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## Declaration of Financial Interests or Relationships

Speaker Name: Julia Boonzaier

I have no financial interests or relationships to disclose with regard to the subject matter of this presentation.

# Influence of rTMS on functional connectivity and hemodynamics in the rat brain

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# Introduction

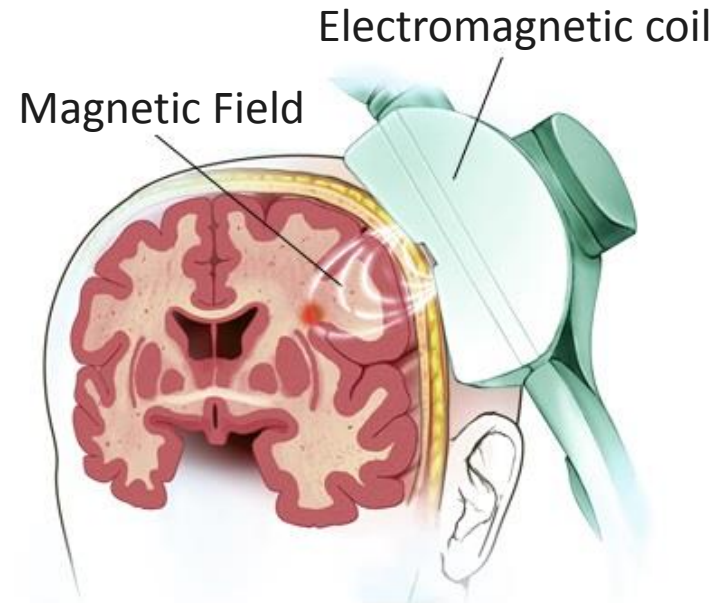
- **Repetitive transcranial magnetic stimulation (rTMS)**

- Neuromodulation
- Cortical excitability
- Plasticity

- Favorable therapeutic approach

- Psychiatric
- Neurological

- Mechanism of action



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- **AIM:**

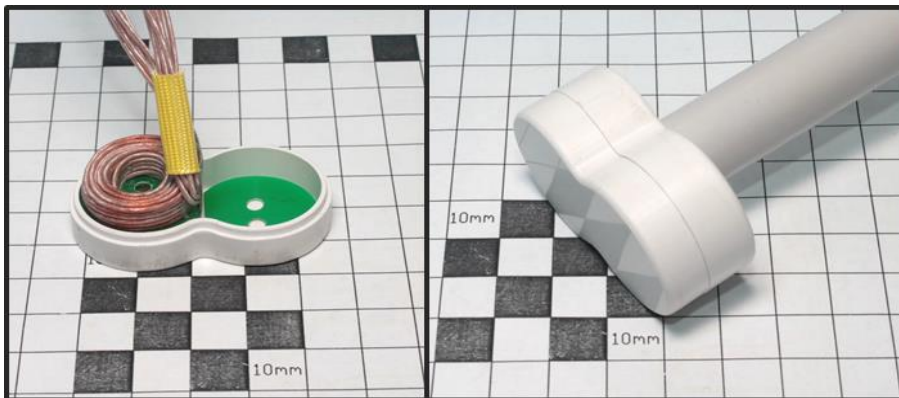
To explore the mechanism of action of rTMS

