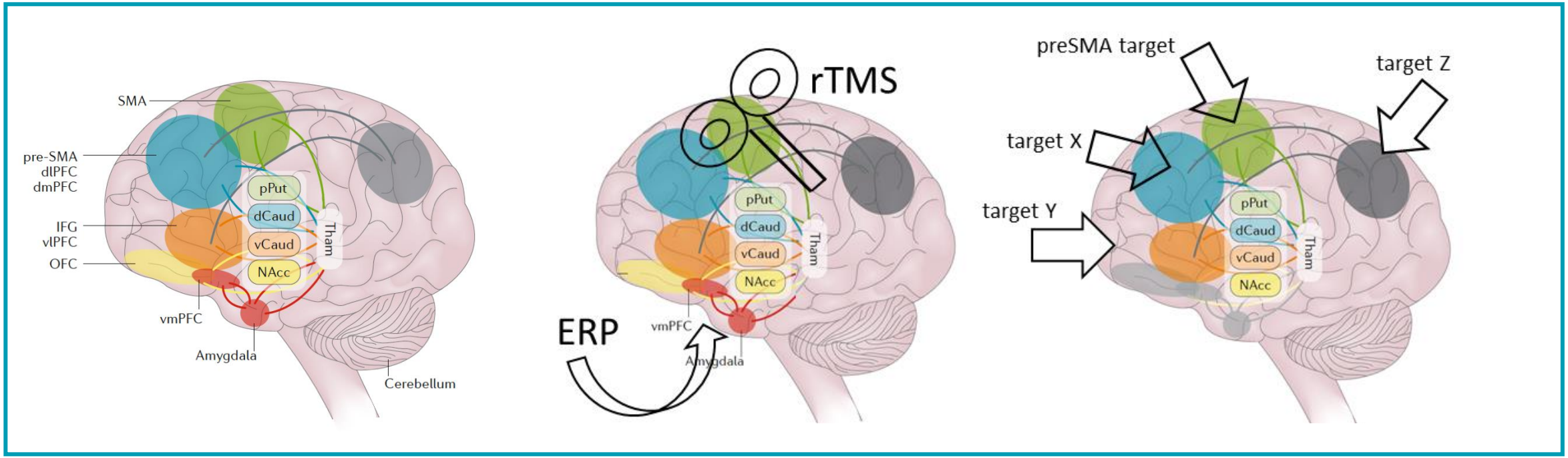
rTMS in OCD
from disease model to personalized targeting



Odile A. van den Heuvel, MD PhD

Psychiatrist / professor of Neuropsychiatry, Amsterdam UMC, Vrije Universiteit, Amsterdam Neuroscience, The Netherlands

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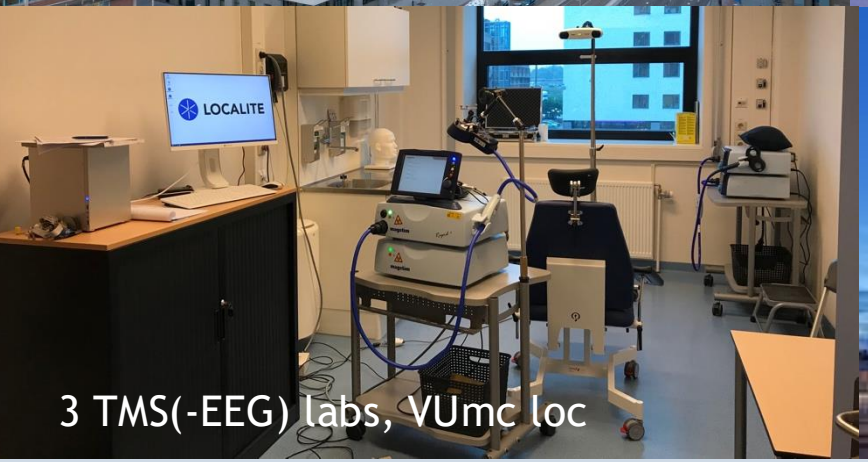
NACT – April 23, 2026 - Stavanger



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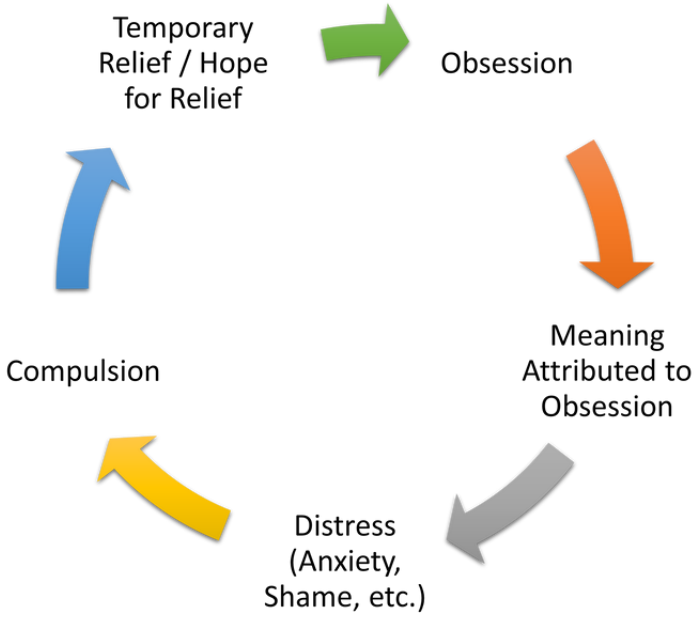
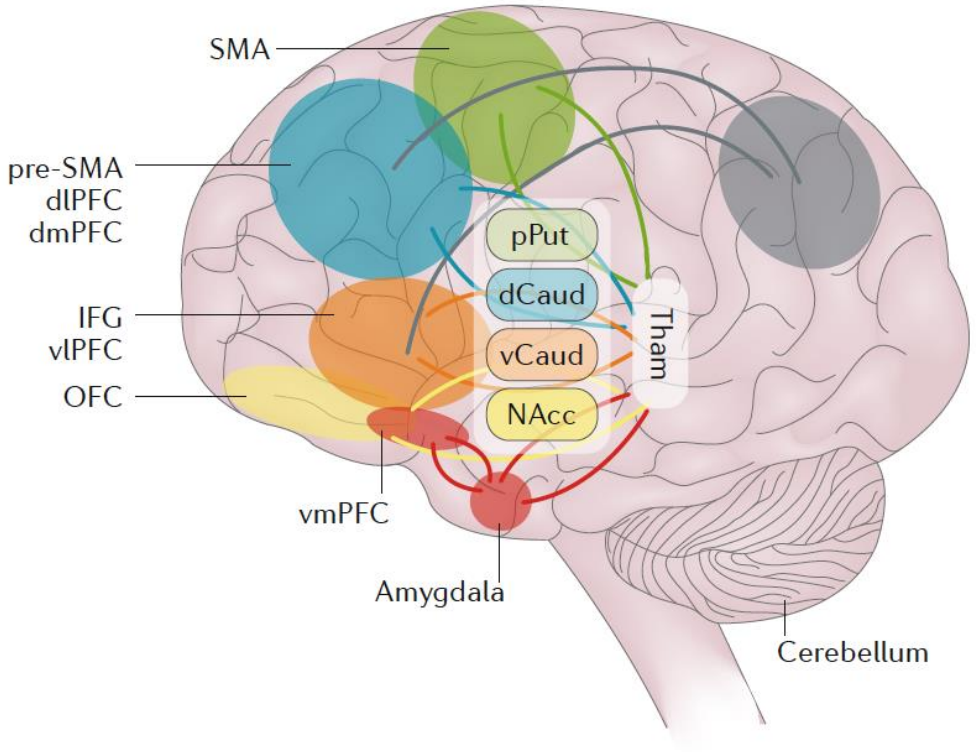
Anatomy of obsessive-compulsive disorder (OCD)



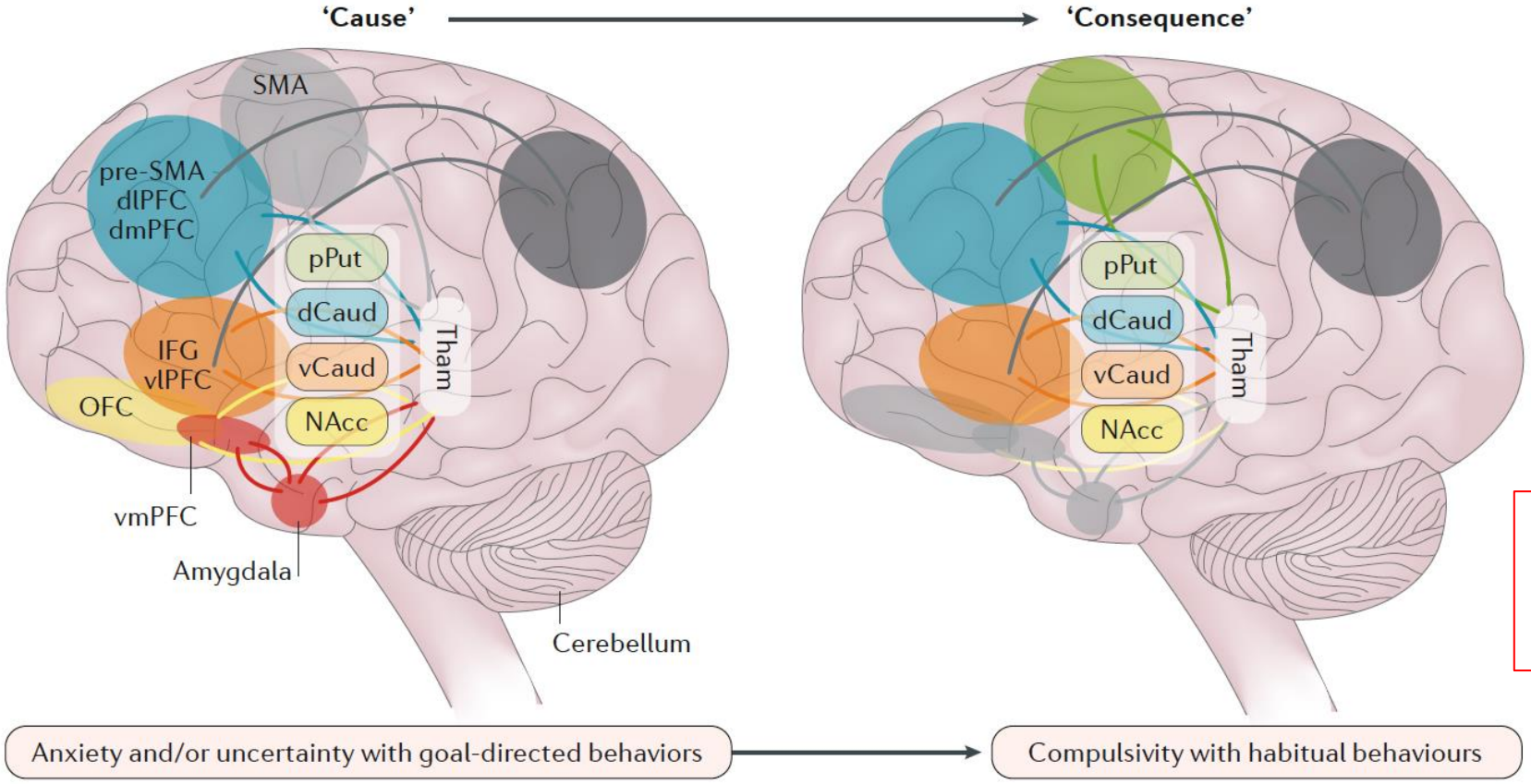


- 'Sensorimotor' CSTC circuit
  - Stimulus-response-based habitual behavior
- 'Dorsal cognitive' CSTC circuit
  - Working memory, planning, emotion regulation
- Frontoparietal network
  - Coordination of cognitive control
- 'Ventral cognitive' CSTC circuit
  - Response inhibition
- 'Ventral motivational' CSTC circuit
  - Stimulus-outcome-based motivational behaviour
- 'Frontolimbic' circuit
  - Fear extinction

Stein et al. *Nature Reviews Disease Primers* (2019)

Lifespan view on disease

Altered neurodevelopment contributes to the vulnerability to develop OCD (driven by altered maturation of the thalamus)



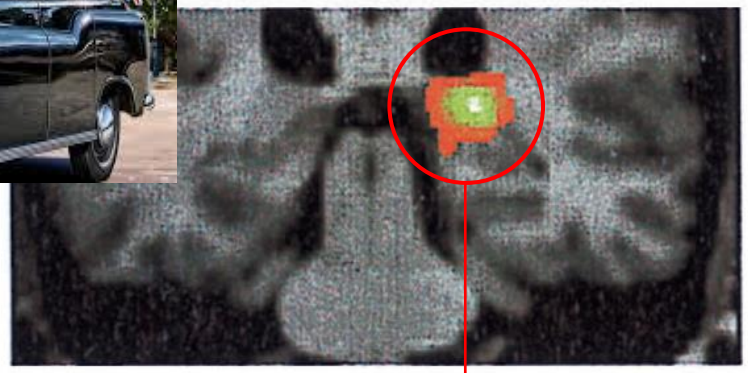
OCD (due to the endless repetitive behaviors), by the power of repetition, 'shapes' the brain

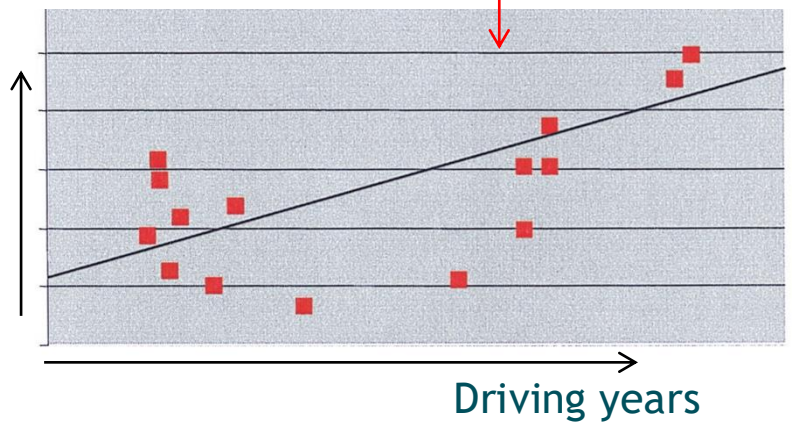
But with treatments we can 'reshape' the brain

Stein et al. *Nature Reviews Disease Primers* (2019)

