 10 TMS sessions and compared with the pre-treatment assessment. Daily VAS pain score decreased gradually by 66% after 9 weeks and was still reduced by 60% at follow-up compared with baseline measures. The MPQ-DLV pain description and intensity values decreased gradually from 160.8 pre-treatment to 130; 103.4 and 84.7 at the end of the 9th week rTMS-treatment ($p<0.01$). rTMS induced a clinically significant pain reduction with a Clinical Global Impression-Improvement scale of 1 (much improved). In this case rTMS was a safe and valuable therapeutic option in his difficult to treat PLP.

Poster nr 11

Xena Serifova

Center for Developmental Psychiatry, Faculty of Medicine, KU Leuven, Belgium; University Center for Obsessive-Compulsive Disorders, UPC KU Leuven, Belgium; Leuven Brain Institute (LBI), KU Leuven, Belgium

Assessing DBS effects in OCD using frequency-tagging EEG: preliminary data from the POSSS study

Obsessive-compulsive disorder (OCD) is a severe psychiatric condition involving intrusive thoughts and compulsive behaviors. While pharmacological and cognitive-behavioural treatments offer relief for many patients, a substantial subgroup remains treatment-resistant. For some of these individuals, deep brain stimulation (DBS) represents a promising therapeutic alternative. However, the implementation of DBS in OCD remains challenging: optimal stimulation settings vary greatly between individuals, are difficult to determine and rely almost exclusively on subjective reports.

In the Pinpointing Obsessive-Compulsive Symptom Severity Study (POSSS), we use a multimodal symptom provocation paradigm to explore whether therapy-induced changes in OCD symptomatology can be captured objectively. We combine frequency-tagging electroencephalography (EEG), eye tracking, heart rate, skin conductance, and self-report measures to assess neural, physiological, and behavioural responsivity to OCD-relevant versus neutral visual stimuli in real-time.

With this approach, we aim to investigate the effects of DBS in a cohort of OCD patients by comparing two conditions: stimulation ON versus OFF. One patient already completed the full protocol, and the preliminary data indicate a clear reduction in frequency-tagged EEG responses to OCD-relevant stimuli during DBS ON versus OFF, while responses to neutral stimuli remained stable.

These initial findings suggest that frequency-tagging EEG holds promise as an objective indicator of therapeutic response. Our ongoing work aims to replicate and extend these findings across patients, with the long-term goal of contributing to a better understanding of DBS in OCD, and supporting more efficient, personalized optimization of stimulation parameters.

Poster nr 12

Thomas Keizers

University of Twente

Simulating the distribution of E-fields during deep brain stimulation for Parkinson's Disease patients using a personalized whole-head model

Computational models are frequently used in Deep Brain Stimulation (DBS) research to investigate the mechanisms behind the therapeutic effects of DBS. The scope of simulations is often limited to the Volume of Tissue Activated (VTA), disregarding weak E-fields outside the basal ganglia. However, studies on transcranial alternating current stimulation (tACS) have shown that weak E-fields in the cortex can modulate single neuron activity, not by altering spiking rates, but by affecting spike timings. We therefore need to understand the distribution of E-fields stemming from DBS throughout the entire head, including the cortex.

Using patient imaging data, we created whole-head models and integrated DBS electrode geometries to calculate the E-fields throughout the head. We combined head segmentations from SimNIBS with electrode trajectory reconstructions from LeadDBS. The resulting volumetric mesh is used to perform simulations of the electric fields using SimNIBS FEM functions. Finally, we determined E-field values in cortical regions using FieldTrip functions and the Brainnetome atlas.

We performed simulations for 4 patients. Preliminary findings show average values greater than 0.1 V/m in cortical regions. The highest values were reached in the insular gyrus, where we find mean E-field magnitudes ranging from 0.70 to 1.50 V/m and 99.9th percentiles ranging from 3.53 to 6.65 V/m.

