

PART II: EMPATHY AND SELF-OTHER DISTINCTION: INSIGHTS FROM FMRI & RTMS

Based on a study conducted by

**Bukowski^{1*}, H., Tik², M., Silani³, G., Ruff⁴, C., Windischberger², C., &
Lamm¹, C.**

¹Social, Cognitive and Affective Neuroscience Unit, Department of Basic Psychological Research and Research Methods, University of Vienna, Vienna, Austria

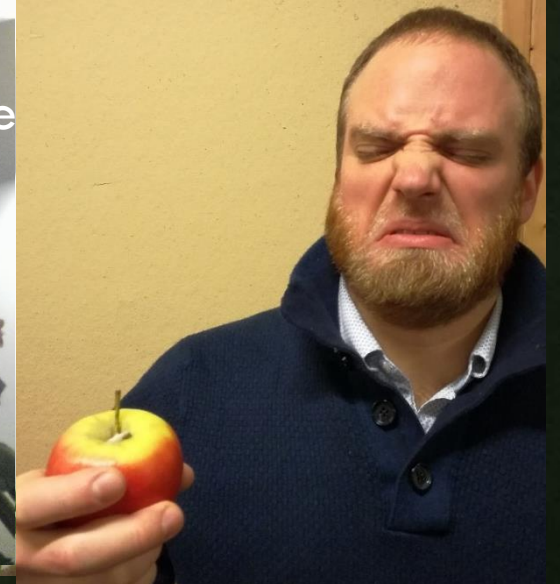
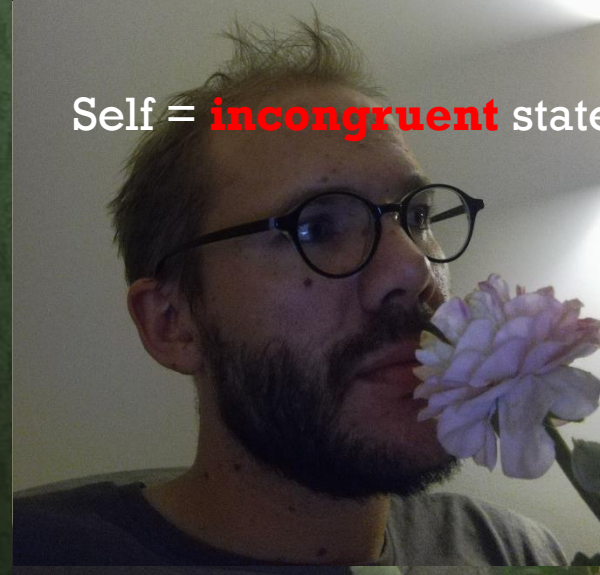
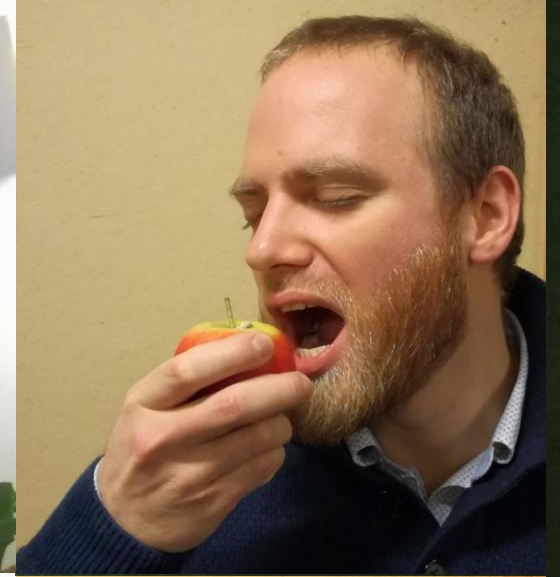
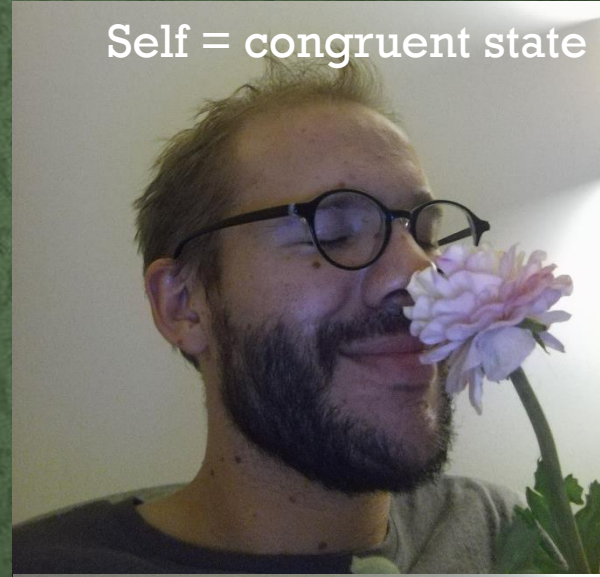
²MR Center of Excellence, Center for Medical Physics and Biomedical Engineering, Medical University of Vienna, Austria

³Department of Applied Psychology: Health, Development, Enhancement and Intervention, University of Vienna, Vienna, Austria

⁴Laboratory for Social and Neural Systems Research, Department of Economics, University of Zurich, Zurich, Switzerland

Are We “Emotional Sponges” ? ...3 Situations

Self = neutral state



Self = **incongruent** state

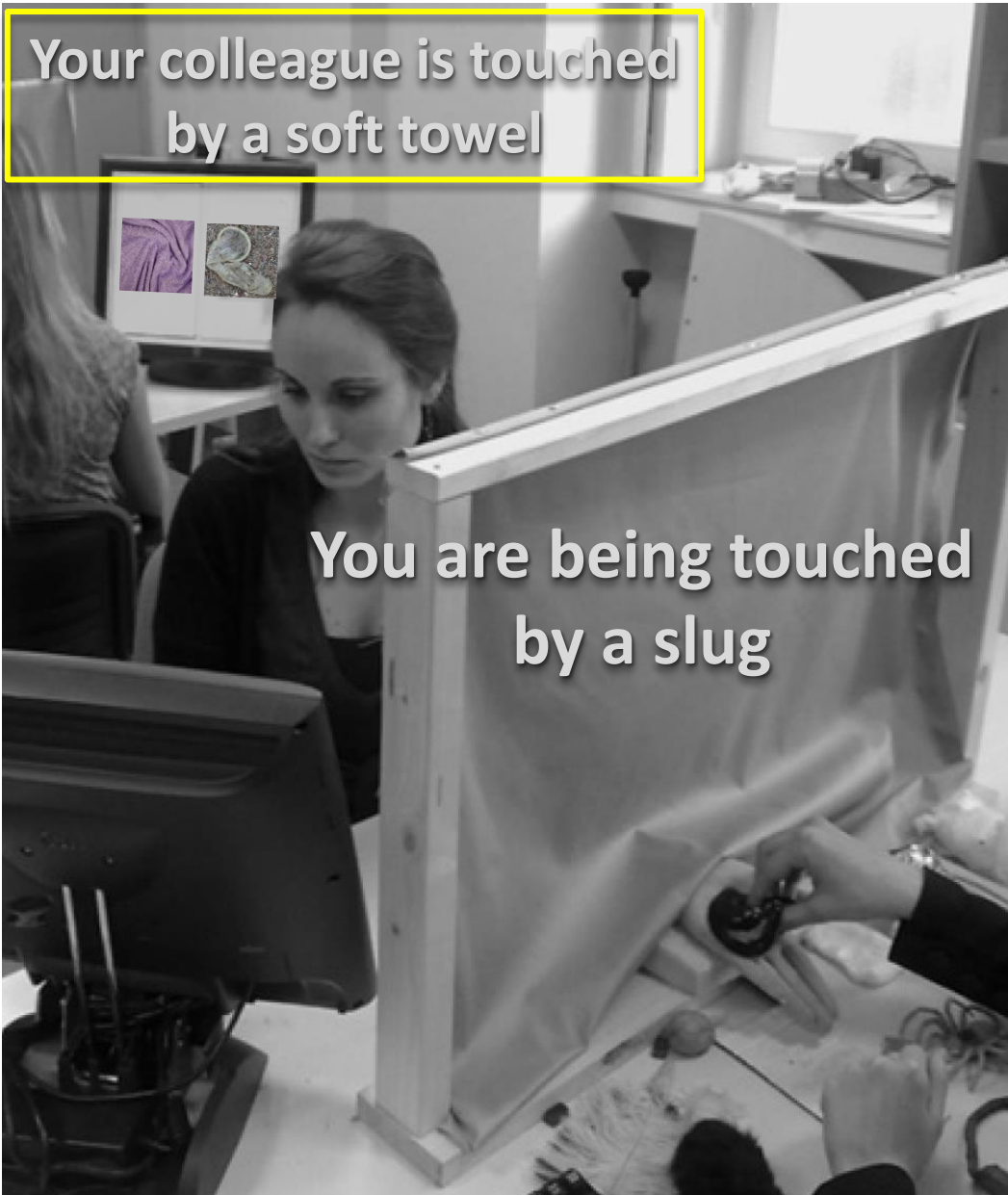
Self-other Distinction (SOD) in Empathy

- Affect sharing is a basic mechanism not suited for all situations
- SOD prevents us from being:
 - excessively influenced by our own emotional state when inferring the emotion of others → egocentric bias
 - excessively influenced by others' emotions when inferring our own emotional state
→ altercentric bias
- Mechanisms of SOD are largely unknown, namely due to the scarcity of SOD measures.
- **Goal:** Investigate with rTMS and fMRI the neurocognitive mechanism of SOD in own other