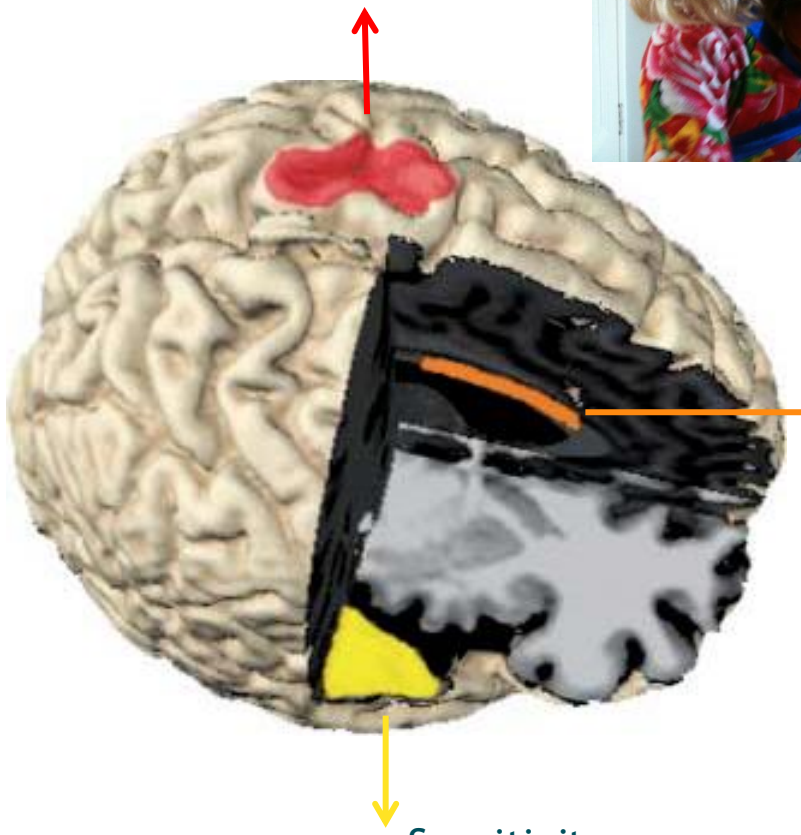
Brain plasticity

= the power of repetition





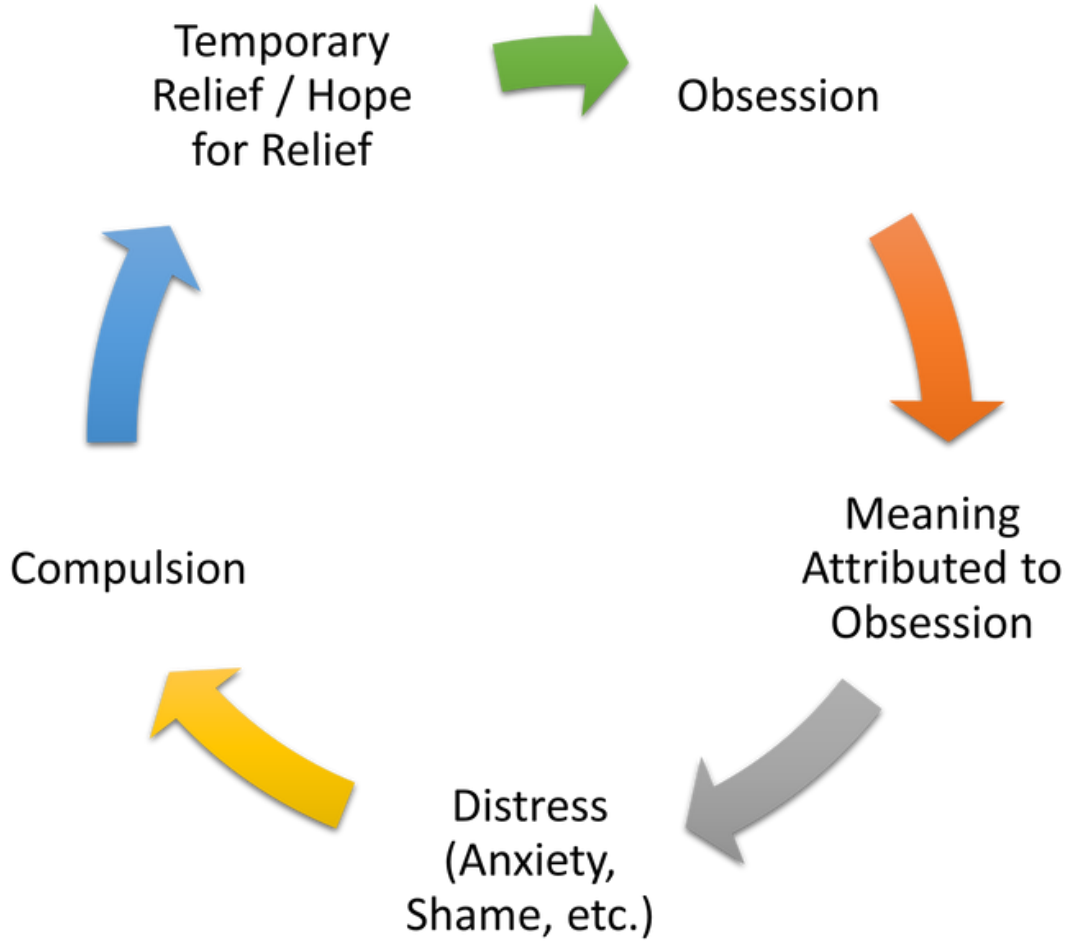
Maguire et al. 2000 PNAS



Münte et al. 2002 Nature Rev Neurosci

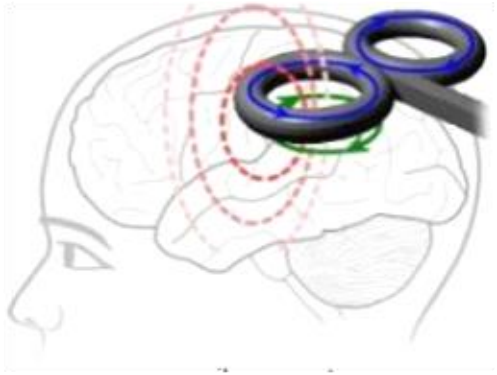
Changing behavior

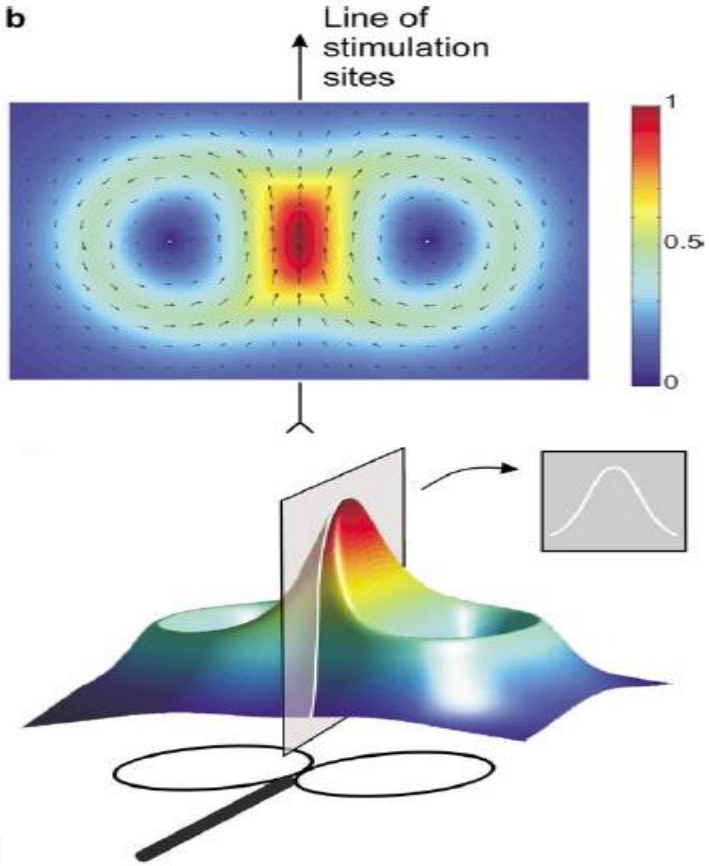
>> Exposure Therapy with Response Prevention to break the OCD cycle

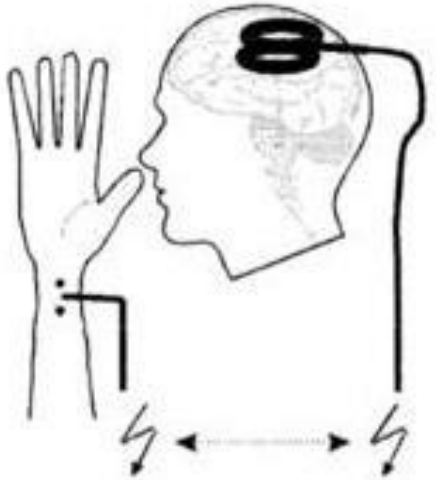


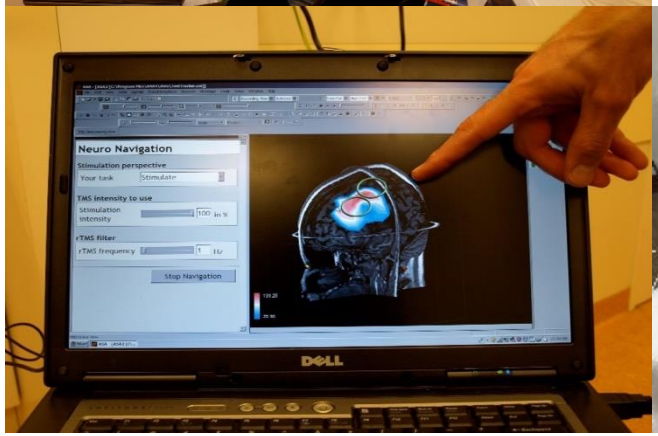
Boosting brain plasticity

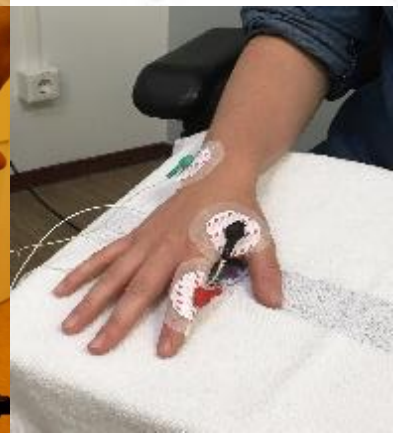
> using repetitive Transcranial Magnetic Stimulation (rTMS)











25 yr journey in OCD

- From task-based fMRI in OCD (& anxiety) to disease model (PhD project 1999-2005)

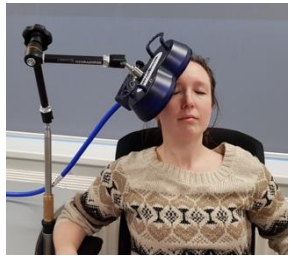

Stella de Wit

- Experimental single session rTMS-fMRI study in OCD (VENI project 2008-2014)
- Proof-of-concept TIPICCO randomized controlled trial (VIDI project 2018-2023)
  - Prediction rTMS response in OCD
  - Analyses on dosing and targeting
- TETRO trial (cost-effectiveness RCT 2021-2027)


Coen Coomans


Hidde Woerdman


Tjardo Postma


Sophie Fitzsimmons


Milan Houben


Wianne Schipper

- From biotypes to personalized targeting (VICI project 2025-2030)

Proof of concept

Single session rTMS-fMRI study

to understand the role of the DLPFC in emotion regulation problems in OCD

Stella de Wit

Controls (n=38):

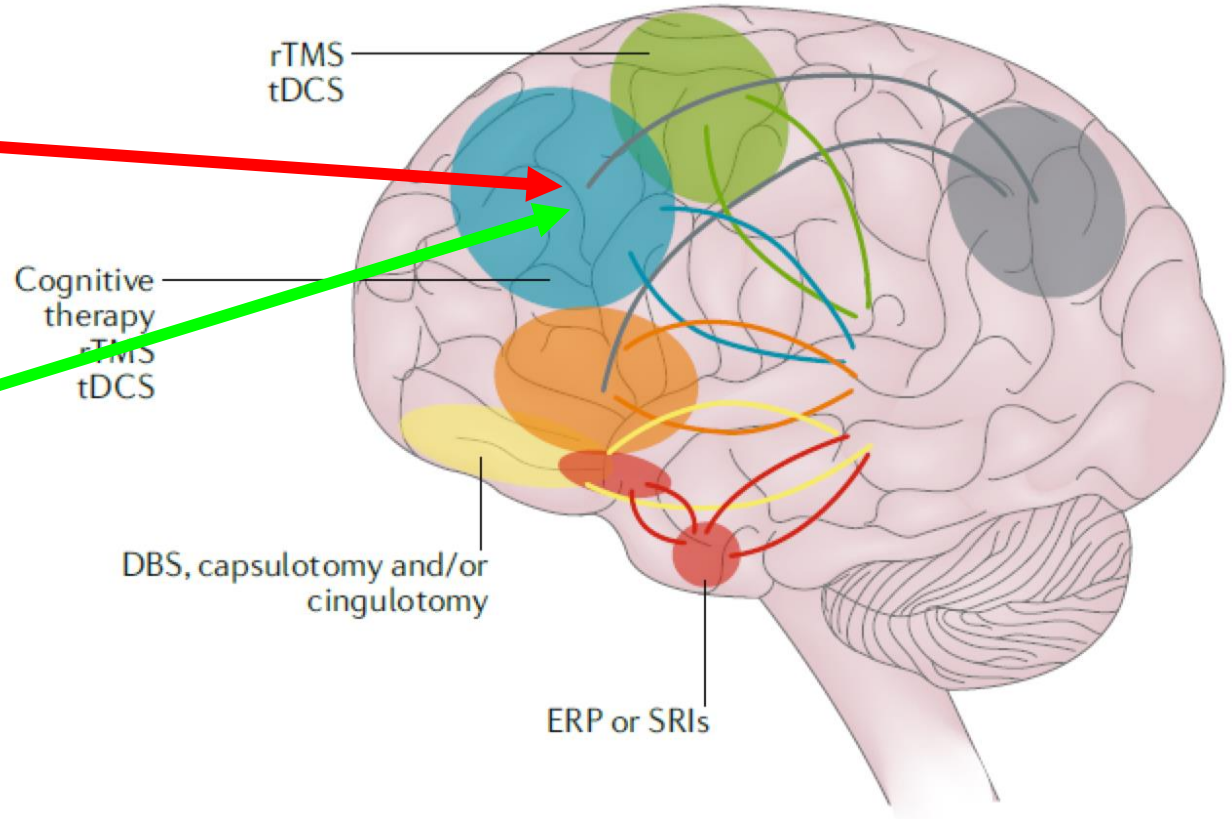
Low-frequency rTMS vs. sham

(= inhibition of control)

OCD patients (n=43):