- Functional connectivity
- Hemodynamics



# Materials & Methods

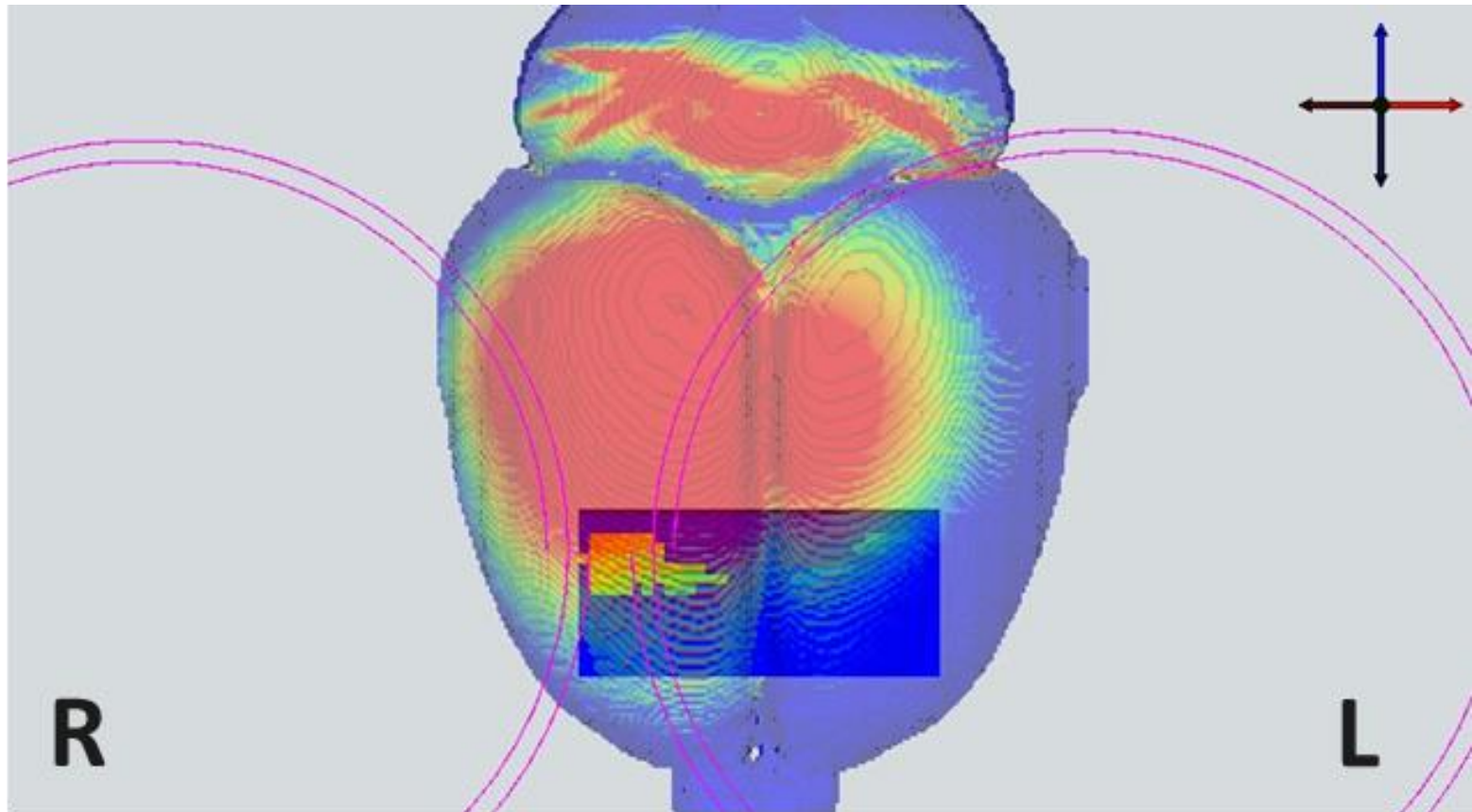
- Healthy, male Sprague Dawley rats
- **Low-frequency (1Hz, 1200 pulses) rTMS**
  - 20 minutes rTMS for 4 days
  - Right sensorimotor cortex
  - 1% Isoflurane