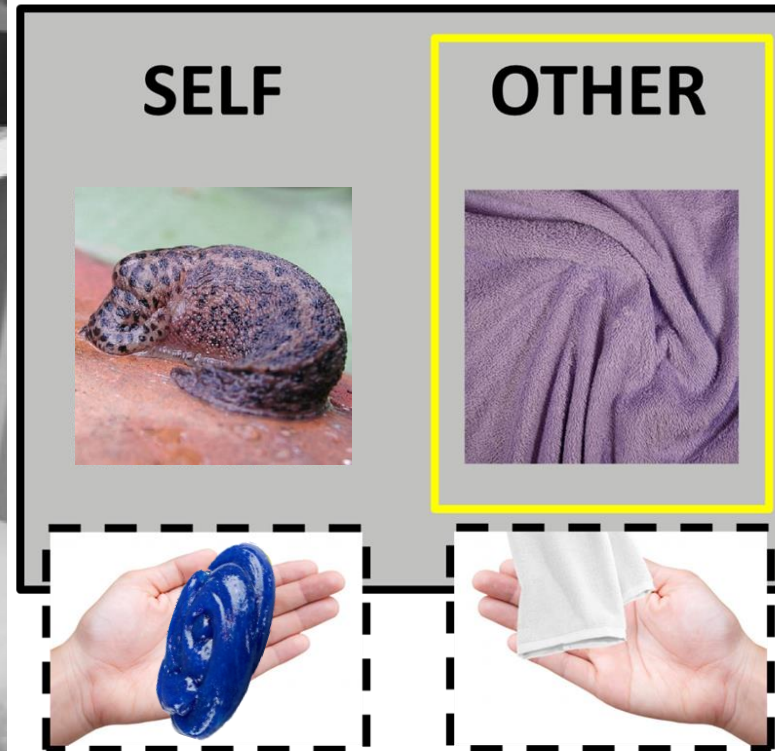
How to measure SOD in Empathy?

- Indirect: Self-report : **Cognitive Empathy** subscale of QCAE (Reniers et al., 2011)
→ dispositional aspect (e.g., “*I am good at predicting how someone will feel.*”)
- Performance-based: **Visuotactile empathy** task (Silani, Lamm, Ruff, & Singer, 2013):
 - You and another person simultaneously experience pleasant or unpleasant visuotactile stimulation.
 - Then report how the other or yourself feel(s). When oneself and another person experience incongruent emotions, SOD is required to avoid being biased (i.e., excessively influenced) by our own or another’s emotion.

Visuotactile empathy task



How does your colleague feel ?



Incongruent emotions condition

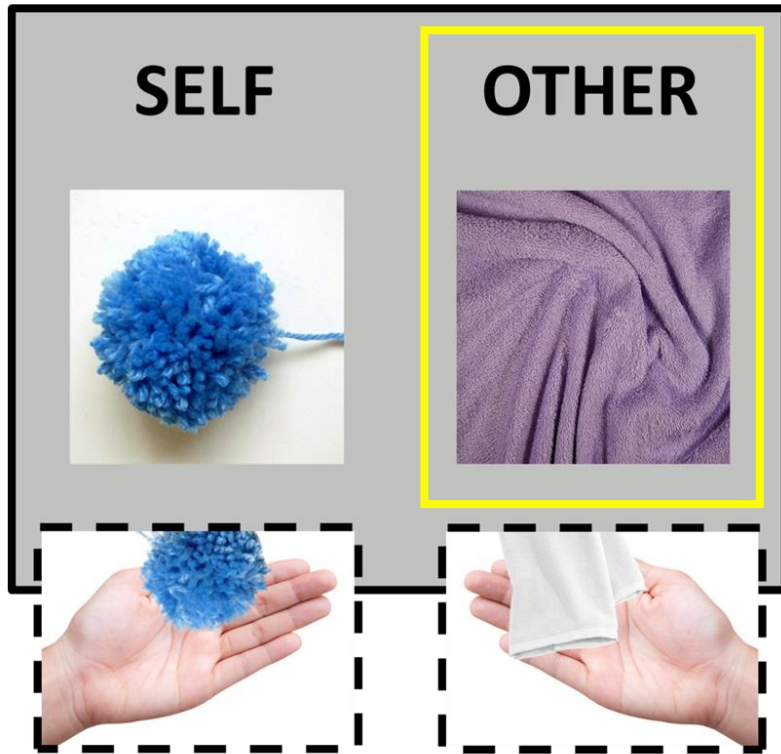


**High bias =
poor SOD
performance**

**= Egocentric
bias**

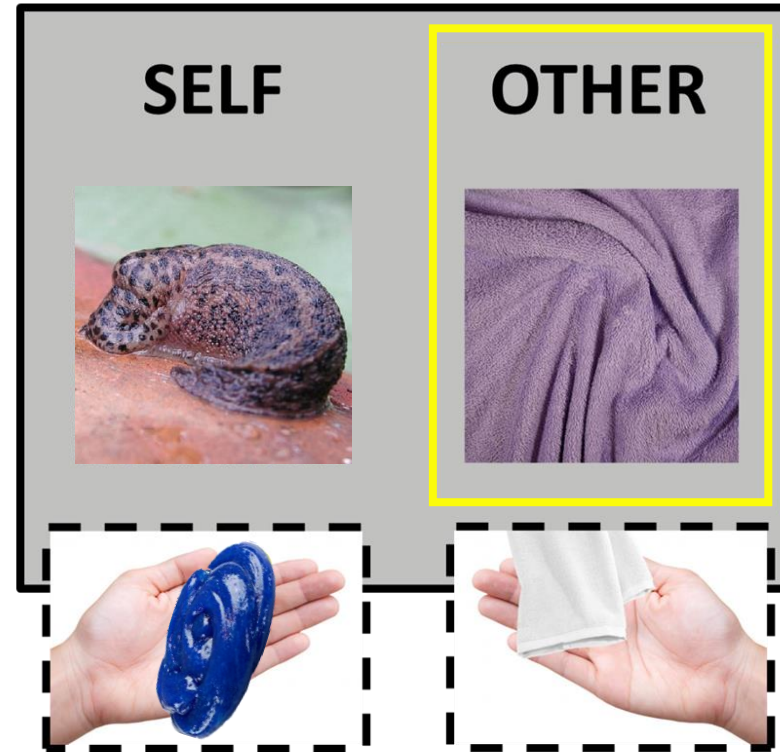
How to measure SOD in Empathy?

How do YOU feel ?



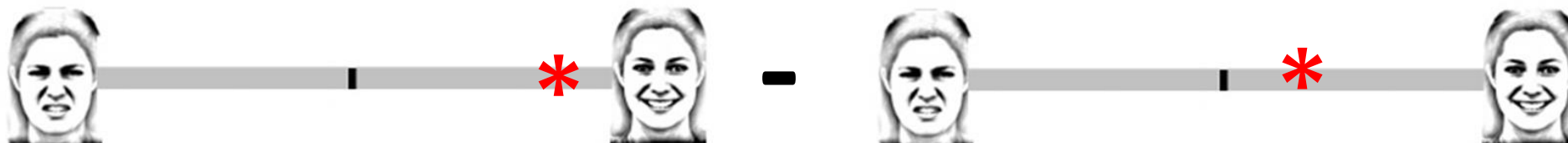
Congruent emotions condition

vs.