Our preliminary results indicate that E-field magnitude values in the cortex exceeded values for which modulation effects have been found in tACS. Further investigation will test different stimulation conditions for Parkinson’s Disease to determine whether cortical neuromodulation plays a role in the clinical effects of DBS.

Poster nr 13

Katinka Coenen

Radboudumc

Longitudinal Prediction of Symptom Severity during Repetitive Transcranial Magnetic Stimulation in Patients with Treatment Resistant Depression

Repetitive transcranial magnetic stimulation (rTMS) is a relatively new and effective biological therapy for treatment-resistant depression (TRD). Research focused on understanding and predicting the effect of rTMS benefits both the patient and the healthcare provider. While several longitudinal studies have identified response trajectories that can be assessed post-treatment – or predicted pre-treatment – in a clinical setting, there is currently no research on effectively recognising response trajectories in patients who are actively undergoing rTMS treatment. This study utilises a growth mixture model (GMM) to identify distinct longitudinal trajectories in symptom severity as a result of rTMS, and subsequently predict treatment response based on (1) predictors at baseline and (2) partial trajectories. All data originates from the CORTEX database, which includes clinical data from the Radboudumc, Amsterdam inGeest and Amsterdam UMC. All patients included in this study (N ≈ 290) were diagnosed with unipolar and treatment-resistant depression, and were treated using the standard Dutch treatment protocol. Symptom severity was assessed every 5 sessions using the Hamilton Depression Rating Scale (HDRS). Preliminary research with a small subset (N = 20) revealed an optimal GMM with two classes: responders and non-responders. This study is still ongoing. The final results should be available by August 2025.

Poster nr 14

Maud Bosman

TechMed Centre, Biomedical Signals and Systems Group, University of Twente, Enschede, the Netherlands

Computational models to investigate the effect of weak DBS fields on the (de)synchronization of neurons

Deep brain stimulation (DBS) is an often effective treatment for the motor symptoms of Parkinson's disease (PD), however, its therapeutic mechanism is still under discussion. Current literature explains the therapeutic mechanism of DBS, which is characterized by short pulses, as solely a result of the strong electric fields. At the same time, non-invasive brain stimulation techniques have shown that sinusoidal weak electric fields can synchronize neurons. We therefore hypothesize that weak electric fields can also play a role in the therapeutic mechanism or side-effects of DBS. In this computational study, we investigate the effect of DBS pulses with a low amplitude (< 10 V/m) on the synchronization of cortical neurons.

We simulated a morphologically realistic cortical neuron using a multicompartment model and a network model consisting of pyramidal cells and interneurons. Both models were stimulated with typical high frequency DBS pulses. We then investigated the effect of the DBS amplitude on the phase locking value (PLV) to the stimulation frequency.

Both models showed synchronization with respect to the stimulation frequency at electric fields below 10 V/m. The PLV increased with the stimulation amplitude for both the single-cell and the network model, while the spike rate remained constant.

Weak electric DBS fields can affect cortical neural dynamics by synchronizing neural activity to the stimulation frequency. This indicates that the weak electric fields can possibly contribute to the therapeutic mechanism of DBS or its side-effects, for example by interacting with the effects of strong electric fields near the target site.

Poster nr 15

Helen Tobback

Vrije Universiteit Brussel

The effect of NIBS on severe alcohol use disorders (AUD)