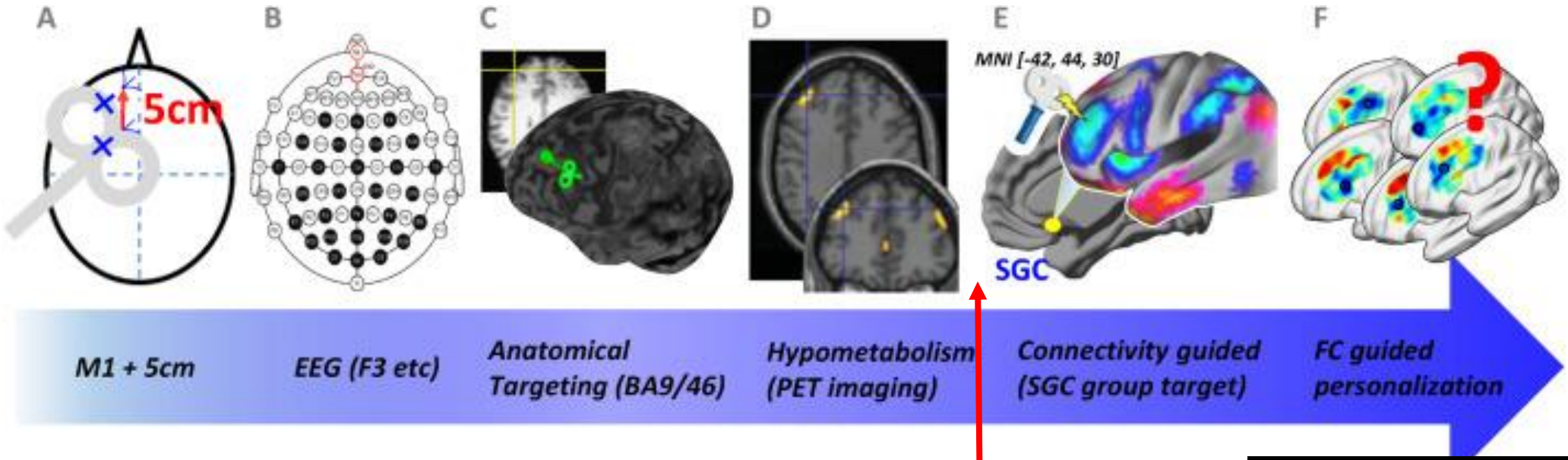
High-frequency rTMS vs. sham

(= stimulation of control)



de Wit et al. *Psychological Medicine* (2015)

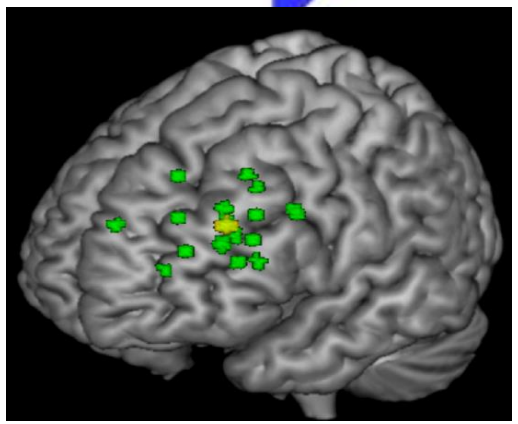
Neuronavigation



Task-fMRI-based targeting

for dorsolateral PFC (DLPFC) rTMS target e.g. emotion regulation task of planning task

for pre-SMA rTMS target e.g. Stop-Signal task



Cash et al, 2021 Biol Psychiatry

de Wit et al. 2015 Psychol Med

Fitzsimmons et al, 2025 Biol Psychiatry

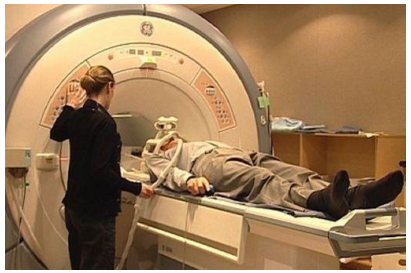
TMS-EEG labs

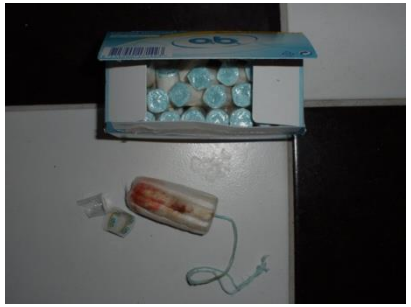

TMS coil
neuronavigation-camera
neuronavigation-screen
stimulator

Proof of concept

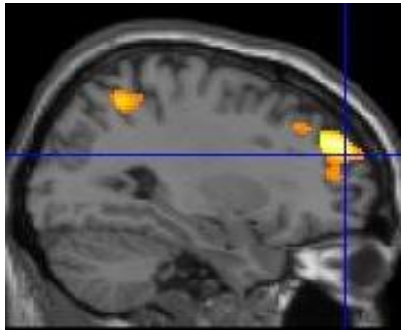
Single session rTMS-fMRI study

day 1
fMRI during
emotion regulation paradigm



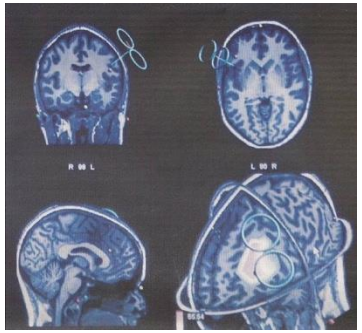


SPM:
Single subject analysis
reappraise > attend
stimulation coordinates



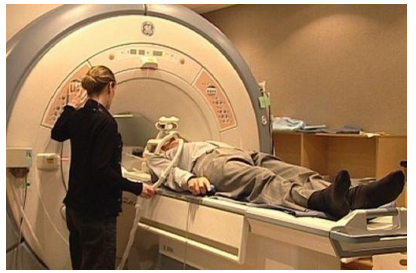
day 2

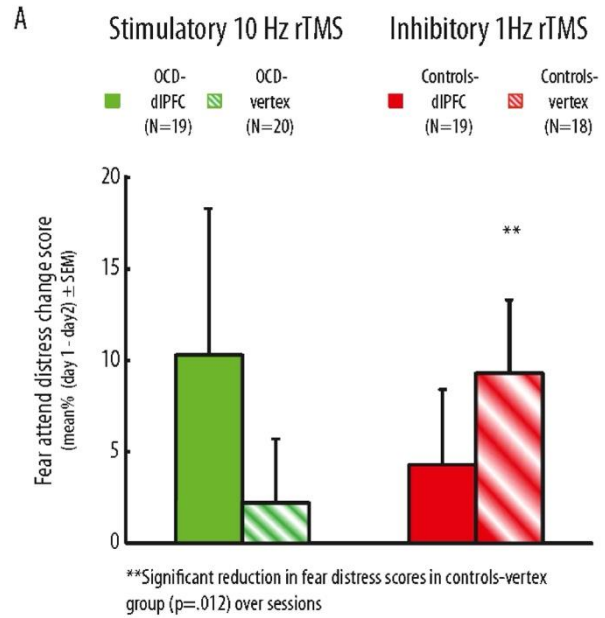
20 min rTMS
(1 Hz, 10 Hz or sham)
using neuronavigation



a.s.a.p.

fMRI during
emotion regulation paradigm

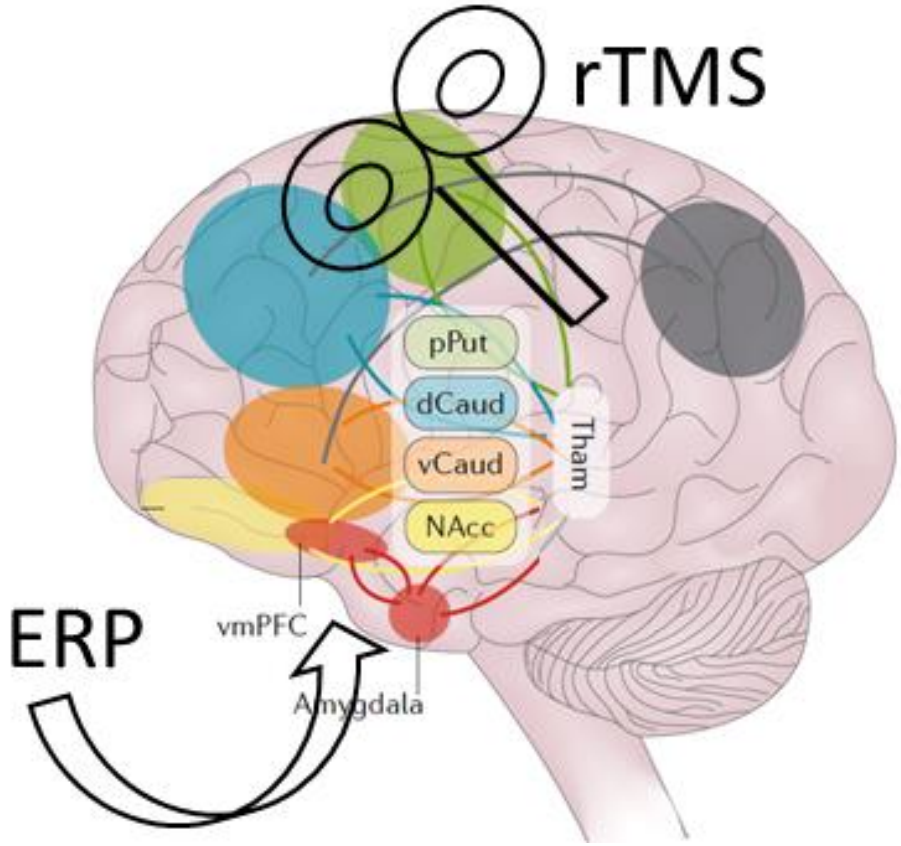




repeated measures analyses day 1 versus day 2, 1st level

2nd level group analysis

de Wit et al. *Psychological Medicine* (2015)



rTMS to boost exposure therapy

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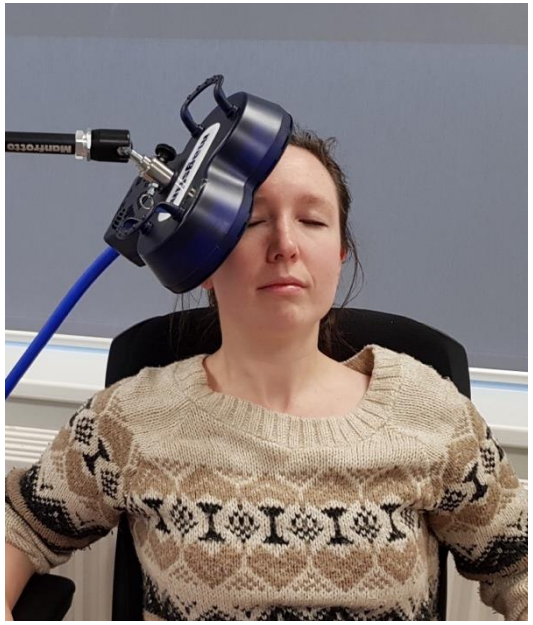
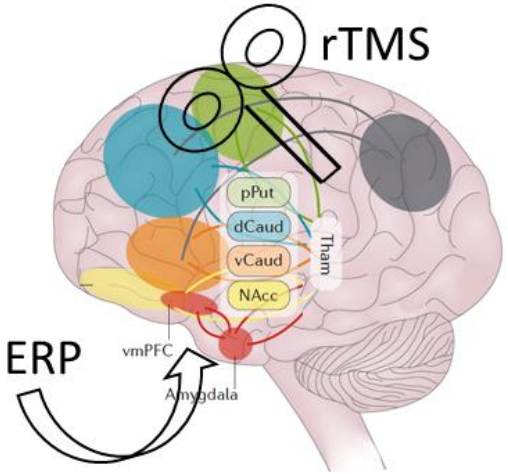
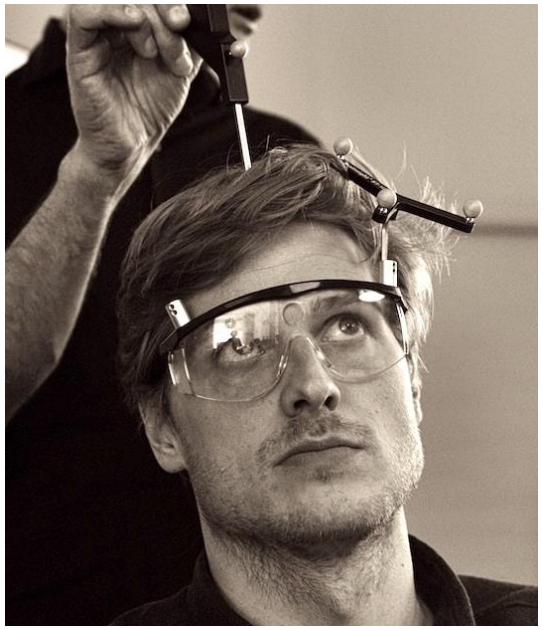
rTMS to boost exposure therapy



Sophie Fitzsimmons, MD PhD
postdoc





Tjardo Postma, MD
AIOS / PhD student

TIPICCO | TMS-induced plasticity improving cognitive control in OCD

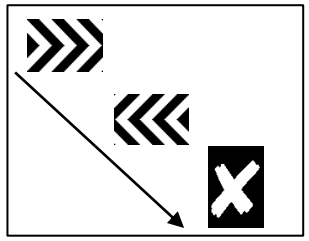
Proof-of-concept RCT in 61 patients
(10 Hz DLPFC, 10 Hz pre-SMA, vertex)

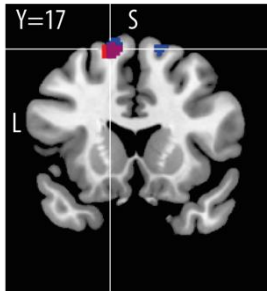
TETRO | TMS for Exposure Therapy-Resistant OCD

Multi-center cost-effectiveness RCT in 250 patients
(1 Hz pre-SMA, sham)