Incongruent emotions condition

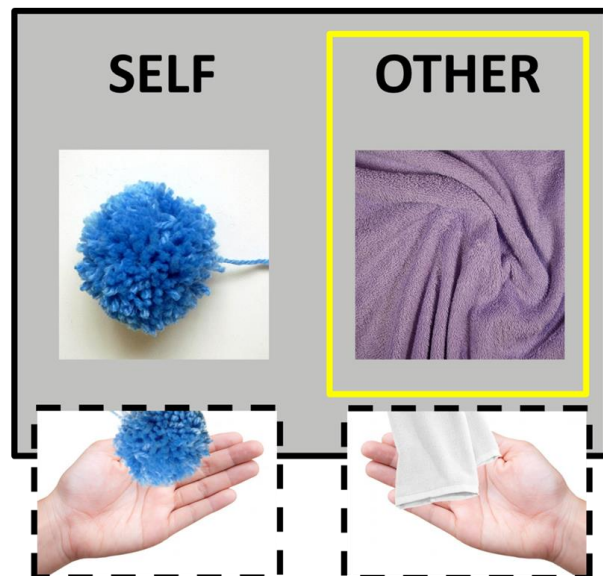
**High bias =
poor SOD
performance**



**= Altercentric
bias**

Other-judgment

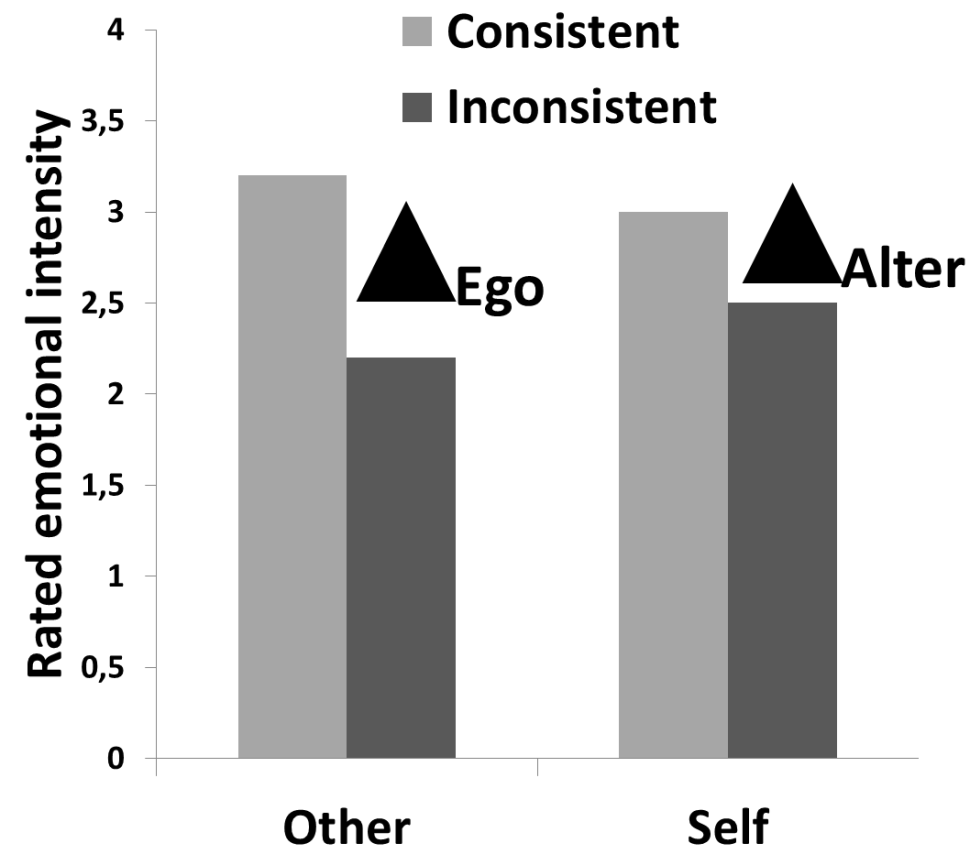
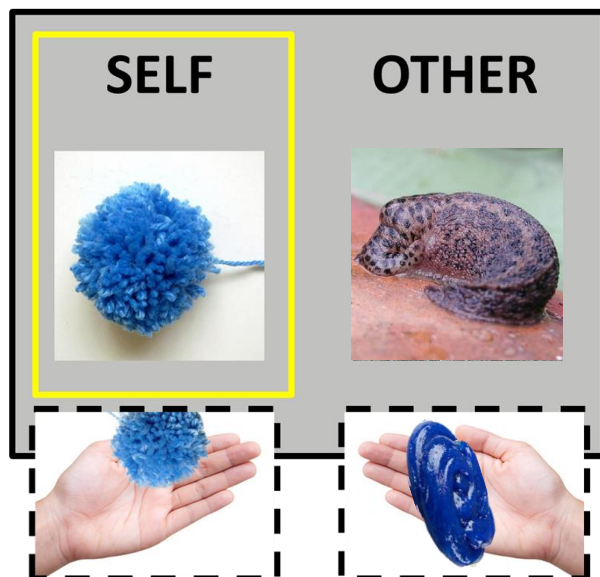
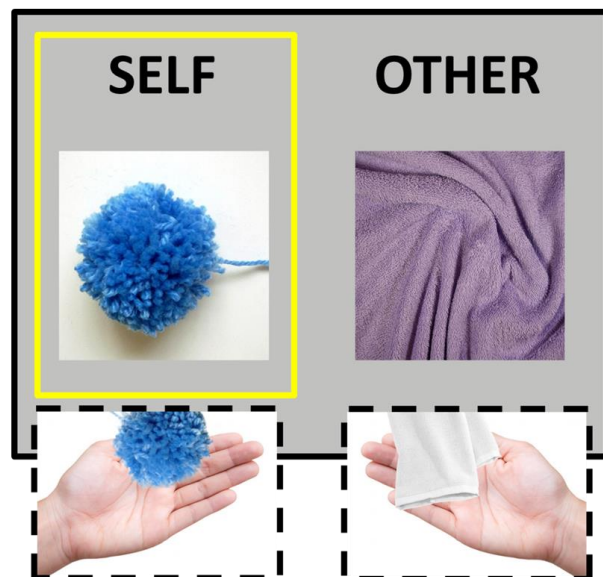
Consistent



Inconsistent



Self-judgment



Self-other distinction
performance in empathy

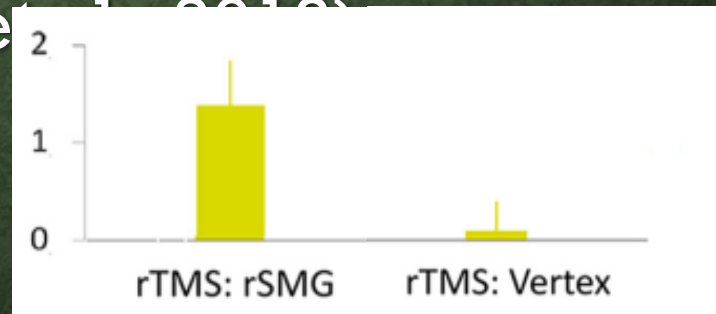
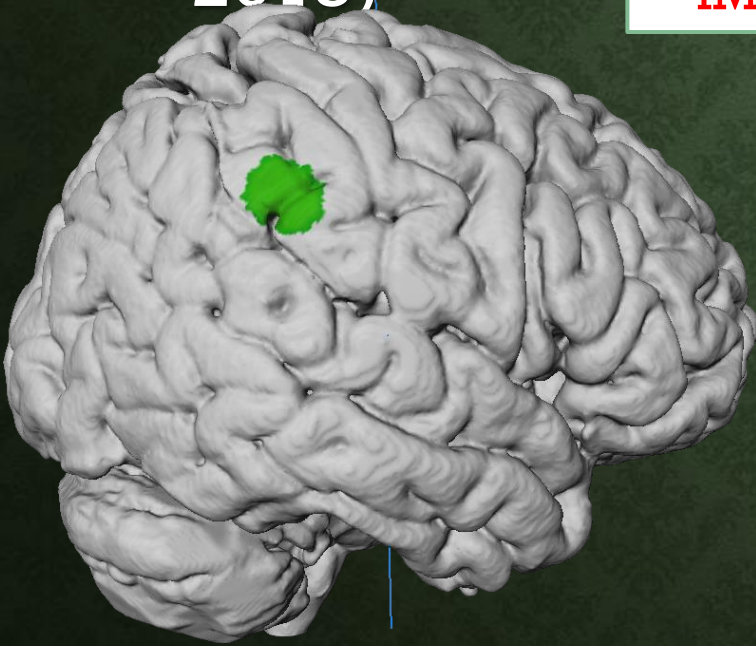
$$= \blacktriangle_{\text{Ego}} + \blacktriangle_{\text{Alter}}$$

FIRST STUDY

- **Right supramarginal gyrus (rSMG; anterior TPJ)** was found more active for emotional egocentricity bias (Silani et al., 2013)

fMRI does not say whether rSMG contributes to SOD or egocentric bias

- **Low freq inhibitory rTMS on rSMG** increased emotional egocentricity bias (Silani et al., 2013)