Alcohol contributes to 3 million deaths worldwide each year. Despite various available treatments, many are associated with high relapse and dropout rates. Transcranial direct current stimulation (tDCS), a non-invasive brain stimulation (NIBS) technique, has attracted growing interest as a promising approach to treat addiction. Yet, no consensus exists regarding ideal parameters (e.g., montage, current, intensity), craving remains the primary subjective outcome, and protocols often include few sessions. This study investigates the impact of 4x1 high-definition tDCS (HD-tDCS), a more targeted tDCS variant, on alcohol use disorders (AUDs). 70 patients with severe AUD took part in a between-subjects design. Participants underwent five sessions of either active or sham anodal HD-tDCS targeting the right dorsolateral prefrontal cortex (dlPFC), delivered across five consecutive days. Craving was rated using a Visual Analogue Scale (VAS) at baseline and following each session. Additionally, EEG activity was recorded both at rest and during a Go/No-Go task and an alcohol-related cue reactivity task—conducted at baseline, post-first session, and post-final session—to assess short- and longer-term effects. Abstinence was also evaluated four weeks post-treatment as a follow-up outcome. The primary aim of this project is to assess potential effects of right dlPFC-targeted tDCS on abstinence, craving, and EEG-related measures. Findings from the ongoing analyses will be presented.

Poster nr 16

Marie Vandormael

Mondriaan

Influencing Safety Memory: intermittent theta burst stimulation over the ventromedial prefrontal cortex

Background: Affective disorders (ADs) are characterized by heightened anxiety. Exposure therapy is a gold standard behavioral therapy for conditions with prominent anxiety, but relapse remains common. Since extinction learning underlies exposure therapy, strategies taht enhance extinction may improve long-term outcomes. The ventromedial prefrontal cortex (vmPFC) plays a key role in inhibiting the amygdala during fear extinction. Previous research suggests that transcranial magnetic stimulation (TMS) over the vmPFC may support this process. Hence, the current study explores the effects of intermittent theta burst stimulation (iTBS) over the vmPFC on fear extinction.

Methods: Forty-two healthy participants were randomly assigned to active or sham TMS. They underwent a three-day fear conditioning protocol consisting of acquisition, extinction and extinction recall phases. Intermittent theta burst stimulation (iTBS;50 Hz bursts repeated at 5 Hz, 600 pulses, 100% resting motor threshold) was applied over the vmPFC prior to extinction.

Results: The active group showed reduced discrimination (CS+ vs. CS-) compared to the sham group during extinction (US expectancy/arousal/fear/valence ratings), and at recall (arousal/valence ratings).

Conclusion: vmPFC-targeted iTBS reduced fear discrimination during extinction and recall, pointing to potential benefits for enhancing extinction learning. These findings may inform future interventions for anxiety disorders.

Poster nr 17

Sandra Anna Schwarz

Til Ole Bergmann Lab & Department of Psychiatry and Psychotherapy, JGU UniMedizin Mainz

A **retrospective naturalistic non-inferiority study comparing the clinical effectiveness of accelerated iTBS and rTMS protocols in treatment-resistant depression at Maastricht UMC+**

At least 30% of the 280 million people diagnosed with depression globally do not respond to traditional psychotherapy or medication treatments, meeting the criteria for treatment-resistant depression (TRD). Transcranial magnetic stimulation (TMS) is a safe and effective non-invasive brain stimulation treatment for depression. Previous non-inferiority studies show no significant differences in antidepressant effectiveness of once-daily standard-duration repetitive transcranial magnetic stimulation (rTMS) and intermittent theta burst stimulation (iTBS) protocols, and a small study of 28 TRD patients in Belgium also showed the non-inferiority of their accelerated forms, a-rTMS and a-iTBS. This naturalistic, retrospective study replicates these findings in a larger sample of 102 Dutch TRD patients. We found a significant reduction in depression over time of 8.9 points (24%) on the Beck Depression Inventory (BDI-II), which did not significantly differ between protocols, and was predicted by lower baseline disability and treatment-resistance, and older age. The longer a-rTMS protocol produced a greater clinically important reduction in depression (34-40%) and higher response (23%) and remission rates (23%) compared a-iTBS (effectiveness of 27-30%, response 18% and remission 14%). Both protocols demonstrated very good practical feasibility and tolerability as measured by the small number of missed sessions and dropouts and no reported serious adverse events (SAEs). However, our depression reduction, response and remission rates were lower than in previous literature. Future research should aim to replicate our findings in a larger and more diverse sample using more predictors for treatment effectiveness, and in a randomised controlled trial (RCT) design that includes placebo-controlled and sham-stimulation conditions.