VIDI project 2018-2023 van den Heuvel

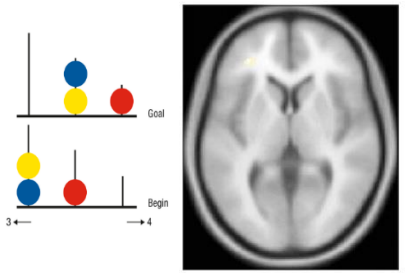
VeZo grant Zorginstituut NL





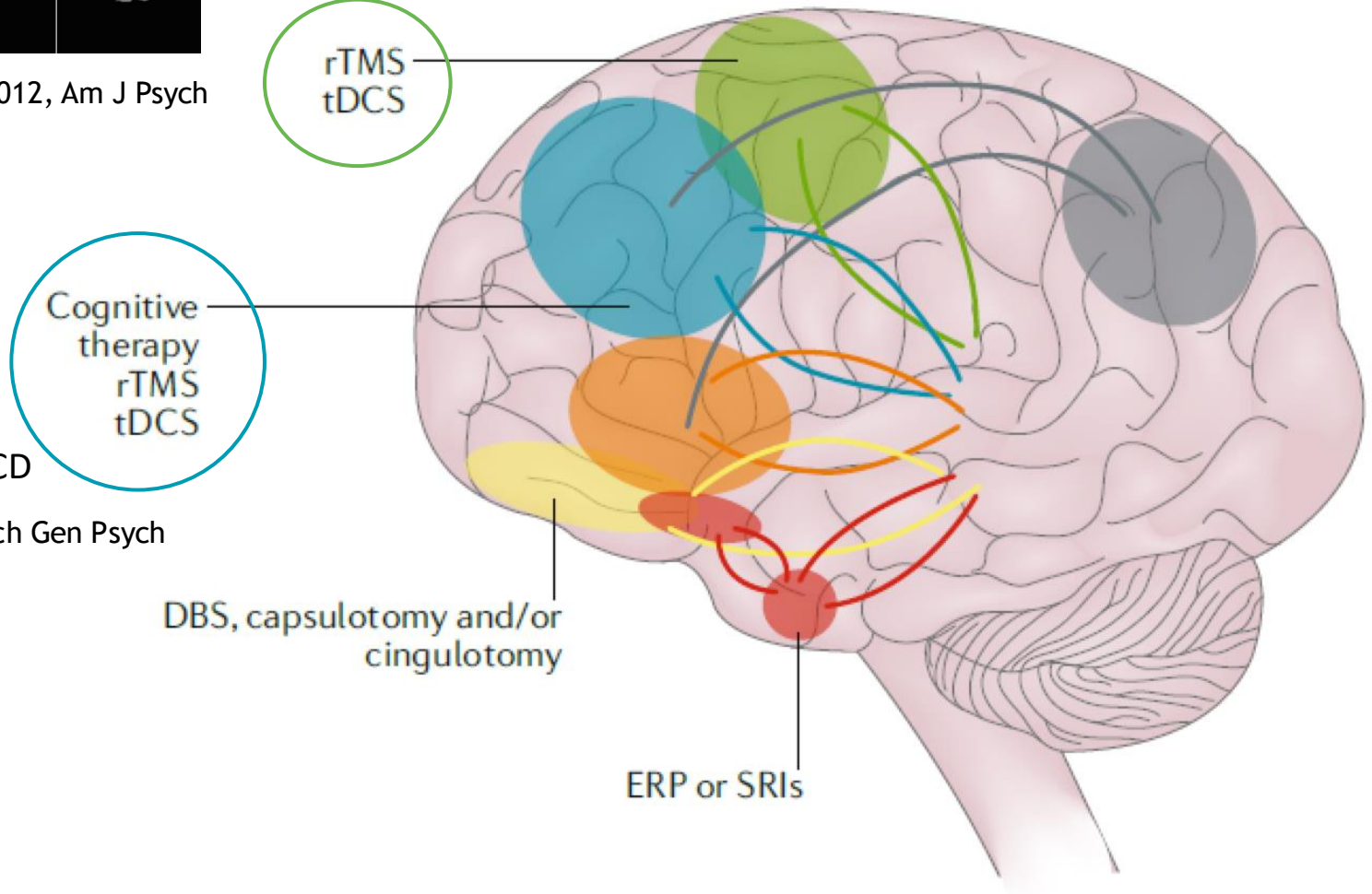
↑ preSMA activity (compensatory) in OCD & siblings

de Wit et al 2012, Am J Psych



↓DLPFC activation in OCD

Van den Heuvel et al 2005, Arch Gen Psych

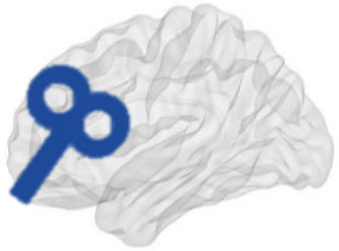


Stein et al. 2019; van den Heuvel et al. 2005; de Wit et al. 2012

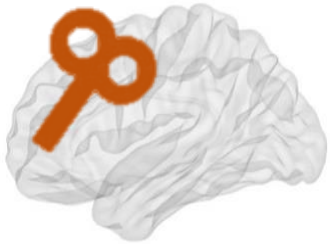
TIPICCO | TMS-induced plasticity improving cognitive control in OCD

Sophie Fitzsimmons

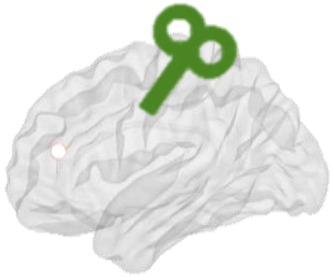
- 3-arm single-blind RCT
- clinicaltrials.gov (NCT03667807)
- 3 treatment protocols:



10 Hz rTMS L DLPFC
100% RMT
N=19



10 Hz rTMS pre-SMA
100% RMT
N=23



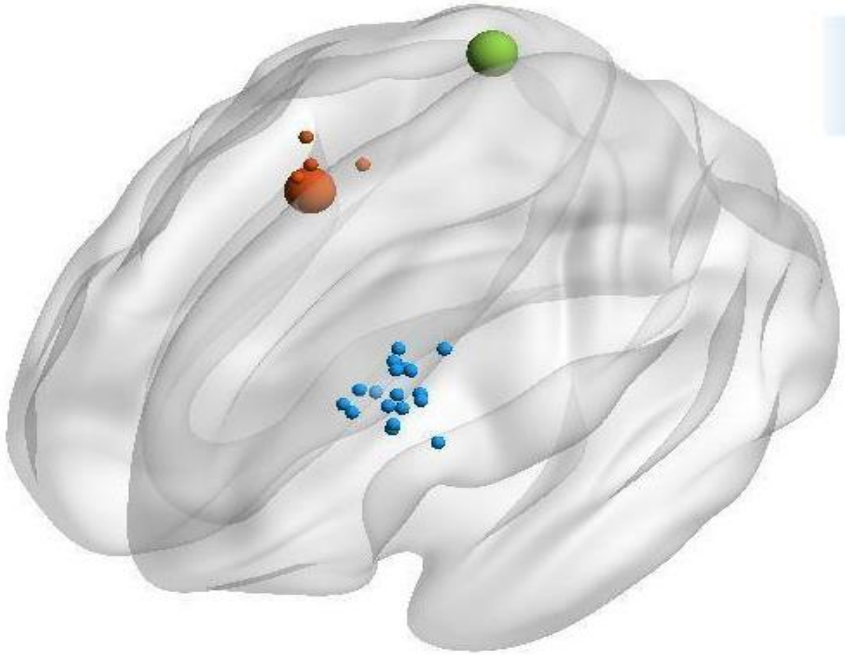
10 Hz rTMS vertex
60% RMT
N=19
('control' condition)

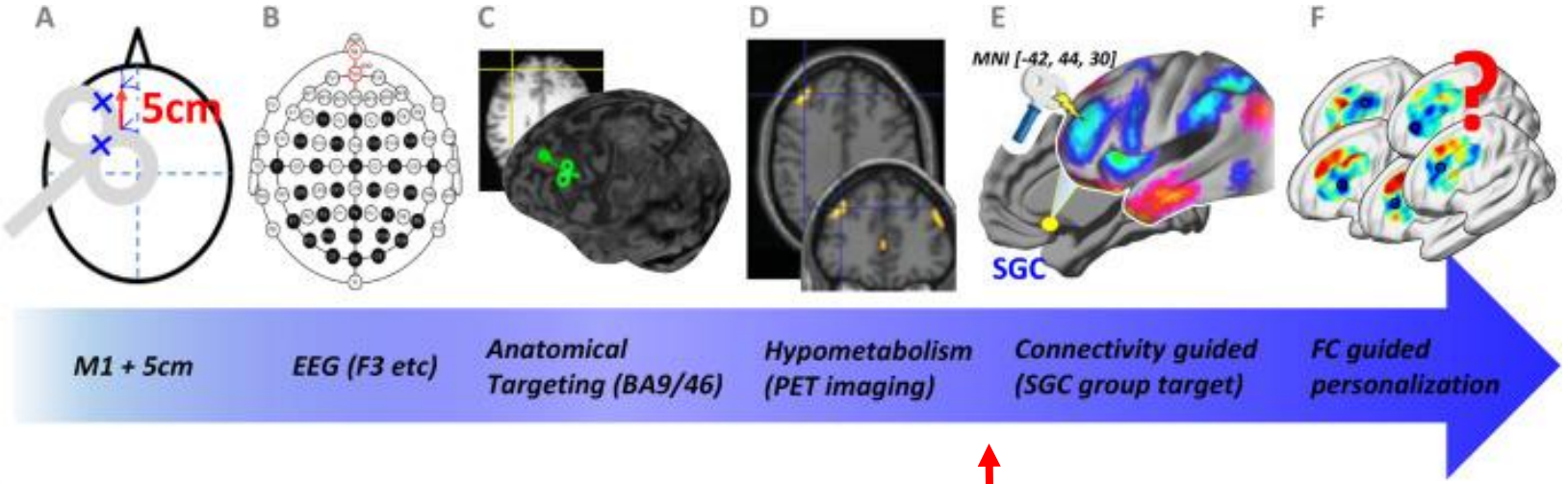
- Treatment:
  - 8 wk (2x/week)
  - 16 x 20-min rTMS + 45 min exposure & response prevention
  - Neuronavigation based on individual functional MRI at baseline

(3000 pulses at 100% RMT, 30 10-s trains, 30s intertrial interval, 20 mins total – based on de Wit et al 2015)

NWO
Netherlands Organisation for Scientific Research

Inter-individual variation
using personalized task-based fMRI informed neuronavigation



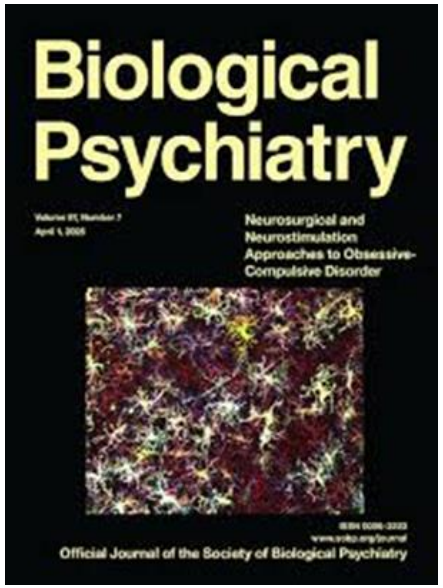


Task-fMRI-based targeting:

Tower of London task (for DLPFC target)
Stop Signal task (for pre-SMA target)

vertex (coordinate 0, -34, 72)

Fitzsimmons et al, *Biological Psychiatry* (2025)



Biological Psychiatry

Archival Report

Transcranial Magnetic Stimulation–Induced Plasticity Improving Cognitive Control in Obsessive-Compulsive Disorder, Part I: Clinical and Neuroimaging Outcomes From a Randomized Trial

Sophie M.D.D. Fitzsimmons, Tjardo S. Postma, A. Dilene van Campen, Chris Vriend, Neeltje M. Batelaan, Patricia van Oppen, Adriaan W. Hoogendoorn, Ysbrand D. van der Werf, and Odile A. van den Heuvel

ABSTRACT

BACKGROUND: Repetitive transcranial magnetic stimulation (rTMS) is an emerging treatment for obsessive-compulsive disorder (OCD). The neurobiological mechanisms of rTMS in OCD have been incompletely characterized. We compared clinical outcomes and changes in task-based brain activation following 3 different rTMS protocols, all combined with exposure and response prevention.

METHODS: In this 3-arm proof-of-concept randomized trial, 61 treatment-refractory adult patients with OCD received 16 sessions of rTMS immediately before exposure and response prevention over 8 weeks, with task-based functional magnetic resonance imaging scans and clinical assessments before and after treatment. Patients receive frequency rTMS to the left dorsolateral prefrontal cortex (n = 19 [13 women/6 men]), high-frequency rTMS left presupplementary motor area (preSMA) (n = 23 [13 women/10 men]), or control rTMS to the vertex (n = women/6 men]). Changes in task-based functional magnetic resonance imaging activation before/after tr were compared using both a Bayesian region of interest and a general linear model whole-brain approach.

RESULTS: Mean OCD symptom severity decreased significantly in all treatment groups ($\Delta = -10.836$, $p < .0$ CI −12.504 to −9.168), with no differences between groups. Response rate in the entire sample was 57.4%. Th lateral prefrontal cortex rTMS group showed decreased planning-related activation after treatment that was as with greater symptom improvement. No group-level activation changes were observed for the preSMA an rTMS groups. Participants in the preSMA group with greater symptom improvement showed decreased erro activation, and symptom improvement in the vertex group was associated with increased inhibition-related activa

CONCLUSIONS: rTMS to preSMA and dorsolateral prefrontal cortex combined with exposure and respon vention led to activation decreases in targeted task networks in individuals showing greater symptom impro although we observed no differences in symptom reduction between groups.

https://doi.org/10.1016/j.biopsych.2024.06.029

Biological Psychiatry

Archival Report

Transcranial Magnetic Stimulation–Induced Plasticity Improving Cognitive Control in Obsessive-Compulsive Disorder, Part II: Task-Based Neural Predictors of Treatment Response

Tjardo S. Postma, Sophie M.D.D. Fitzsimmons, Chris Vriend, Neeltje M. Batelaan, Ysbrand D. van der Werf, and Odile A. van den Heuvel

ABSTRACT

BACKGROUND: Repetitive transcranial magnetic stimulation (rTMS) has the potential to increase the clinical effect of exposure with response prevention psychotherapy for obsessive-compulsive disorder (OCD). We investigated the use of task-based functional magnetic resonance imaging for predicting clinical outcomes to different rTMS protocols combined with exposure with response prevention in OCD.

METHODS: Sixty-one adults with OCD underwent rTMS and exposure with response prevention and were randomized to different high-frequency rTMS conditions: left dorsolateral prefrontal cortex (n = 19), left presupplementary motor area (n = 23), and control stimulation at the vertex at low intensity (n = 19). The Tower of London task and stop signal task were used to assess pretreatment activation during planning and inhibitory

Biological Psychiatry: CNNI

Archival Report

Increased Amygdala Activation During Symptom Provocation Predicts Response to Combined Repetitive Transcranial Magnetic Stimulation and Exposure Therapy in Obsessive-Compulsive Disorder in a Randomized Controlled Trial

Milan Houben, Tjardo S. Postma, Sophie M.D.D. Fitzsimmons, Chris Vriend, Neeltje M. Batelaan, Adriaan W. Hoogendoorn, Ysbrand D. van der Werf, and Odile A. van den Heuvel

ABSTRACT

BACKGROUND: Repetitive transcranial magnetic stimulation (rTMS) combined with exposure and response prevention is a promising treatment modality for treatment-refractory obsessive-compulsive disorder (OCD). However, not all patients respond sufficiently to this treatment. We investigated whether brain activation during a symptom provocation task could predict treatment response.