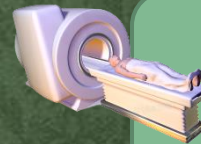
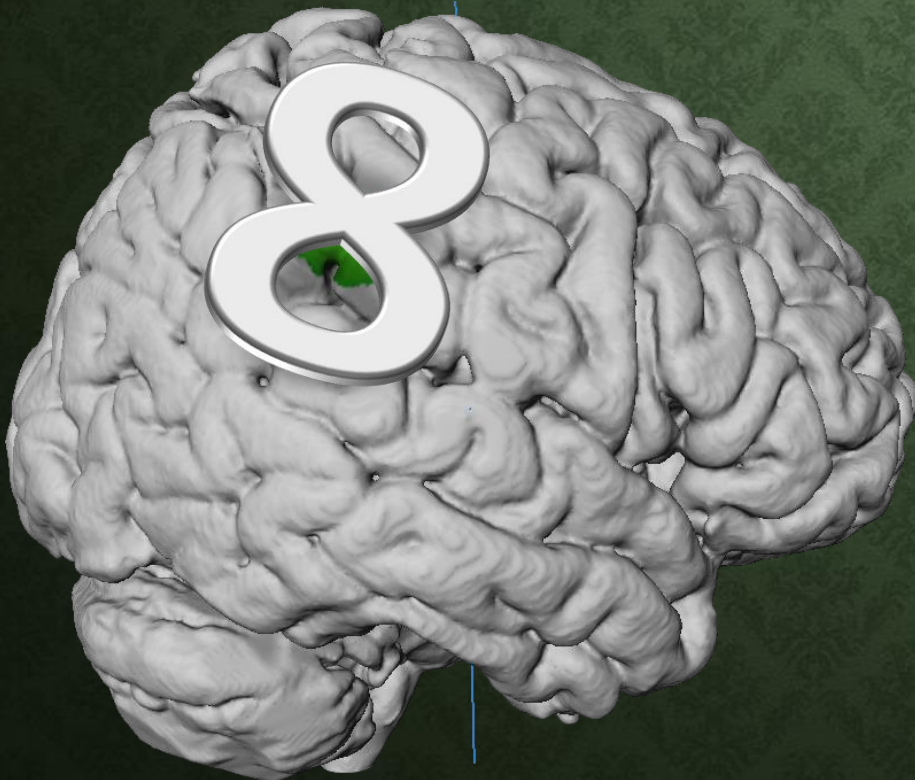


rTMS caused disruption, which says that rSMG contributes to SOD, but how?

PRESENT STUDY

Combined offline **fMRI-rTMS** study, within-subject design (N=31)

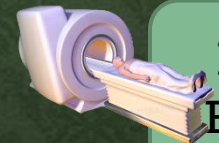
repeated Transcranial Magnetic Stimulation:
continuous theta burst stim (cTBS: 600 stim in 40 sec)



Brain anatomy (T1)
Motor task
Empathy practice



Minimal motor threshold
rTMS - cTBS
on rSMG or Vertex (control site)

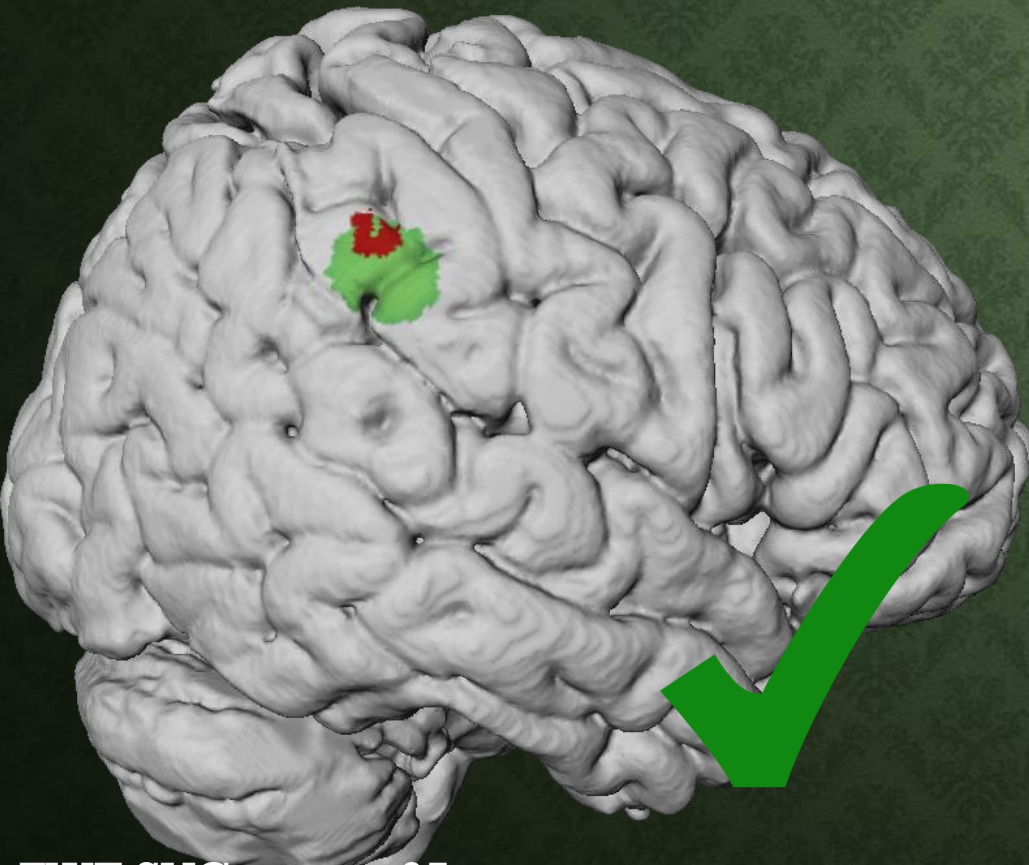


Empathy block 1 (5-25 min)
Empathy block 2 (30-50 min)

x 2 sessions (1 week apart)

RESULT

**Neural correlates of SOD:
Incongruent > Congruent**



FWE SVCorr $p < .05$

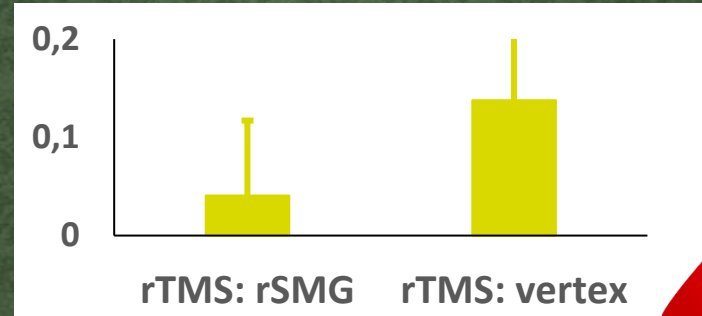
BEHAVIOUR:

Significant main effect of Congruency ($p = .014$), with a lower mean emotional intensity in the incongruent emotions condition



RESULT: rTMS on behavior

→ **Marginal interaction rTMS site x Congruency ($p = .069$)**



→ Congruency effect (bias) tends to **decrease** ! → **Enhanced** SOD by cTBS on rSMG!

Is the effect of cTBS always disruptive ?

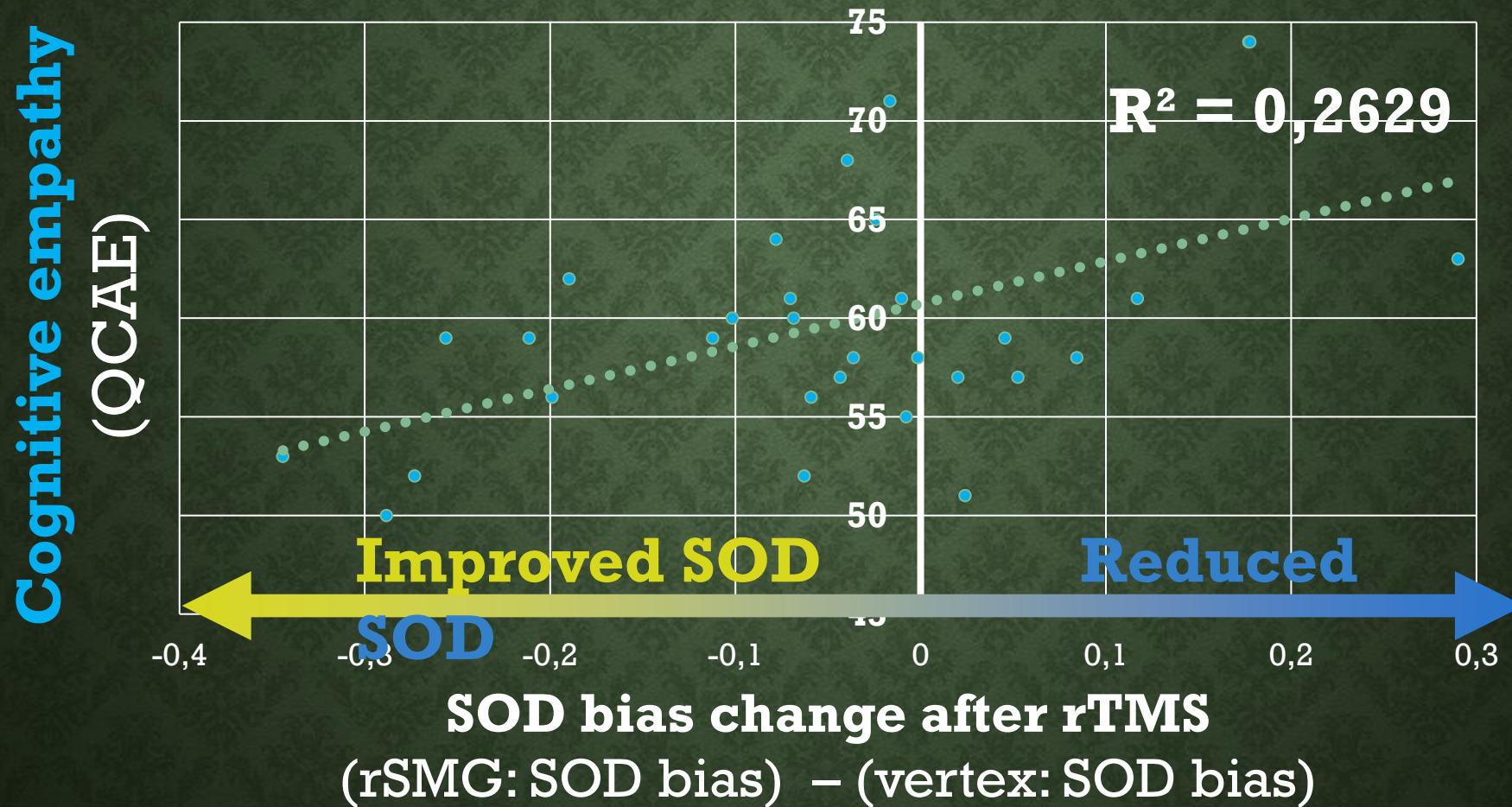
Evidence for highly variable effects of cTBS accounted by individual differences