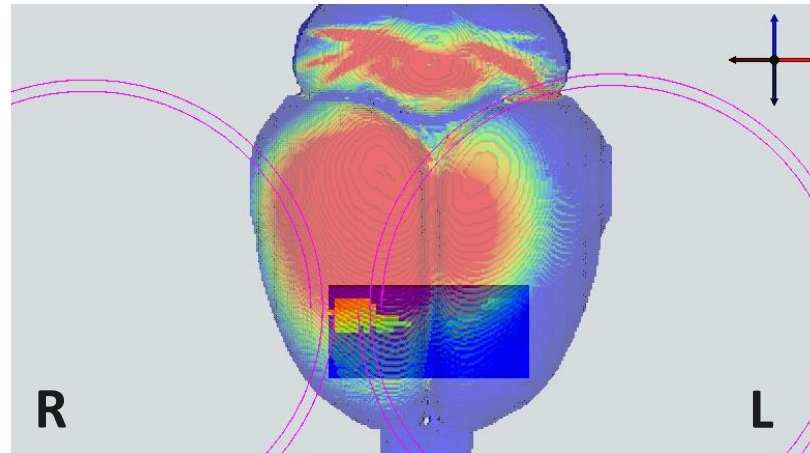
25 mm Figure-of-Eight Coil



# Materials & Methods



# Materials & Methods



## Contralateral Motor Evoked Potential



# Materials and Methods

**Day 0**

**Pre-stimulation MRI**

Isoflurane 1.5%

**Day 3-6**

**rTMS**

Isoflurane 1%

**Day 7**

**Post-stimulation MRI**

Isoflurane 1.5%

## 9.4 Tesla Varian MRI system

### – Anatomical MRI

- Balanced SSFP
- TR/TE = 5/2.5 ms, Flip angle = 20°
- Resolution = 250  $\mu$ m isotropic

### – rs-fMRI

- 3D Gradient echo, EPI
- TR/TE = 26.1/15 ms, Flip angle = 13°
- Resolution = 600  $\mu$ m isotropic

### – Dynamic susceptibility contrast-enhanced MRI

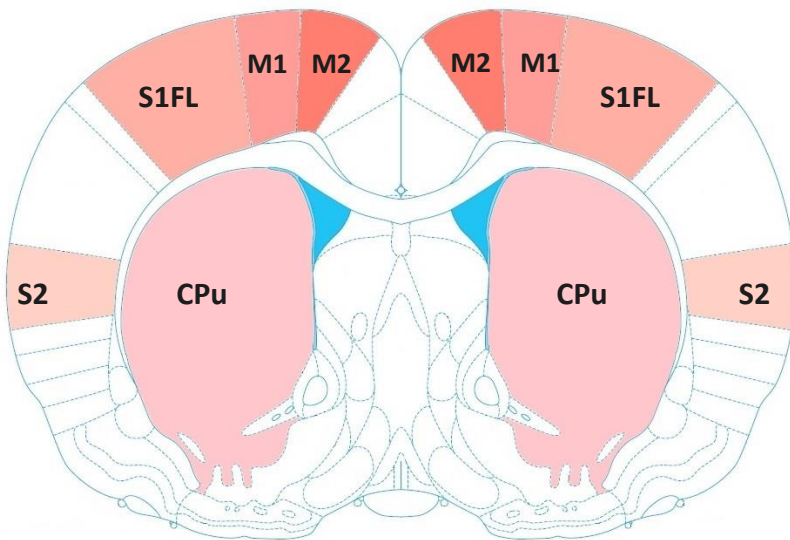
- 2D Gradient echo, EPI
- TR/TE = 330/11 ms, Flip angle 40°
- Resolution = 764x764x1  $\mu$ m
- i.v. bolus of Gadobutrol (Gadovist ®), 0.35 mmol/kg bodyweight



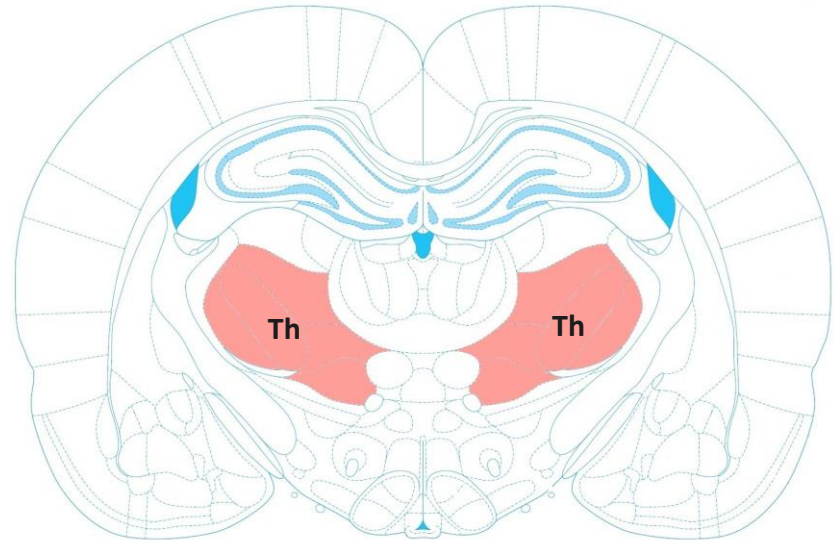


# Materials & Methods

- **Analysis:**
  - Inter- and intrahemispheric functional connectivity
  - Relative Cerebral blood flow (CBF) in the stimulated sensorimotor cortex
    - Calculated from perfusion MRI data
    - Tracer arrival time-insensitive deconvolution