METHODS: Sixty-one adults with OCD (39 female/22 male) underwent symptom provocation with OCD- and fear-related visual stimuli during functional magnetic resonance imaging prior to an 8-week combined rTMS and exposure and response prevention treatment regimen. Participants received one of the following 3 rTMS treatments as part of a randomized controlled trial: 1) 10-Hz rTMS (110% resting motor threshold) to the left dorsolateral prefrontal cortex, 2) 10-Hz rTMS (110% resting motor threshold) to the left presupplementary motor area, or 3) 10-Hz control rTMS (60% resting motor threshold) to the vertex. Multiple regression and correlation were used to examine the predictive value of task-related brain activation for treatment response in the following regions of interest: the dorsomedial prefrontal cortex, amygdala, dorsolateral prefrontal cortex, and left presupplementary motor area.

RESULTS: The different treatment groups responded equally to treatment. Higher pretreatment task-related activation of the right amygdala to OCD-related stimuli showed a positive association with treatment response in all groups. Exploratory whole-brain analyses showed positive associations between activation in multiple task-relevant regions and treatment response. Only dorsal anterior cingulate cortex activation to fear-related stimuli showed a negative association with treatment outcome.

CONCLUSIONS: Higher pretreatment right amygdala activation during symptom provocation predicts better treatment response to combined rTMS and exposure and response prevention in OCD.

https://doi.org/10.1016/j.bpsc.2024.10.020

Commentary

When, How, and Where: Combining Psychotherapy and Neuromodulation for Obsessive-Compulsive Disorder

Sarah Ann Smith and Katharine Dunlop

Despite being among the 10 most personally debilitating disorders and the fourth most common psychiatric disorder, obsessive-compulsive disorder (OCD) remains difficult to treat. Pharmaco- and psychotherapy, including exposure and response prevention (ERP) therapy, are first-line interventions to treat OCD, and yet only 50% of patients with OCD achieve a clinically meaningful improvement in symptoms after monotherapy or combination therapy (1). Repetitive transcranial magnetic stimulation (rTMS)—as either monotherapy or an adjunctive agent to psychotherapy or medication—potentially offers an effective alternative for patients who do not respond adequately to first-line treatments. However, investigations into rTMS for OCD differ substantially in treatment design, including stimulation site and individual targeting approaches, as well as how and when to combine this intervention with psychotherapy.

The companion articles by Fitzsimmons *et al.* (2) and Postma *et al.* (3) in the current issue of *Biological Psychiatry* provide valuable mechanistic and clinical insights into two potential rTMS stimulation sites in combination with ERP therapy. Patients enrolled in the study received 16 sessions of neuronavigated 10-Hz rTMS immediately before a session of ERP. rTMS was randomized to two candidate stimulation sites with documented treatment efficacy in OCD, the left dorsolateral prefrontal cortex (DLPFC) or presupplementary motor area (preSMA), or a control site, the vertex. Functional magnetic resonance imaging (fMRI) was acquired in all participants before and after treatment, which included tasks designed to engage circuits recruiting stimulation sites of interest, including during the Tower of London (TOL) task and the stop signal task (SST). Crucially, baseline neural activity during these tasks was used to identify participant-specific DLPFC or preSMA targets, once daily sessions. It could be that active rTMS on non-ERP days or multiple rTMS sessions per day—perhaps before and after ERP—could clarify whether additional rTMS sessions are required to evaluate this combination therapy. Similarly, participants received rTMS and ERP at each session, and it is unclear whether having participants initiate rTMS or ERP simultaneously, staggered, or sequentially could bolster clinical efficacy. One possible option could include an initial accelerated rTMS course to initiate neuronal plasticity or metaplasticity (2), followed by integrated rTMS-ERP sessions to further modulate this effect. Future studies will be required to clarify when and how many rTMS and ERP sessions are necessary to maximize the clinical benefit in OCD.

Another outstanding area of investigation is targeting approaches to individualize rTMS for patients diagnosed with OCD. Innovatively, patients enrolled in these studies received personalized rTMS over the preSMA or DLPFC, and targeting was performed using task-based fMRI. This task-based approach could address potential limitations of using resting-state fMRI to guide stimulation. More specifically, resting-state connectivity-based rTMS targeting in major depressive disorder has conflicting evidence on whether it improves clinical efficacy over scalp heuristics (4), and this modality may be sensitive to modeling choices (5). Task-based fMRI may address some of these hurdles as it tends to better explain interindividual differences in behavior and psychopathology over resting-state fMRI (6). However, while every participant randomized to the DLPFC rTMS arm received an individualized stimulation target using the TOL task, 74% of those randomized to the preSMA rTMS arm did not have an identifiable preSMA hotspot during the SST and were stimulated over a literature-derived target.

Fitzsimmons et al, *Biol Psychiatry* (2025)

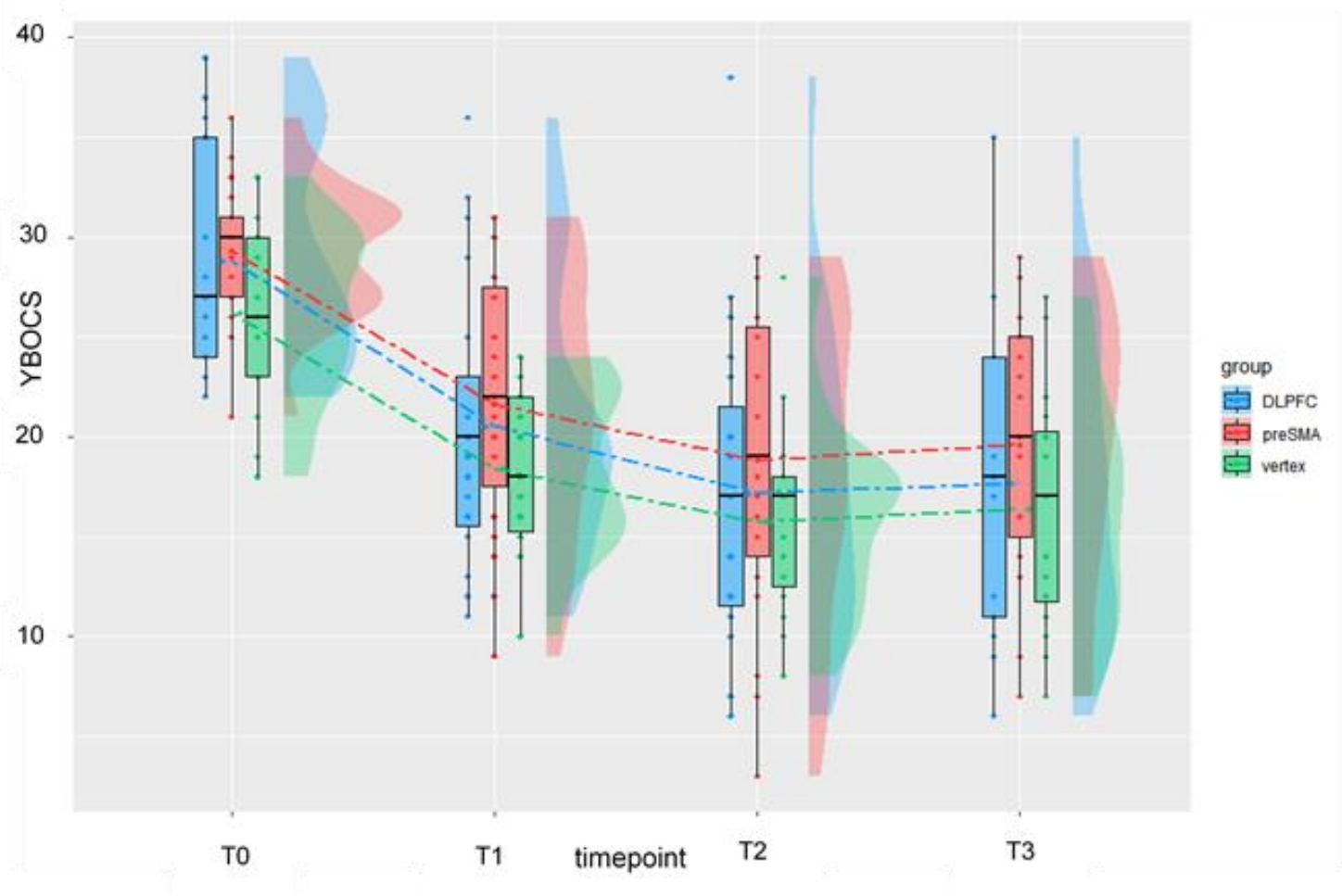
Postma et al, *Biol Psychiatry* (2025)

Houben et al, *Biol Psych CNNI* (2025)

Results

TIPICCO | TMS-induced plasticity improving cognitive control in OCD

symptom change (YBOCS) over time

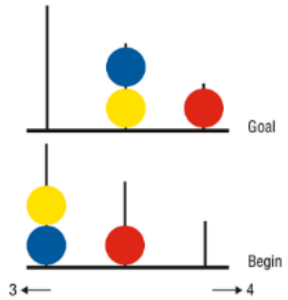


- Significant reduction in OCD symptoms over time ($p<0.001$) in this treatment-resistant sample
- 57,4% response (>35% reduction on YBOCS)
- No difference between groups

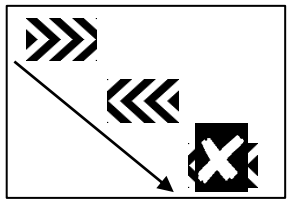
Fitzsimmons et al, *Biological Psychiatry* (2025)

Results

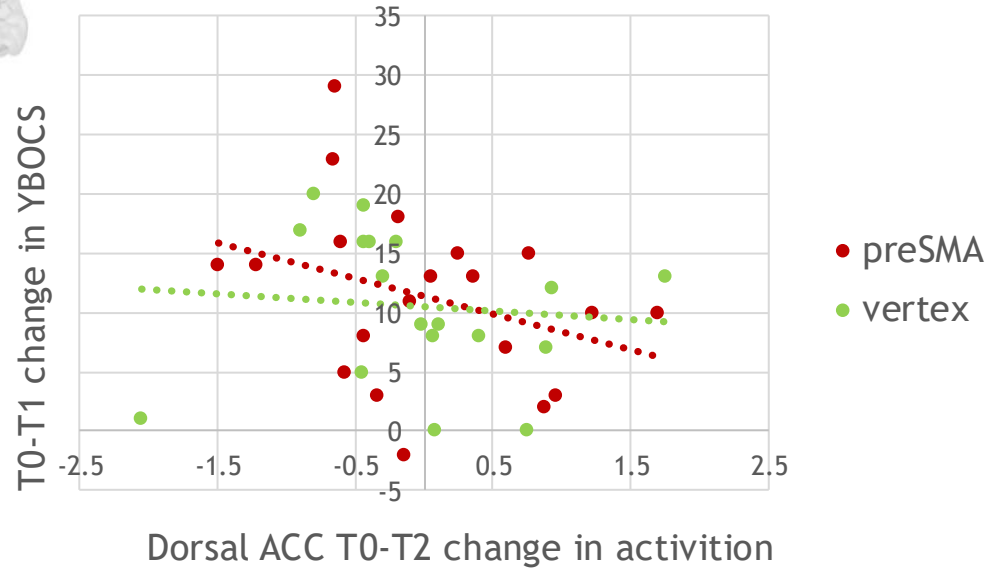
pre-post rTMS - fMRI during tasks



>> After DLPFC rTMS: more reduction in planning-related activity after rTMS associated with better clinical response



>> After pre-SMA rTMS:
Reduction in error-related activity is associated with better clinical response

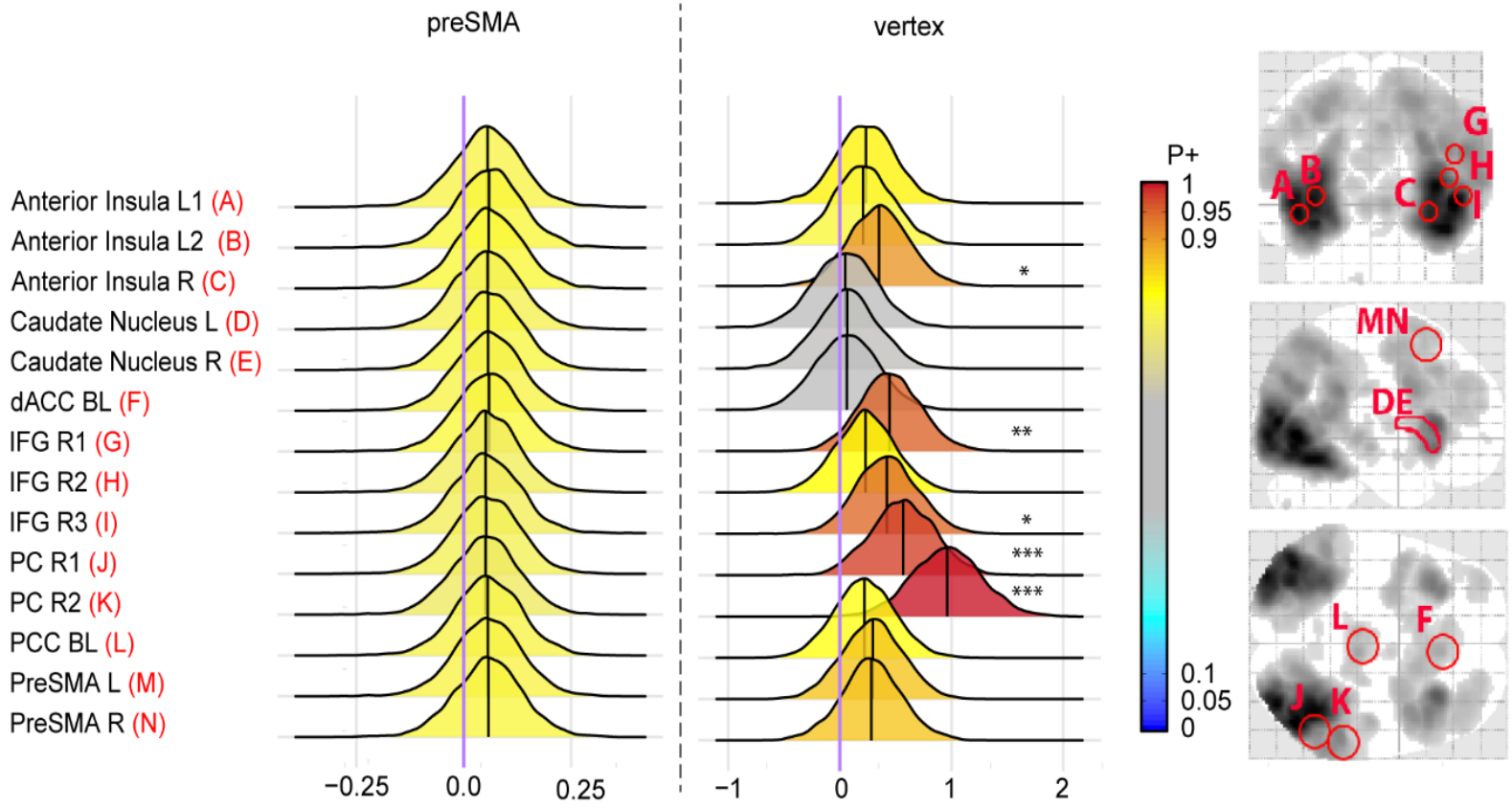


Fitzsimmons et al, *Biological Psychiatry* (2025)