(e.g., MEP latencies: Huang & Mouraux, 2005; morphology of TMS site: Hartwright et al., 2016)

cTBS has long lasting effect for a short stimulation time but variable effects!

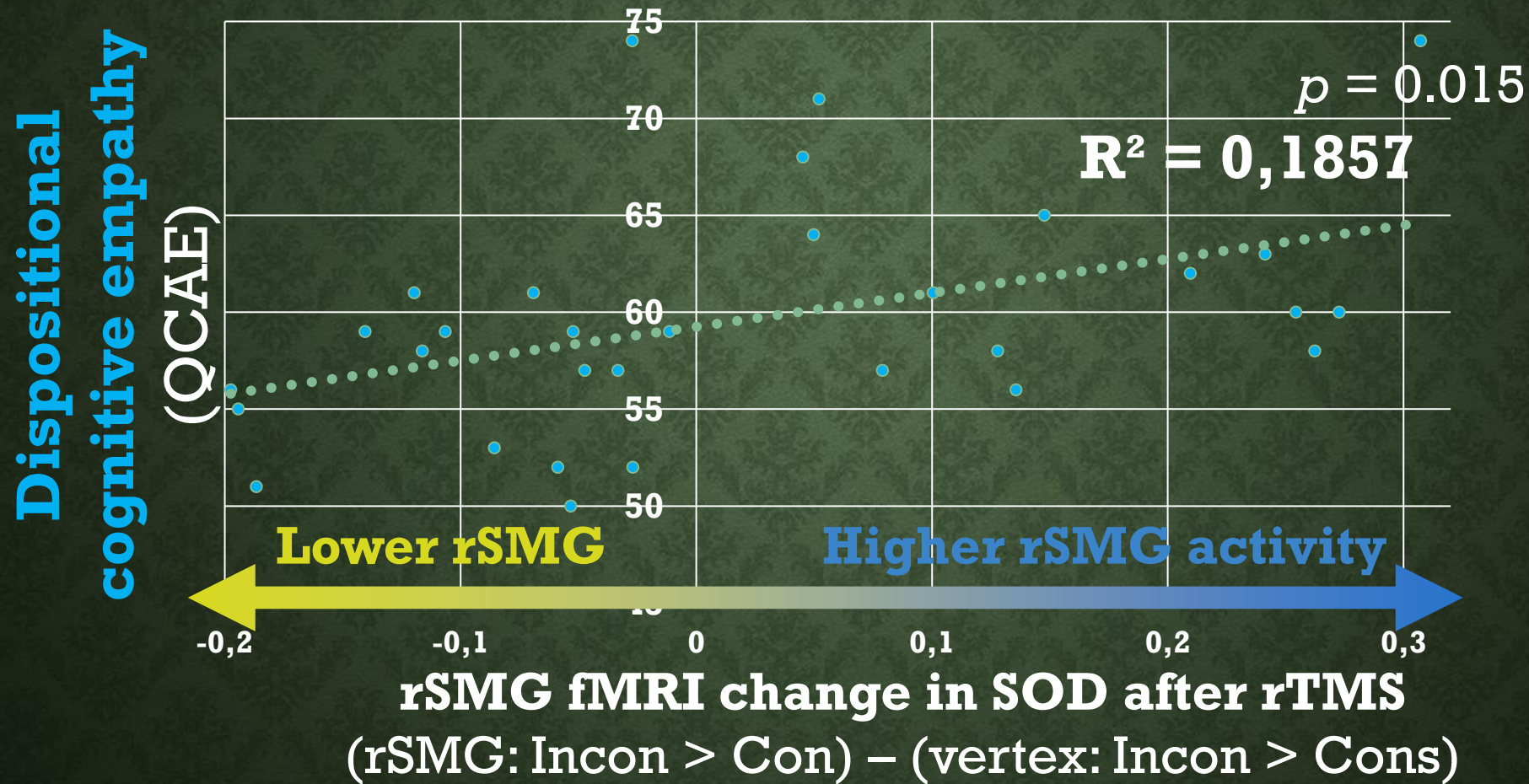
**WHAT IF WE INCLUDE
INDIVIDUAL DIFFERENCES IN
DISPOSITIONAL COGNITIVE EMPATHY
?**

Significant Congruency x rTMS site x **Dispositional Cognitive Empathy** (covariate) interaction ($p = .003$)