Poster nr 18

Eva Oostra

Amsterdam UMC

The impact of Independent Component Analysis on TMS-EEG outcomes: A Within-Subject comparison across Motor and Prefrontal Stimulation

Background: Standardized guidelines for transcranial magnetic stimulation with electroencephalography (TMS-EEG) data acquisition and preprocessing are lacking, for example on the application of independent component analysis (ICA). ICA is an effective method to help remove unwanted artifacts during preprocessing. A recent meta-analysis suggested it may also significantly affect TMS evoked potential (TEP) amplitudes. We investigated the impact of applying zero, one, or two rounds of ICA on TMS-EEG outcomes within a single dataset.

Methods: Twenty-five healthy participants received 51 single-pulse stimulations over the left primary motor cortex (M1) and dorsolateral prefrontal cortex (DLPFC), with simultaneous EEG recording. Data were preprocessed three times: with zero, one, or two rounds of ICA. TEP amplitudes and identification, and the area under the curve of the local mean field potential (LMFP-AUC) were compared across conditions.

Results: After M1 stimulation, preprocessing without ICA resulted in significantly larger P30 and P60 amplitudes and LMFP-AUC. After DLPFC stimulation, zero ICA rounds led to fewer identified P30 and N40 peaks, but larger P60 and P180 amplitudes, as well as greater LMFP-AUC. The N100 component remained stable across ICA conditions for both brain areas.

Discussion: The largest differences were found between using zero versus one or two ICA rounds, particularly after DLPFC stimulation; likely due to increased eye-blink artifacts. This study is the first to directly compare ICA effects on both motor and non-motor TMS-EEG data. We recommend applying at least one round of ICA, with explicit eye-blink removal for prefrontal stimulation, to ensure more reliable TMS-EEG outcomes.

Poster nr 19

Eva Oostra

Amsterdam UMC

Investigating excitation and inhibition brain properties of patients with Bipolar Depression: an explorative case-control TMS-EEG study

Background: Bipolar disorder (BD) may be linked to an imbalance between excitatory and inhibitory neurotransmission in the brain. However, electrophysiological properties of the brain derived from patients with BD are rarely investigated, even with an low-cost available technique such as transcranial magnetic stimulation combined with electroencephalography (TMS-EEG). With this pilot trial, we aim to explore the excitation and inhibition properties in patients with BD and compare this with a healthy control (HC) dataset.

Methods: Ten patients diagnosed with BD with a current depression and 25 HC received 153 TMS pulses, consisting of 51 single pulse and paired pulse paradigms (51 pulses with 2ms inter-stimulus-interval (ISI) and 51 pulses with 10ms ISI), delivered over the bilateral dorsolateral prefrontal cortex (DLPFC). The area under the curve of the local mean field potentials (LMFP-AUC) of the early response (until 80 ms after TMS pulse is administered) and late response (81-270ms after TMS pulse) is used as the primary outcome measure. Secondary, we will investigate whether there is a difference in amplitude of the N100 peak between groups.

Results: Currently, we found after left DLPFC stimulation using spTMS in HC, a mean LMFP-AUC early of 191 (SE=20.0) μV, a mean LMFP-AUC late of 899 (70.7) μV, and a mean amplitude of -6.66 (SE=1.05) μV of the N100 peak. Two final participants with BD will be assessed before the 1st of July 2025, after which the final statistical analysis of the outcome measures in the BD group and between groups will be performed.

Poster nr 20

Carmen Plevin

Smart TMS

Impact of Poor Sleep on TMS outcomes for Depression/Anxiety

Background: Sleep is important for neuroplasticity, including long-term potentiation and depression. Transcranial magnetic stimulation (TMS) facilitates these plastic changes. The hypothesis states that poor sleep would negatively influence TMS outcomes. However, a retrospective review of 983 patients (Kweon et al, 2024. Front Psychiatry. 15:1458696) found no link between baseline sleep disturbance and TMS treatment outcomes.