Results

pre-post rTMS - fMRI during inhibition

>> After vertex rTMS: Increase in inhibition-related activation (in IFG and parietal cortex) is associated with better clinical response



Bayesian ROI-based analysis, Chen et al 2021

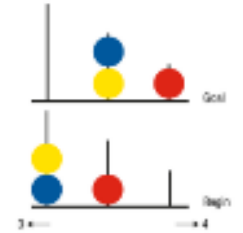
Fitzsimmons et al, *Biological Psychiatry* (2025)

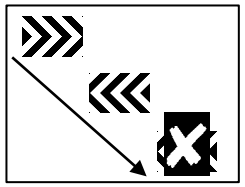
Prediction

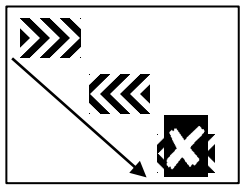
rTMS response, based on baseline fMRI - **during planning and inhibitory control**

Tjardo Postma

>> more planning- and inhibition related activity pre-treatment predicts better treatment response (driven by effects in the vertex rTMS condition)







- During **planning**
  - ↑ activation = ↑ response to vertex rTMS + ERP
- During **response inhibition**
  - ↑ activation = ↑ response to vertex rTMS + ERP
- During **error processing**
  - ↓ activation = ↑ response to vertex rTMS + ERP
  - ↑ activation = ↑ response to preSMA rTMS + ERP

Postma et al, *Biological Psychiatry* (2025)

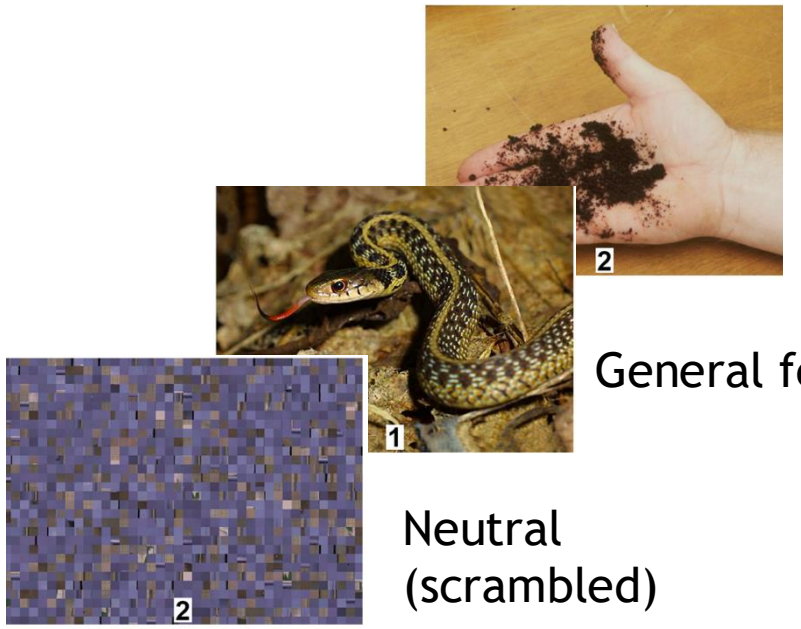
Prediction

rTMS response predicted by baseline fMRI **during symptom provocation**

Milan Houben

>> right amygdala activation during symptom provocation at baseline predicts better treatment response (in all groups)

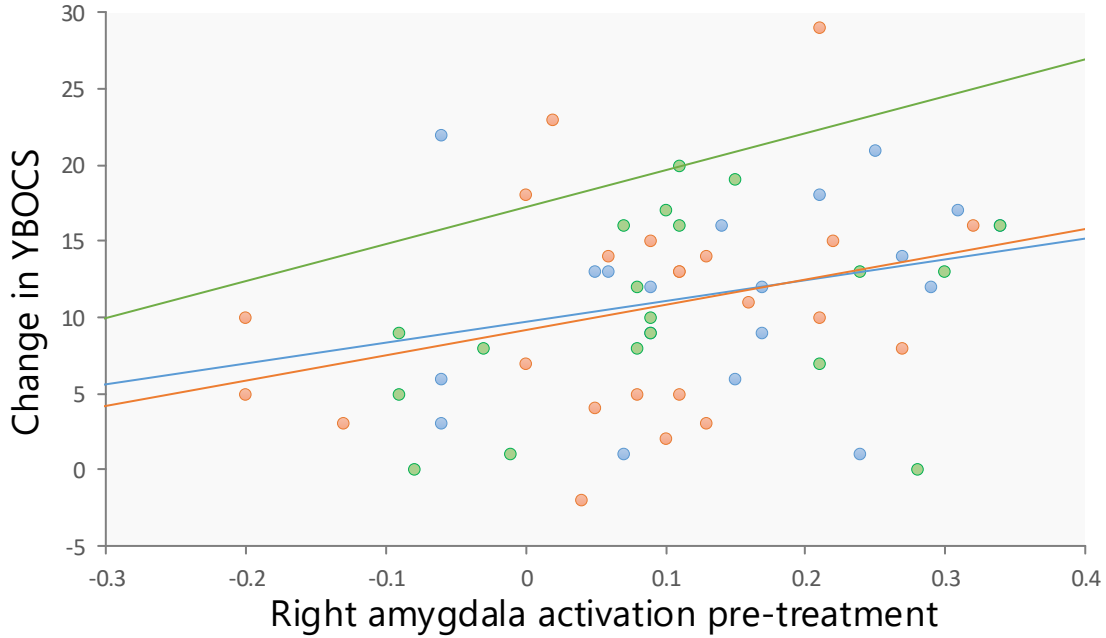
Variable	B	SE B	p
Left dmPFC	19.71	14.84	0.19
Right dmPFC	-12.78	11.71	0.28
Left amygdala	-5.86	7.83	0.46
Right amygdala	17.71	8.13	**0.03**



OCD specific

General fear

Neutral (scrambled)



Houben et al. *Biol Psych CNNI* (2025)

Summary TIPICCO trial

TIPICCO | TMS-induced plasticity improving cognitive control in OCD

- rTMS target specific effects on the brain (during executive and inhibitory control)

  (Fitzsimmons et al. 2025 Biol Psych)

- Variation in treatment response explained by pre-treatment task-fMRI-based activations
  - During **executive and inhibitory control** (Postma et al. 2025 Biol Psych)
  - During **symptom provocation** (Houben et al. 2025 Biol Psych CNNI)

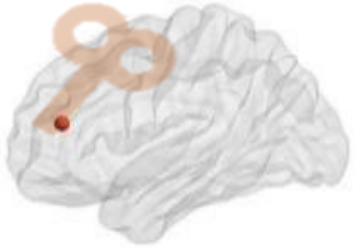
- Variation in treatment response explained by pre-treatment resting state fMRI connectivity between stimulated target and normative network (Coomans et al, under review)

- rTMS-induced E-fields show that we probably under-dosed, mostly at deeper targets such as pre-SMA (Woerdman et al, under review)

https://www.tetro-ocd.nl

TETRO

TMS for Exposure Therapy-Resistant OCD



1500 pulses of 1 Hz rTMS
L pre-SMA N=150
N=167

1500 pulses of 1 Hz sham-rTMS
L pre-SMA N=75
N=83

Tjardo Postma

Placebo-controlled multi-center RCT
250 OCD patients with insufficient response to ERP (with/without medication)
Focus on the added value of 1 Hz pre-SMA rTMS versus sham as adjuvant to intensive ERP
4 sessions/week, for 5-7 weeks
Every rTMS session followed by 90 minutes guided ERP

Zorginstituut Nederland

VeZo grant Zorginstituut NL
(PI: van den Heuvel)
Study period: 2021-2027

Amsterdam UMC
Universitair Medische Centra

GGZ inGeest

Radboudumc

Pro Persona
geestelijke gezondheidszorg

Maastricht UMC+

Mondriaan
voor geestelijke gezondheid

neurocare

adf
stichting

TETRO

TMS for Exposure Therapy-Resistant OCD

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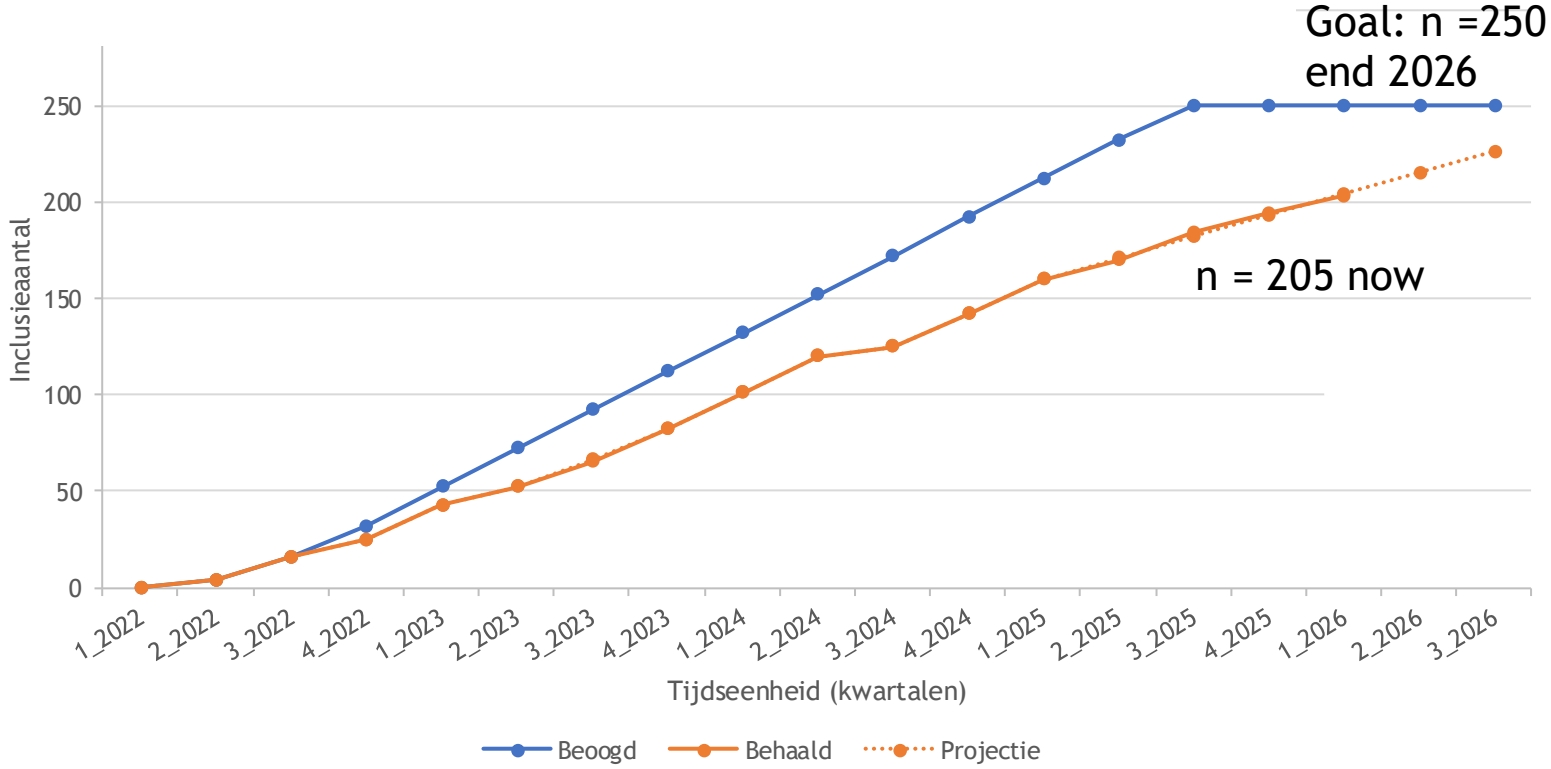

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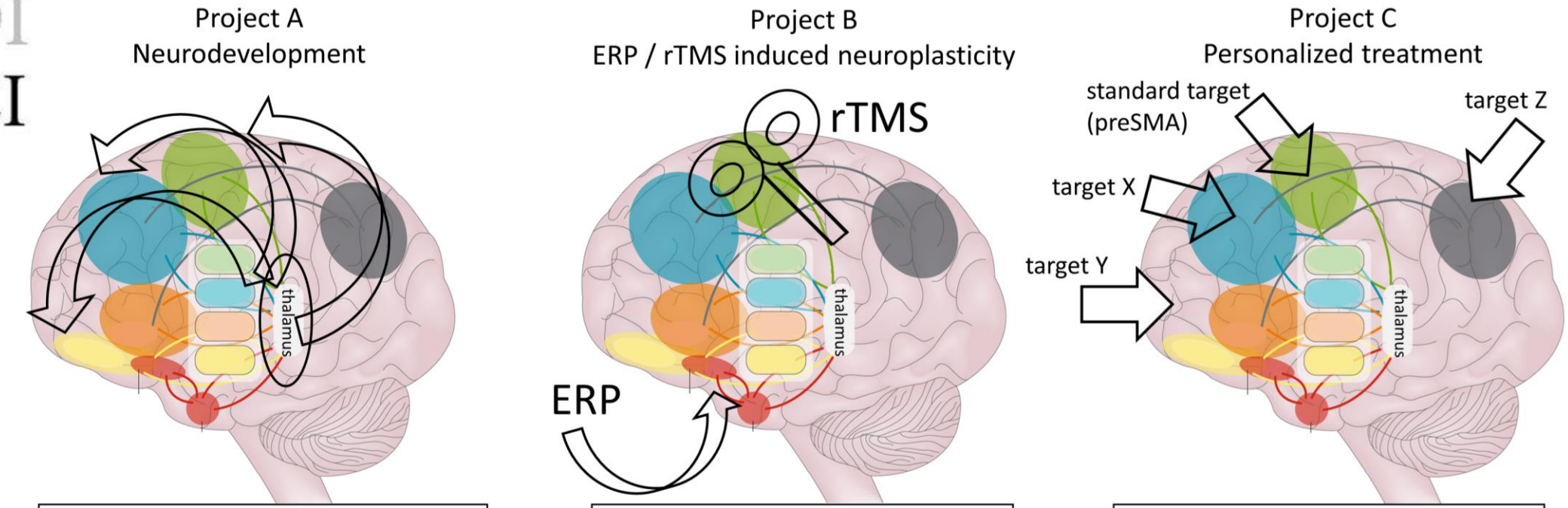
neurocare

adf stichting

VENI
VIDI
VICI



A1: thalamus-driven cortical maturation (longitudinal cohort approach)