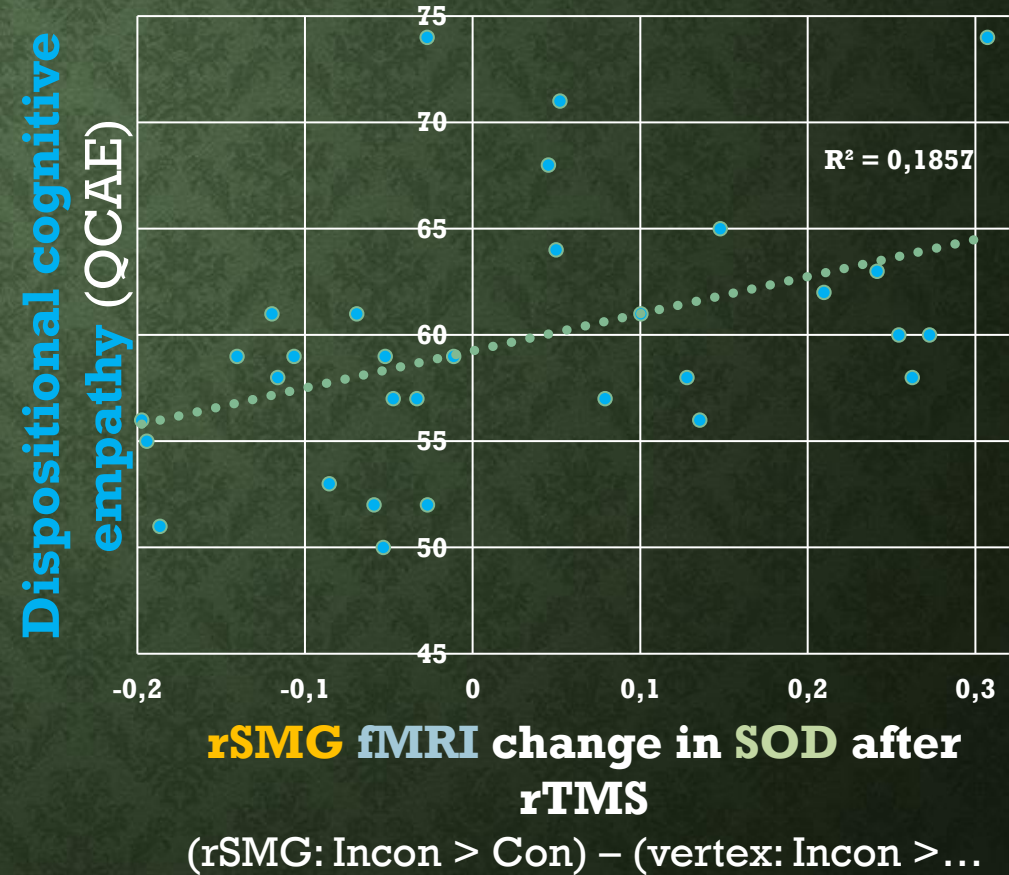
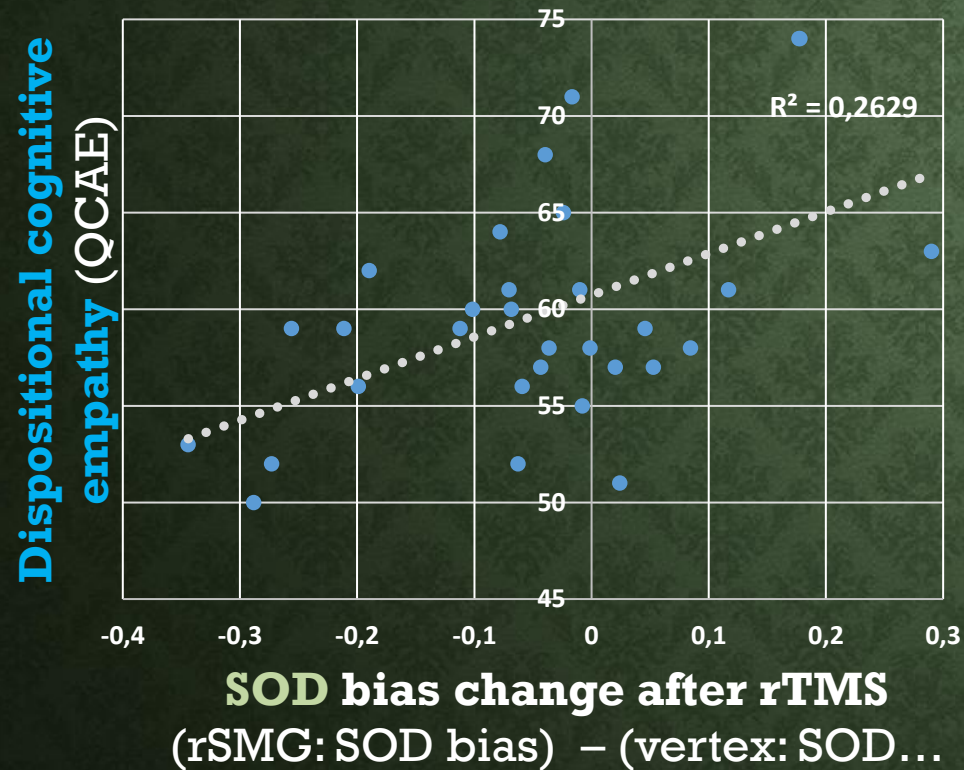
→ **Facilitatory** effect of cTBS rTMS on SOD performance in relation with **lower dispositional cognitive empathy** (“*bads getting good & goods getting bad*”)

Extent of rSMG activity for Incongruent > Congruent (→ SOD)



→ **Lower** rSMG activation during SOD after rTMS on rSMG in relation with **lower dispositional cognitive empathy** (“bads getting good need less rSMG & goods getting bad need more rSMG”)

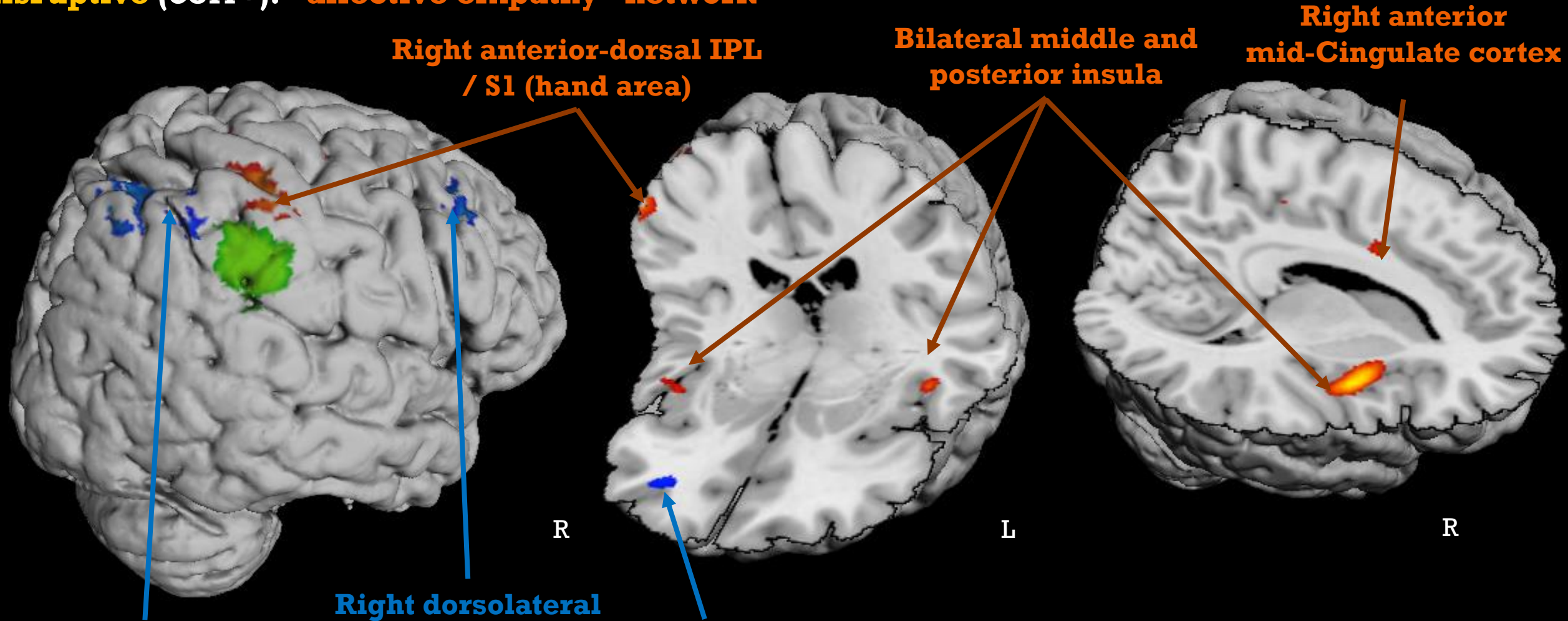
rTMS **facilitatory** and **disruptive** effects on behavioral & brain index of **SOD** have a mirror relation with **disp. Cognitive Empathy**



Same associations at the **whole brain**?
Positive or negative associations?

rTMS « **facilitatory** » vs. « **disruptive** » effects engage two opposed networks (or strategies?) to perform SOD

disruptive (corr+): “**affective empathy**” network



N=31; $p < 0.005$ (unc), $k=5$, whole-brain, network labelling from Neurosynth (v4-top)

**Right intraparietal
sulcus
+ angular gyrus**

**Right dorsolateral
PFC**

Right OFC

facilitatory (corr-): “**cognitive control**” + “**decision-making**”
networks

DISCUSSION

- rSMG contributes to Self-other Distinction (SOD)
- rTMS effects are modulated by dispositional Cognitive Empathy both at behavioral and brain levels
- Facilitatory effect for low disp. CE, associated with “cognitive control / decision-making” network
- Disruptive effect for high disp. CE, associated with “affective empathy” network
- ➔ Evidence for a brain-behavior-personality interplay in SOD
- ➔ Was the rTMS effect variable? Or was the individual reaction to the same rTMS effect variable?
- ➔ Hypothesis: The rSMG performs *domain-specific* top-down regulation that – when disrupted – can be replaced by recruiting the *domain-general* top-down network

THANKS

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SCAN-Unit

& ESCAN !!



BACKUP SLIDES



SUMMARY & CONCLUSION

- Replicated recruitment of **rSMG** during **Self-other Distinction (SOD)**
- Unexpected marginal « **facilitatory** » effect of cTBS **rTMS** on **rSMG** on **SOD** performance
- rTMS effects **modulated by disp. Cognitive Empathy** both at behavior & brain levels
- **Facilitatory** effect for low **disp. CE**, associated with “**cognitive control/decision-making**” network
- **Disruptive** effect for high **disp. CE**, associated with “**affective empathy**” network

→ First time understanding of the brain-behavior-personality interplay in **SOD**

→ Although exploratory, variable **rTMS** effect seems accounted by personality trait

HOW TO MEASURE SELF-OTHER DISTINCTION (SOD) ?

Self-report-based:

Cognitive Empathy subscale of QCAE (Reniers et al., 2011): Report agreement on 19 statements:

- I am good at predicting how someone will feel.
- When I am upset at someone, I usually try to “put myself in his shoes” for a while.