Methods: A retrospective chart review analysed TMS outcomes in depression/anxiety patients in a naturalistic clinical setting. Exclusion criteria: incomplete data, <18 years, and <15 sessions. N = 221, (117 male). Entry criteria were PHQ9 > 10. PHQ-9 item 3 (score range 0–3) measured sleep disturbance. Multiple linear regression tested sleep scores as predictors of final PHQ-9 scores, adjusted for baseline.

Results: Results revealed a non-statistically significant effect (β = -0.289, 95% CI [-1.40, 0.83], t(218) = -0.510, p > .05), sleep scores accounted for 19% of the variance in PHQ-9 improvement (R^2 = .19). The overall model was non-significant (β = 0.927, 95% CI [-2.03, 3.89], t(218) = 0.616, p > .05). Participants had an average PHQ-9 reduction of 34%, with 96 (43%) participants having at least 50% reduction in scores. Response rates were statistically significant (t(220) = 13.17, p > .05, Cohen's D = 0.89).

Conclusion: Results suggest that poor sleep disturbances does not predict outcomes for TMS depression/anxiety patients. Future research should separate hypersomnia and insomnia to explore this in more detail.

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Carmen Plevin

Smart TMS

Exploring TMS for Neurodivergent Populations

Background: Neurodivergence describes individuals with cognitive functions or neurological processes differing from typical, including attention deficit hyperactivity disorder (ADHD) and autism spectrum disorder (ASD) (Dwyer, 2022). While TMS is effective for treating depression/ anxiety in neurotypical patients, its impact on neurodivergent populations is less studied (Hyde et al., 2022). Emerging evidence suggests comparable efficacy across groups (Smith et al., 2022). This study hypothesises no significant difference in response rates between neurotypical and neurodivergent patients.

Methods: A retrospective chart review analysed TMS treatment outcomes for depression/anxiety. Patients aged 18+, ≥15 completed sessions and baseline PHQ-9 ≥ 10 were included. Neurodivergence was identified via clinical assessment. PHQ-9 reductions were compared across 3 groups (neurotypical, ADHD and ASD) using a one-way ANOVA.

Results: Results revealed no statistically significant differences in PHQ-9 reduction between neurotypical, ADHD and ASD groups ($F(2, 441) = 1.24$, $p > 0.05$, $\omega 2 = .0011$). The neurotypical group ($n = 414$) had an average reduction of 7.96 points ($SD = 7.17$) on the PHQ-9 scale, the ADHD group ($n = 16$) and ASD group ($n = 14$) had average reductions of 6.6 points ($SD = 5.06$) and 11.4 ($SD = 8.34$), respectively. The small effect size ($\omega 2 = .0011$) supports the hypothesis that TMS treatment outcomes do not differ significantly between neurotypical and neurodivergent patients.

Conclusion: Results suggest that TMS is equally effective for neurodivergent and neurotypical populations. Future research should replicate these findings in a larger sample confirming these outcomes and explore individual differences within neurodivergent populations.

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Poster nr 22

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The cerebellum in sensory gating: A combined tACS-EEG study in healthy volunteers

Introduction: The posterior cerebellum is proposed to play a role in filtering sensory information through its efferent and afferent connections to the cerebral cortex to prevent sensory overload. The aim of the present study was to disrupt pre-attentive sensory gating by applying exogenous oscillatory field potentials to the posterior cerebellum.

Methods: In a single blind controlled cross-over design fourteen healthy adult volunteers underwent 50 Hz cerebellar or occipital transcranial alternating current stimulation (tACS) with an estimated surface peak intensity of 0.17 V/m. Order of stimulation was counterbalanced and on separate days controlled for time of day. Sensory gating was assessed during (online) and after (offline) tACS by recording event-related electrocortical N1-P2 responses to binaural paired auditory-clicks. Average percentage change in alpha (8-12 Hz) activity was measured to control for state-dependent changes of arousal over time.