A2: cortical maturation & glutamate function (at ultra-high resolution)

B1: treatment-induced change in
- neural circuit function/structure
- BDNF pathway

B2: prediction of response & relapse

C1: multi-modal MRI-based individualized precise coil positioning

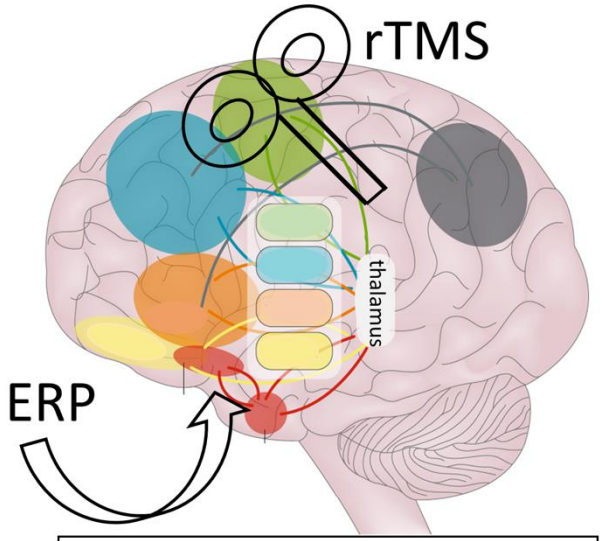
C2: biotype-informed rTMS target selection

MRI-input for prospective targeting

treatment targets for young adults

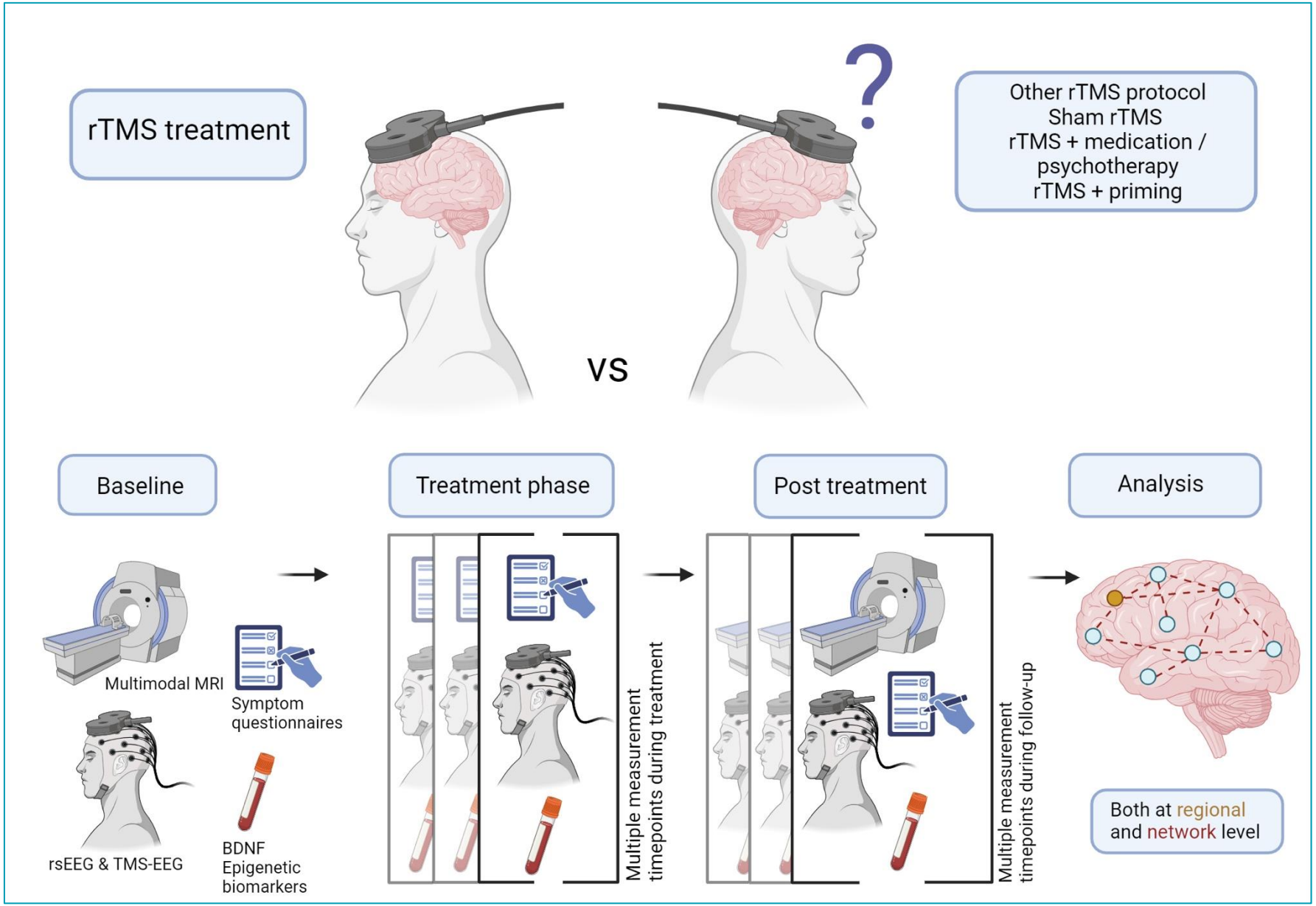
ERP = exposure with response prevention, rTMS = repetitive transcranial magnetic stimulation, preSMA = pre-supplementary motor area, BDNF = blood-derived neurotrophic factor

Project B
ERP / rTMS induced neuroplasticity



B1: treatment-induced change in
- neural circuit function/structure
- BDNF pathway

B2: prediction of response & relapse

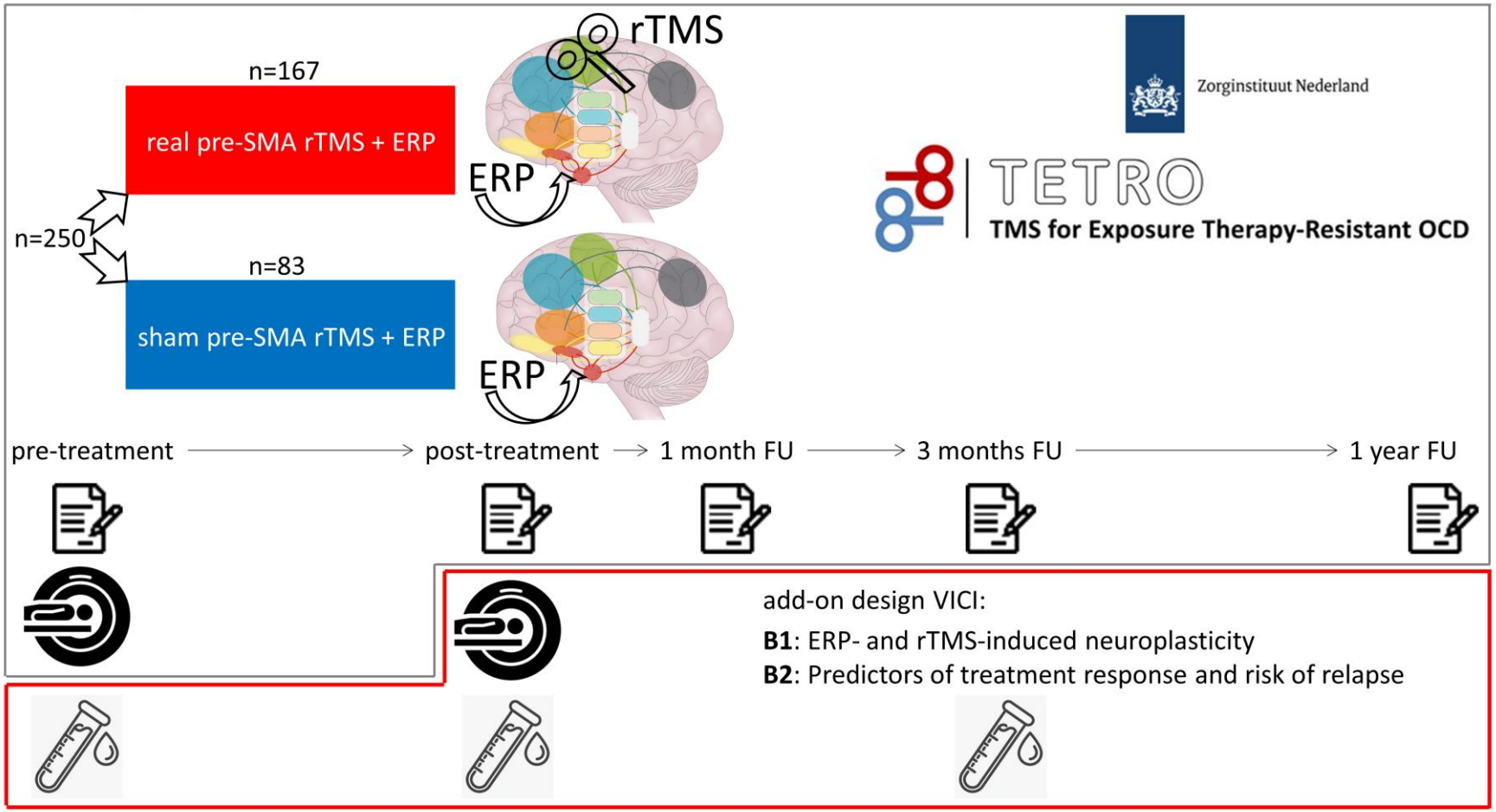


Fitzsimmons et al. *Biological Psychiatry* (2024)

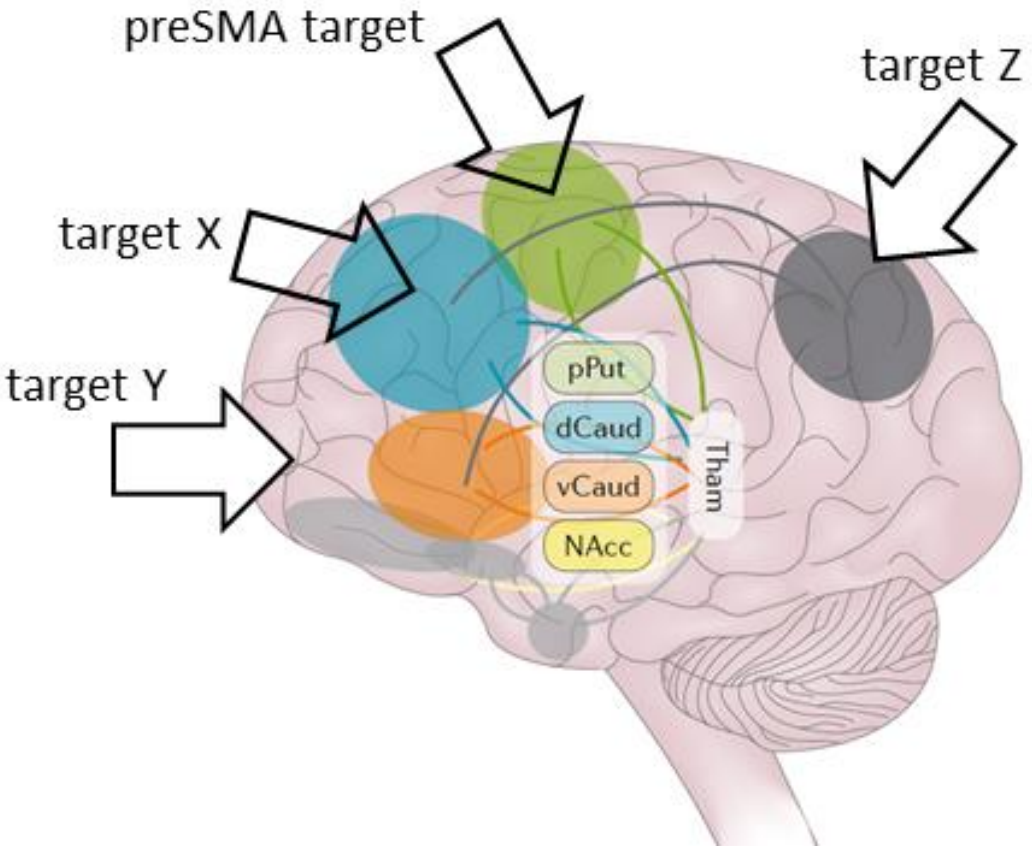
VENI
VIDI
VICI

Treatment-induced plasticity

Wianne Schipper



Personalized targeting



What is best target?

And how to best position the coil?