➔ **Dispositional cognitive empathy**

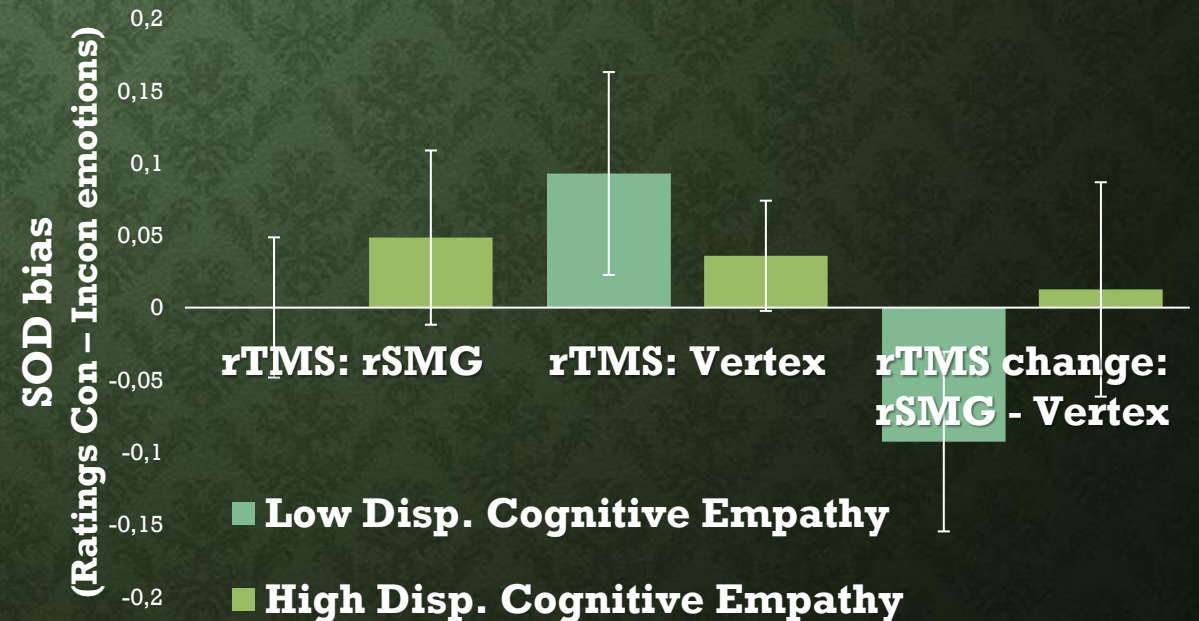
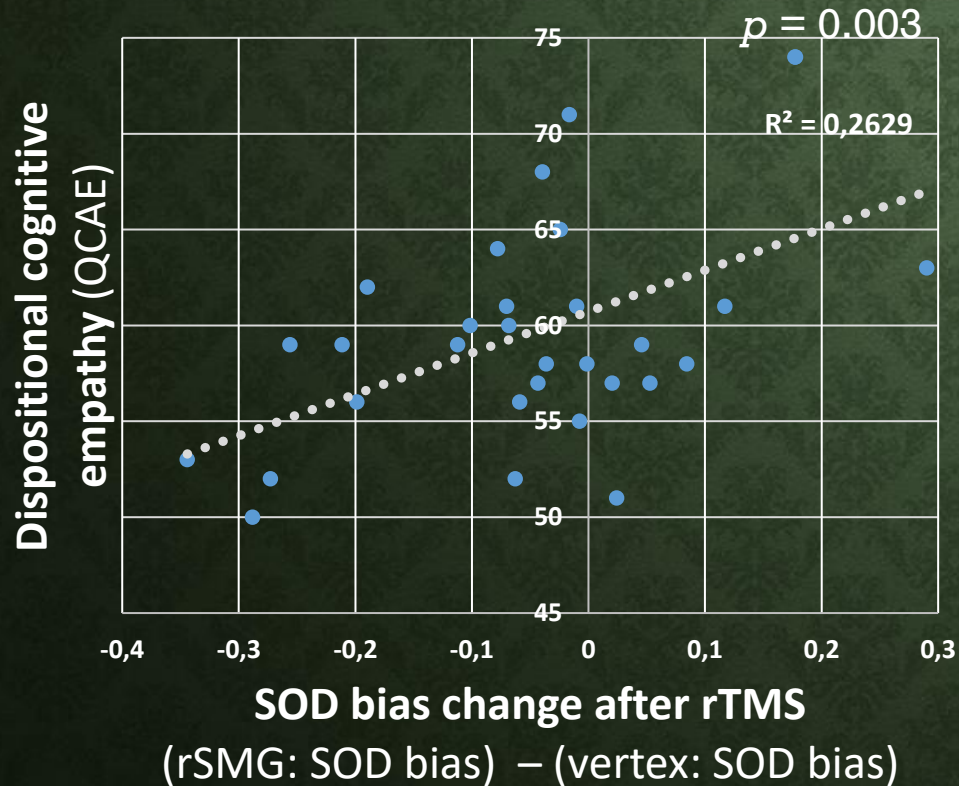
Performance-based:

Visuotactile empathy task (Silani, Lamm, Ruff, & Singer, 2013): Report how other or self feels following emotions induced by



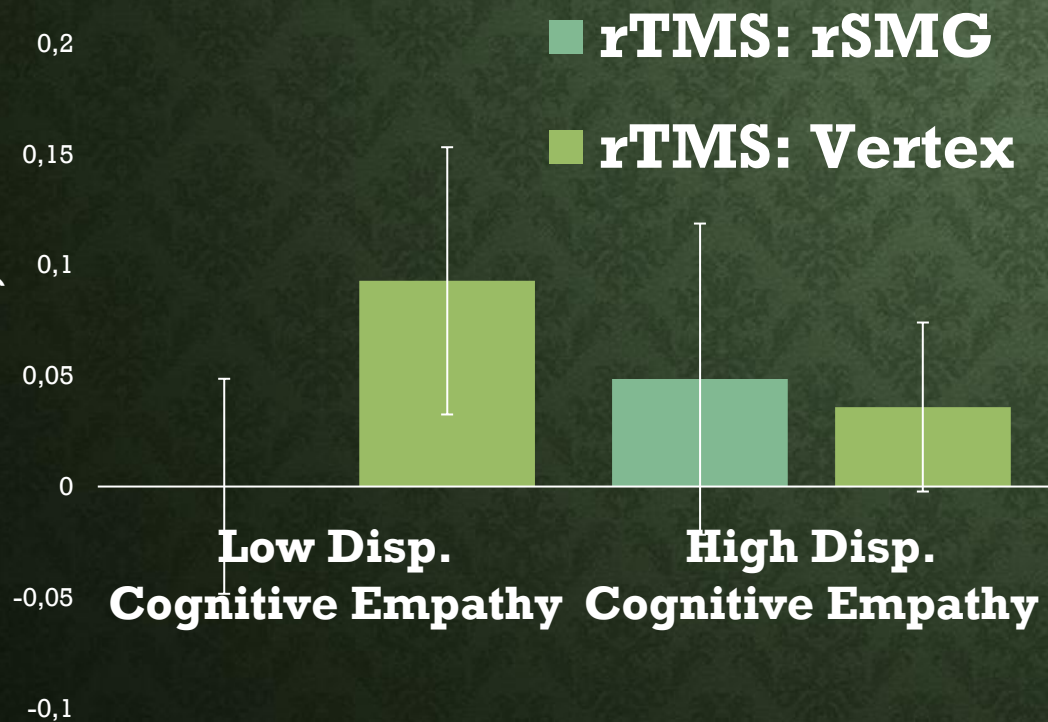
RTMS EFFECT MODULATED BY DISPOSITIONAL COGNITIVE EMPATHY

→ **LOW SOD bias** (i.e., better **SOD** performance) after **rtms** on **RSMG**...
... for **LOW Dispositional Cognitive Empathy** individuals !