Results: The repeated measurements ANCOVA showed a statistically significant tACS*time interaction, $F(2, 12) = 5.17$, $p = 0.04$, indicating a stronger rather than weaker suppression of the electro-cortical N1-P2 response to the second auditory click in offline as compared to online cerebellar tACS when controlled for alpha activity. No evidence was found for occipital tACS-related modulation of sensory gating.

Discussion: Results concur with the proposed cerebellar involvement in filtering sensory information. The unexpected increase of sensory gating after cerebellar tACS may suggest a cortical compensatory mechanism during cerebellar perturbation which resulted in an overshoot after tACS. Findings should however be interpreted with caution and replication in a larger sample is warranted.

Poster nr 23

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Exploring instant transcranial electrical stimulation effects on brain-wide functional connectivity using simultaneous MEG

Various disorders including Alzheimer's disease are characterized by cognitive impairment and underlying brain oscillatory slowing and impaired functional connectivity (FC). Transcranial electrical stimulation (tES) is a non-invasive brain stimulation technique that's able to improve memory by altering neuronal excitability. However, technical difficulties of measuring brain activity during tES impede the investigation of its exact working mechanisms. The study aim is therefore to explore instant tES effects on brain FC using magnetoencephalography (MEG).

In this concurrent tES-MEG session, 3-minute 40 Hz transcranial alternating current stimulation (tACS), anodal transcranial direct current stimulation (tDCS) and sham tACS was applied between electrodes on the precuneal region and right shoulder and alternated with 3-minute rest periods in healthy adults (n=20). An atlas-based beamformer was utilized to obtain resting-state source-space MEG.

Reduced global delta (0.5-4 Hz) and increased global beta (13-30 Hz) relative power (RP), as well as increased (sub)cortical theta (4-8 Hz) phase lag index (PLI) and decreased cerebellar beta PLI after tDCS was found. After tACS, parietal theta RP and central theta PLI was reduced and hub network gamma (30-48 Hz) RP and central gamma PLI was increased. Hub network gamma RP and central gamma PLI was decreased after sham tACS.

Directly after tES, brain activity and FC changes reflect a shift in prevalence and enhanced connectivity from lower to higher frequencies, except for an opposite pattern for FC changes after tDCS. In combination with expected similar MEG changes during stimulation, this will provide clinically-relevant insights into the short-term neuromodulatory working mechanisms of tES.

Poster nr 24

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Is 1 mA Theta-Band tACS Sufficient to Enhance Offline Frontoparietal Connectivity? An Electrical Field Simulation in Older Adults with Amnestic Mild Cognitive Impairment

Background: With reliable evidence of cognitive improvement (Grover et al., 2023), transcranial alternating current stimulation (tACS) is a promising tool to treat Mild Cognitive Impairment (MCI; Rektorová, 2024). However, a minimum electrical field (EF) dose of ~0.3 V/m is required to elicit clear physiological effect (Wischnewski et al., 2023). The COGMAX project applied theta-band tACS in individuals with MCI but found no specific stimulation effects. This study investigates whether simulated EF magnitudes predict offline changes in frontoparietal connectivity.

Methods: Fifty-three COGMAX participants were included (mean age = 71.7 years, 69.8% male). They were randomly assigned to either sham condition (n = 19) or real (n = 34) 1 mA tACS over F3 and P3 (Cz as return). The median of connectivity changes (weighted phase-lag index) before and after ten sessions were used to classify responders (greater improvement) and non-responders. Mean EF magnitudes were simulated using simNIBS and extracted from gray matter ROIs (F1, P1, and C1). Predictive value of EF was assessed via logistic regression and ROC analysis.