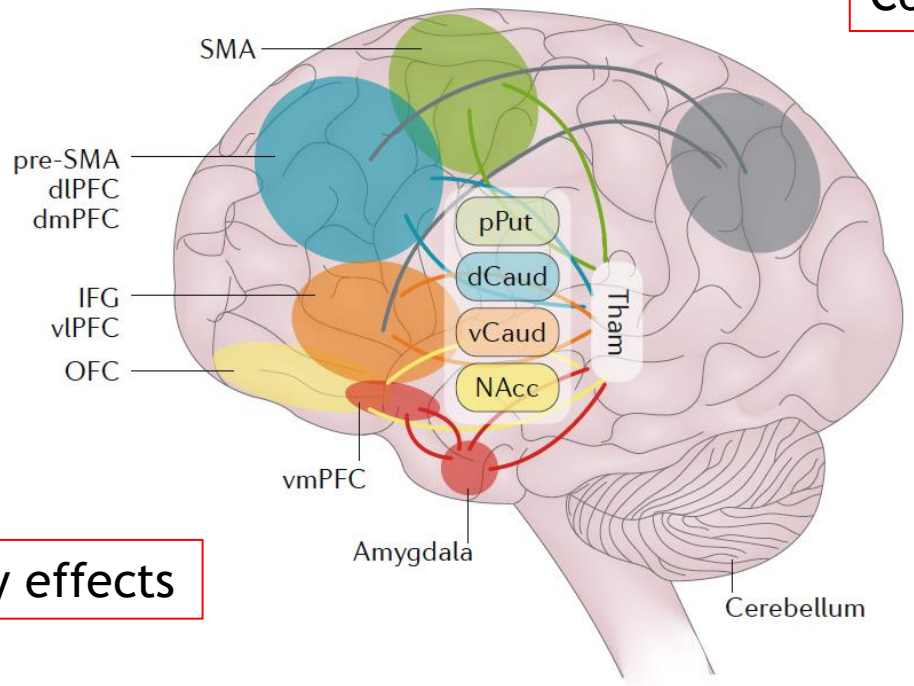
oa.vandenheuvel@amsterdamumc.nl

‘The’ OCD brain doesn’t exist

Neurodevelopmental effects

Medication effects

Compensatory effects



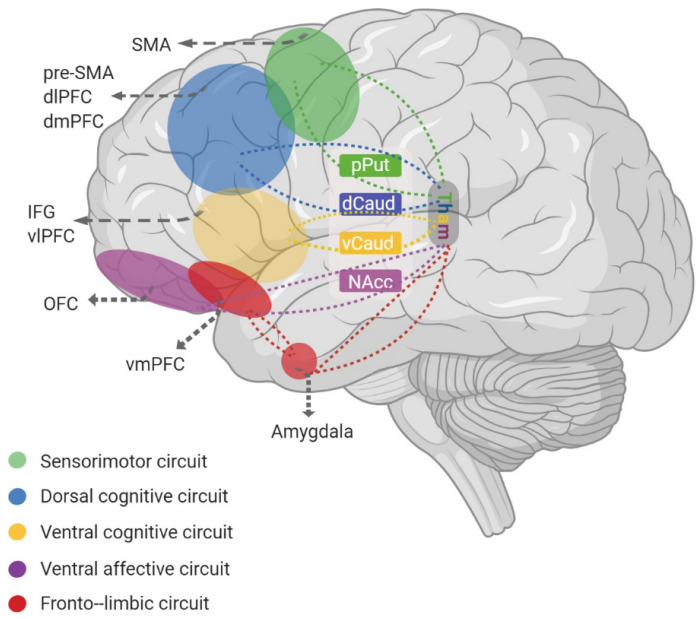
- ‘Sensorimotor’ CSTC circuit
  - Stimulus-response-based habitual behavior
- ‘Dorsal cognitive’ CSTC circuit
  - Working memory, planning, emotion regulation
- Frontoparietal network
  - Coordination of cognitive control
- ‘Ventral cognitive’ CSTC circuit
  - Response inhibition
- ‘Ventral motivational’ CSTC circuit
  - Stimulus-outcome-based motivational behaviour
- ‘Frontolimbic’ circuit
  - Fear extinction

Onset and chronicity effects

Symptom profile dependent

Stein et al. *Nature Reviews Disease Primers* (2019)

Biotype-based targeting > n-of-1 designs!



1

Fronto-limbic circuit
Clinical profiles:
Dysregulated fear
Intolerance of uncertainty

Treatment approach:
Reduce fronto-limbic hyperactivity
Increase dorsal cognitive top-down control

Potential treatment methods:
CBT / SSRIs
Amygdala/vmPFC fMRI-neurofeedback
dlPFC rTMS
ALIC deep brain stimulation

2

Sensorimotor circuit
Clinical profiles:
Sensory phenomena
Excessive habit-formation

Treatment approach
Reduce sensorimotor circuit overactivity
Regulate insula activity (sensory phenomena only)

Potential treatment methods:
Habit-reversal training
SMA rTMS
H-coil insula rTMS
Ondansetron

3

Ventral cognitive circuit
Clinical profiles:
Impaired response inhibition

Treatment approach:
Increase ventral cognitive circuit hypoactivity

Potential treatment methods:
IFG fMRI-neurofeedback
STN/VS deep brain stimulation

4

Ventral affective circuit
Clinical profiles:
Altered reward responsiveness

Treatment approach:
Restore reward mechanisms

Potential treatment methods:
SSRIs
Dopamine-acting medication (e.g. methylphenidate)
NAcc fMRI-neurofeedback
NAcc deep brain stimulation

5

Dorsal cognitive circuit
Clinical profiles:
Executive dysfunction

Treatment approach:
Increase hypoactive dorsal cognitive circuit function

Potential treatment methods:
CBT
Methylphenidate
dlPFC and pre-SMA rTMS/tDCS

Shephard et al. *Molecular Psychiatry* (2021)

MEGA-OCD consortium



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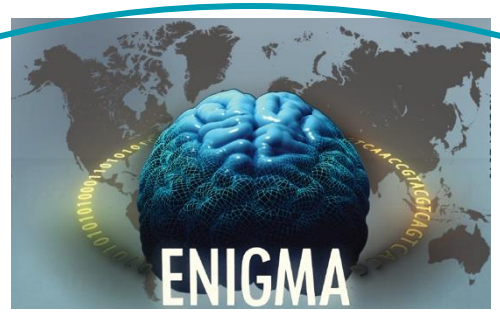
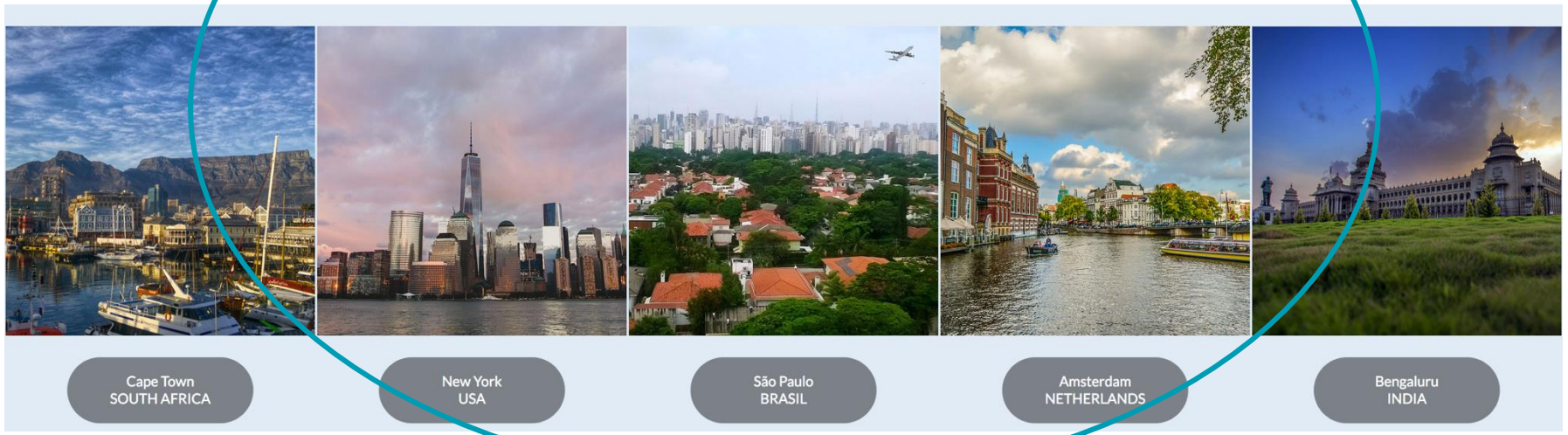




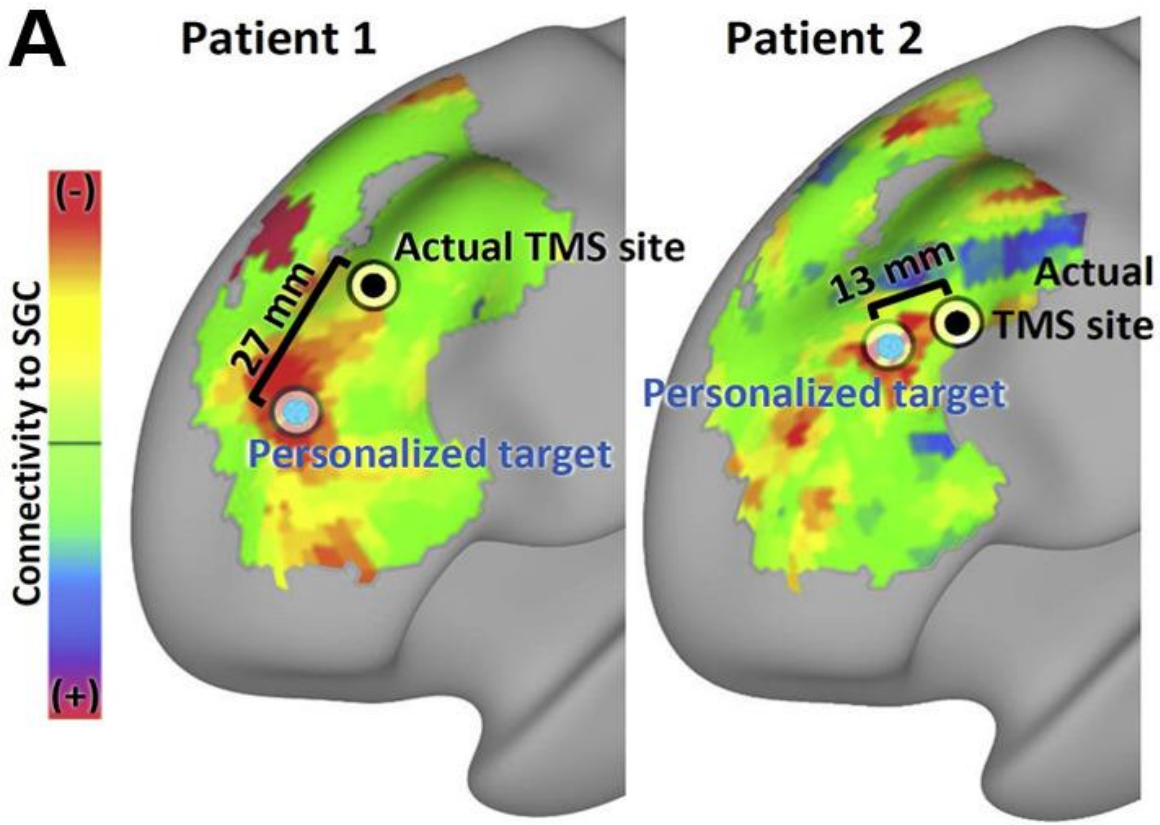
- Multi-modal MRI-based biotypes of OCD

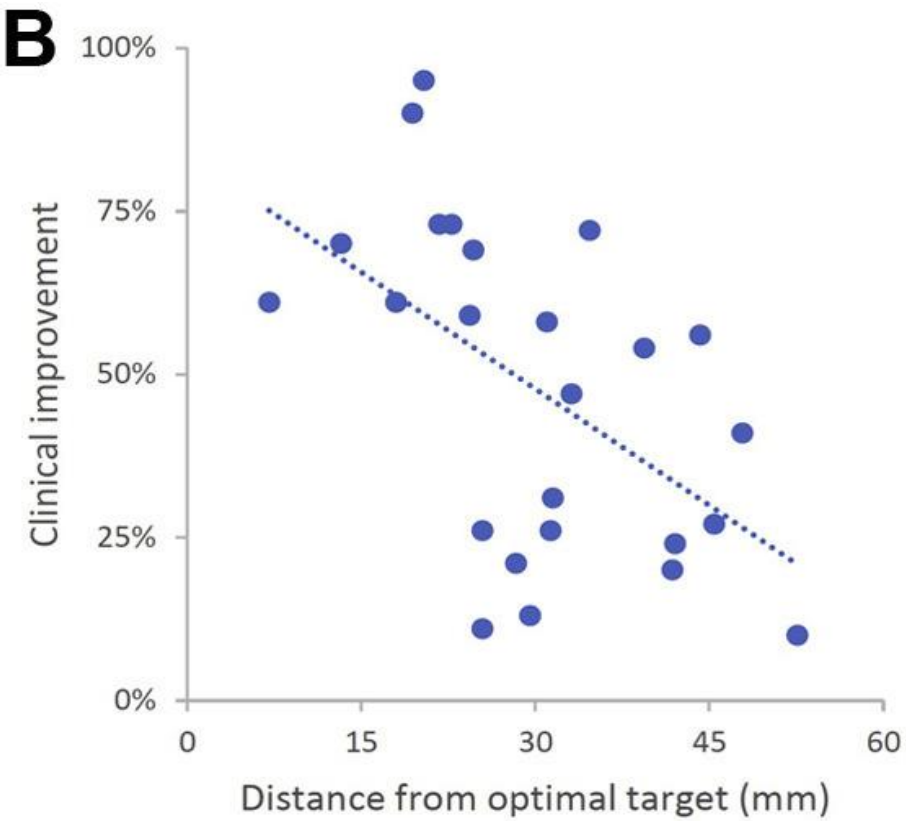
↓

input for VICI grant

Personalized coil positioning

but… which anti-correlations for OCD (instead of sgACC) most relevant? amygdala? STN?





Cash et al. *Biological Psychiatry* (2021)

Take home message

- rTMS might potentiate the response to CBT / ERP
- Unclear yet what the cost-effectiveness is of current rTMS protocols
- Unclear yet what the optimal target is (and this might be biotype-dependent)
- Multiple potential options to deal with inter-individual variation in brain anatomy (but the methods warrant future prospective studies)
- Due to chronic disease vulnerability, risk of relapse remains

VENI (2008-2012)
VIDI (2018-2023)
VICI (2025-2030)

Amsterdam Neuroscience

Amsterdam UMC
Universitair Medische Centra

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Zorginstituut Nederland

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adf stichting

TETRO
TMS for Exposure Therapy-Resistant OCD

ENIGMA-OCD & Global OCD consortium

Paul Thompson
Dan Stein †
Blair Simpson



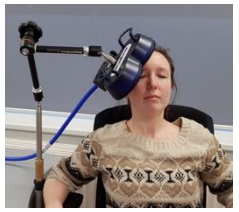
And all site-PI's and consortium members

International OCD Foundation

NIMH
National Institute of Mental Health

rTMS findings (VENI & VIDI project, analyses TIPICCO trial)


Stella de Wit

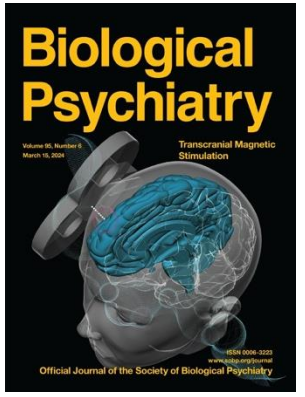

Sophie Fitzsimmons


Tjardo Postma


Milan Houben


Coen Coomans


Hidde Woerdman



ecnp Neuroscience applied

Neuromodulation
ECNP Network

Biological Psychiatry
Volume 95, Number 6, March 15, 2024
Special issue: TRANSCRANIAL MAGNETIC STIMULATION

Guest Editors:
Odile A. van den Heuvel and Lindsay M. Oberman