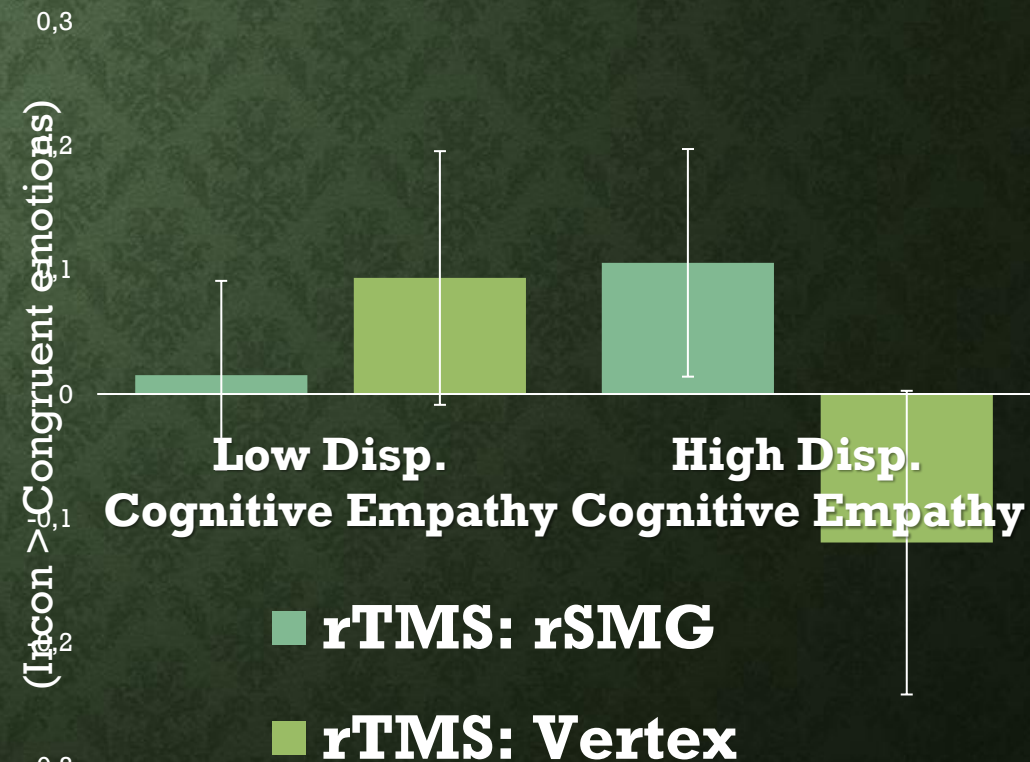


SOD bias

(Ratings Con - Incon emotions)



rSMG activation during SOD



N=31; $p < 0.005$ (unc), $k=5$, whole-brain

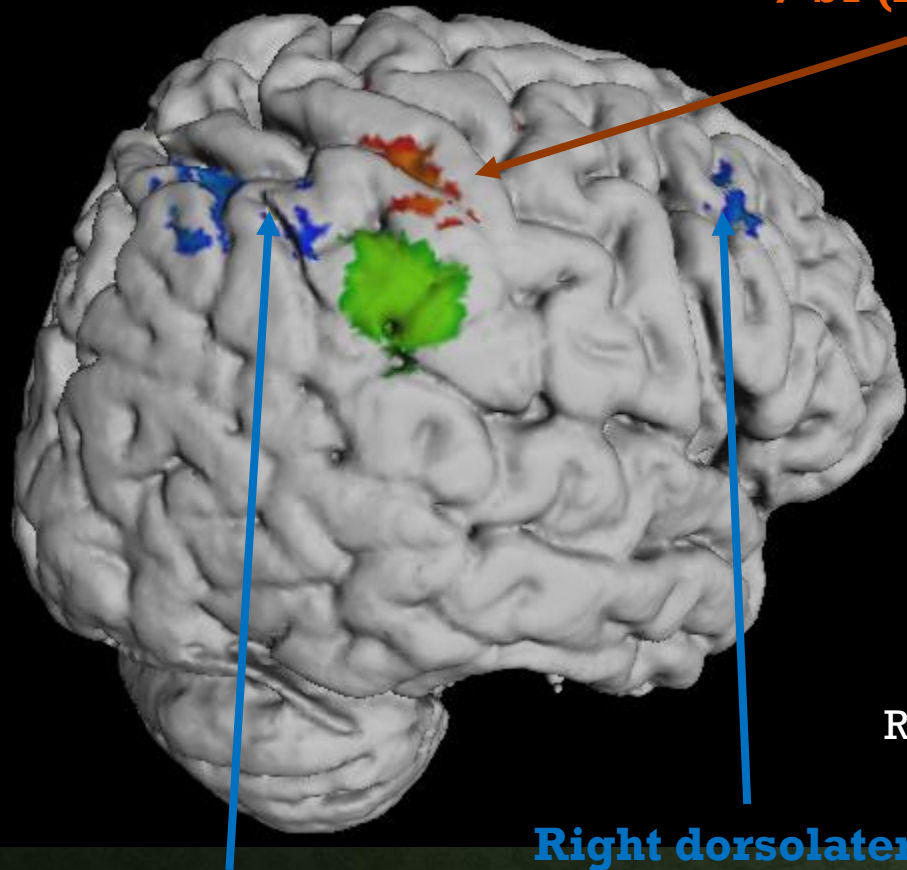
Positive association between Cognitive Empathy trait and rTMS effect on rSMG on self-other distinction
(rSMG: Inc-Con) – (vertex: Inc-Con)

Right SMG
from Silani et al., 2013

Right anterior-dorsal IPL / S1 (hand area)

Bilateral middle and posterior insula

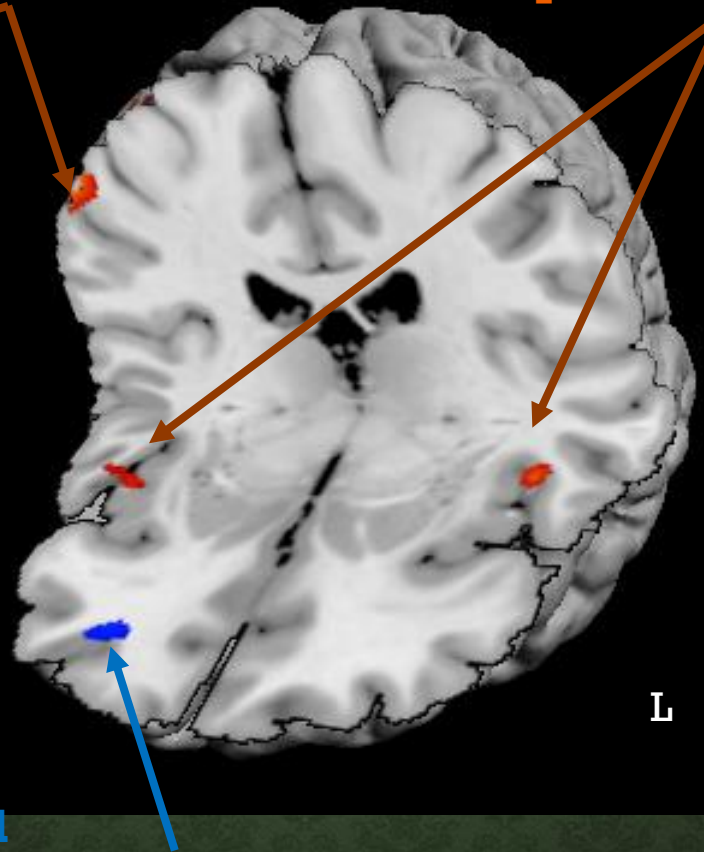
Right anterior mid-Cingulate cortex



R

Right dorsolateral PFC

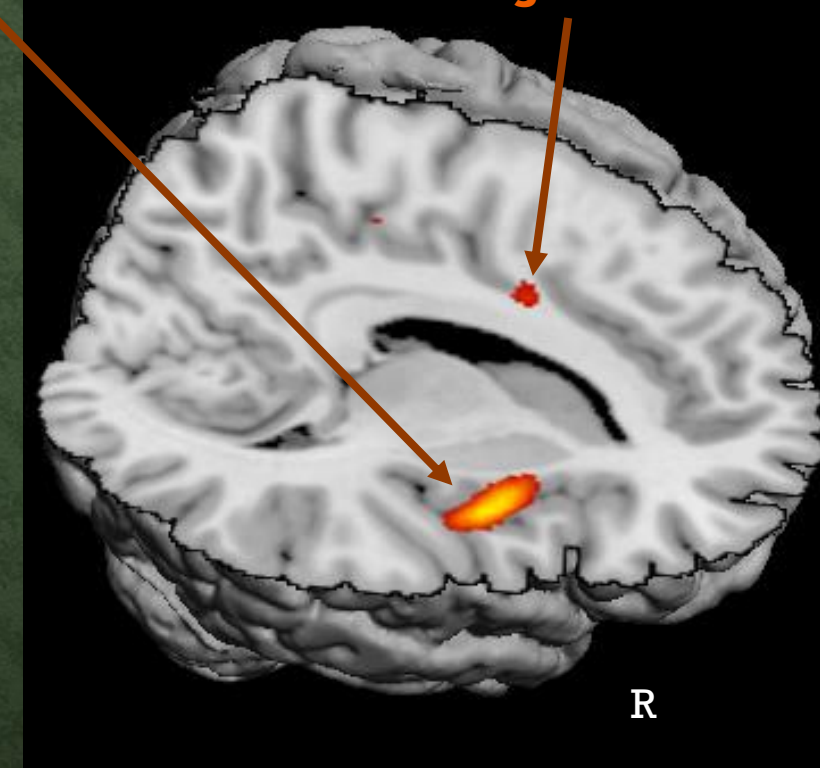
Right intraparietal sulcus + posterior-dorsal IPL (dorsal TPJ)



L

Right OFC

Negative association between Cognitive Empathy trait and rTMS effect on rSMG on self-other distinction
(rSMG: Inc-Con) – (vertex: Inc-Con)



R