Results: The strongest EF was near the return electrode. No participants reached the 0.3 V/m threshold in frontal or parietal regions and only few did centrally. In the real stimulation group, EF near the return electrode predicted responder classification better (AUC = 62.3%, 95% CI: [42.4%, 82.2%]) than EFs at target sites, although none predicted better than chance.

Conclusion: The preliminary results suggest that the COGMAX montage did not generate sufficient EF at intended targets, supporting critiques by Saturnino et al. (2017), Future dua-site tACS studies should consider using higher intensities (e.g., 2 mA) and focal ring montages.

Poster nr 25

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Slow theta tACS modulation of hippocampal-cortical connectivity increases temporal similarity

The temporal organization of episodic memory is thought to depend critically on the hippocampus, potentially coordinated by theta-band oscillations. Here, we used concurrent transcranial alternating current stimulation (tACS) and functional magnetic resonance imaging (fMRI) to examine whether slow theta stimulation (3 Hz) applied over the left parietal cortex modulates hippocampal–cortical functional connectivity during memory encoding, and how this relates to subsequent temporal memory. Participants viewed sequences of images under different tACS conditions (3 Hz, 8 Hz, and no stimulation) and later judged the temporal distance between item pairs. Behaviorally, 3 Hz stimulation led to significantly compressed temporal distance judgments compared to 8 Hz, suggesting altered temporal memory reconstruction. Neurally, 3 Hz tACS selectively reduced hippocampal connectivity with medial frontal, posterior cingulate, and medial occipital cortices during encoding, while 8 Hz had no significant effect. Importantly, increased 3 Hz tACS-induced connectivity between the hippocampus and right superior parietal cortex during encoding predicted shorter temporal distance judgments at retrieval. These results provide novel evidence that slow theta oscillations can shape hippocampal - cortical network dynamics in a frequency- specific manner, influencing the construction of temporal relations in memory. Our findings have potential implications for developing oscillation-based interventions targeting memory deficits in clinical populations.

Poster nr 26

Naz Mirzai

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Neuromodulation interventions in Lewy Body Disease: a systematic review

Background: Lewy body disease (LBD), involves motor, cognitive, and psychiatric symptoms such as hallucinations and delusions, which heavily impact caregivers. Current treatments, mainly cholinesterase inhibitors and NMDA antagonists, offer modest benefits. Among non-pharmacological treatments, there is the neurostimulation approach. This study aims to identify types of neurostimulation interventions used in LBD and their effectiveness. Method: Databases including PUBMED, SCOPUS, Cochrane, and APA PsycArticles were searched to identify articles published between 2000 and 2024 on neurostimulation interventions that aimed to improve clinical symptoms in LBD. Results: 15 studies involving 297 individuals with LBD and 5 different types of neurostimulation intervention: 2 invasives (electroconvulsive therapy (ECT) and deep brain stimulation (DBS)) and 3 non-invasives (transcranial alternating current stimulation (tACS), transcranial magnetic stimulation (TMS), and transcranial direct current stimulation (tDCS)). Neuropsychiatric (particularly psychotic) symptoms show improvement with both invasive (ECT) and non-invasive (TMS) stimulation. Two studies have examined deep brain stimulation, reporting one null and one positive effect on neuropsychiatric symptoms, but no observed effects on cognitive symptoms. Conclusion: Neurostimulation interventions appear effective for neuropsychiatric symptoms, particularly psychotic symptoms. However, we will show that further studies are needed to evaluate their impact on cognitive domains and specific symptoms such as hallucinations, especially in the case of DBS, for which evidence is currently limited. Additional follow-up research also seems necessary to determine the most effective and durable neurostimulation techniques.

Poster nr 27

Marie Poncelet

UHasselt

Protocol for a Multicentre, Randomised, 4-Arm, Sham-Controlled Study on the Synergistic Effects of Music and Transcranial Alternating Current Stimulation in Patients with Disorders of Consciousness.

Following a severe acquired brain injury some patients may remain in a disorder of consciousness (DoC), a clinical spectrum encompassing coma, unresponsive wakefulness syndrome, and minimally conscious state. Despite medical advances, effective treatments remain limited, necessitating innovative approaches. Non-invasive brain stimulation approaches have been investigated but their effects remain moderate. Music is another promising approach, as it may influence consciousness and responsiveness by modulating neural oscillations in the brain's auditory-motor network. However, clinical outcomes are still modest. It is hypothesised that enhancing the auditory-motor network oscillatory dynamics could boost the effect of music therapy. Transcranial Alternating Current Stimulation (tACS) offers a mean to modulate such dynamics. To explore this hypothesis, a randomised, sham-controlled, single-session study is designed to investigate the synergistic effects of tACS applied synchronously to music, on neural, behavioural, and physiological outcomes. Specifically, the study examines how this combined intervention affects coupling between auditory and motor brain networks. The study will include 35 DoC patients (aged 18+) due to acquired brain injury. Each will complete four sessions, separated by a washout period of one week, in a pseudo-randomised order: 1) music + tACS, 2) tACS only, 3) music + sham tACS, and 4) control (audiobook + sham tACS). Preferred music at 100 bpm will be used, while tACS will be applied over the primary motor cortex of the dominant hand at 2mA peak-to-peak, and synchronised to the rhythm of the music. Outcome measures, including EEG, Coma Recovery Scale-revised, heart rate, and video recordings, will be collected before and after stimulation. The result of this project is to further unravel the mechanism of auditory-motor coupling on the recovery of patients with DoC and bring forward a novel therapeutic strategy for such a population.

Poster nr 28

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Online artifact removal in closed loop EEG-tACS setup

Transcranial alternating current stimulation can be used to stimulate the brain with electrical current in order to modulate brain states during various cognitive tasks. Adjusting the stimulation parameters based on ongoing brain activity requires a closed loop setup with EEG to measure the brain activity in real-time. However, tACS introduces an artifact which propagates over the scalp and is subsequently picked up by an EEG device. Such an artifact is known to non-linearly affect EEG recordings there by making it difficult to distinguish the true effect (for example entrainment) from the artifact. Moreover, implementing an efficient method in real-time remains a challenge. Here we explore real-time artifact removal strategies. We first focus on a method using singular value decomposition (SVD). SVD can be used (also in real-time) to decompose a system into spatio-temporal parts which are ordered according to their contribution to the total explained variance. We hypothesize that the artifact can be decomposed apart into one of the temporal eigenvectors of the system and can be removed by removing that eigenvector.

Poster nr 29

Laurie Galas

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Phase-specific closed-loop TMS stimulation to facilitate memory performance of specific items in visual working memory

Working memory performance has been linked to oscillatory mechanisms in the theta band, with growing evidence that different memory items are represented at distinct oscillatory phases. It is unclear what determines which representation is active at which phase, some proposing it is linked to temporal order, while others propose order is dependent on the likelihood that a stimulus will occur. In the present study, we aim to test these two hypotheses by delivering TMS at distinct phases of ongoing theta oscillations. Using a closed-loop TMS-EEG setup, we will stimulate dorsolateral prefrontal cortex at one of six tested theta phases during the retention period of a working memory task. Participants will memorize the orientation of two sequentially presented Gabor patches, receive around 10 TMS pulses at the designated phase using online EEG processing, and then report the orientation of either the first or the second Gabor, as indicated by a response cue. At the beginning of the trial, a precue will indicate the most likely target, which will be valid on 75% of trials. If temporal order determines phase order, we expect memory enhancement of the first and second item at different phases. If likelihood determines the order, we should see that item-specific phase-dependent enhancement relate to target validity. Here, we present the proposed research as well as preliminary pilot data. Our approach will provide new insights into the phase-dependent role of frontal theta oscillations in supporting working memory and clarify the TMS-induced facilitation underlying mechanism