Bregma 0.84 mm

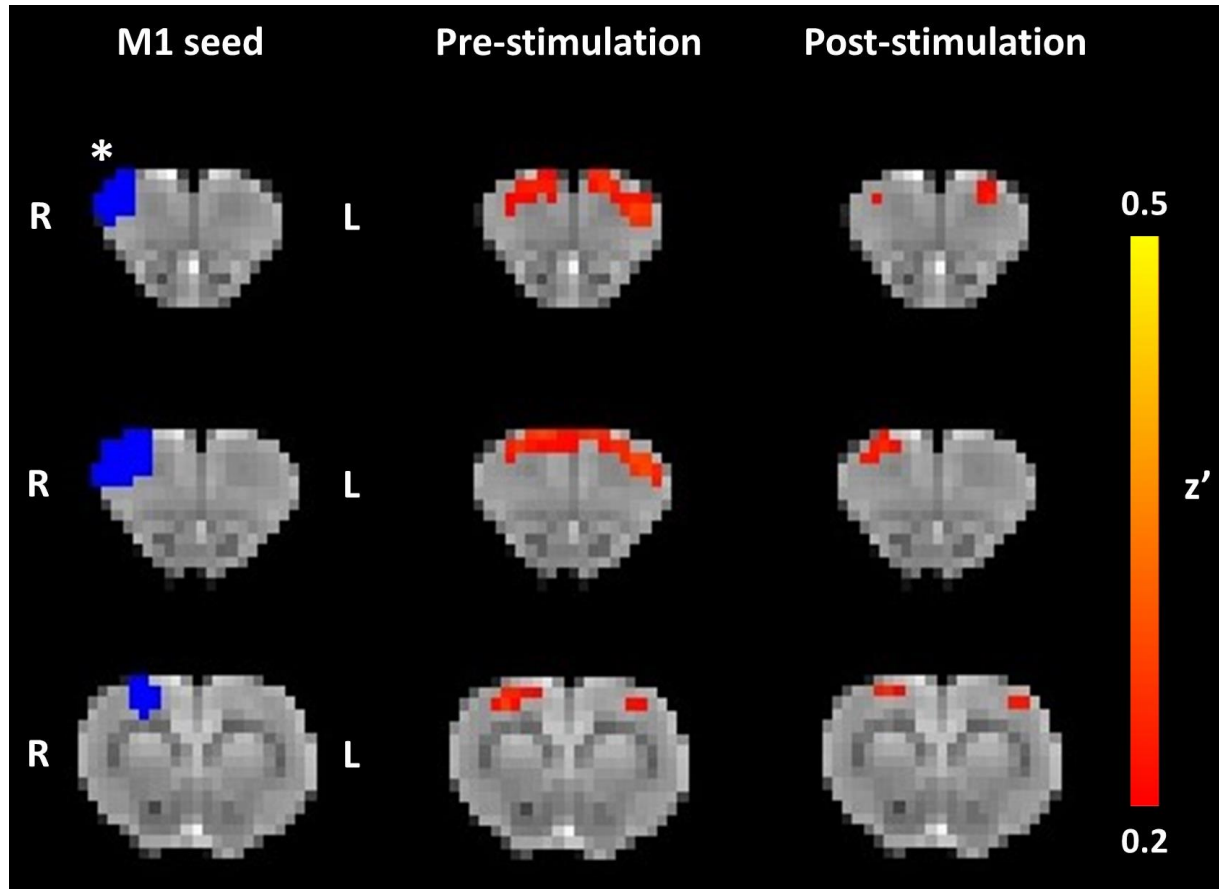


Bregma -2.92 mm





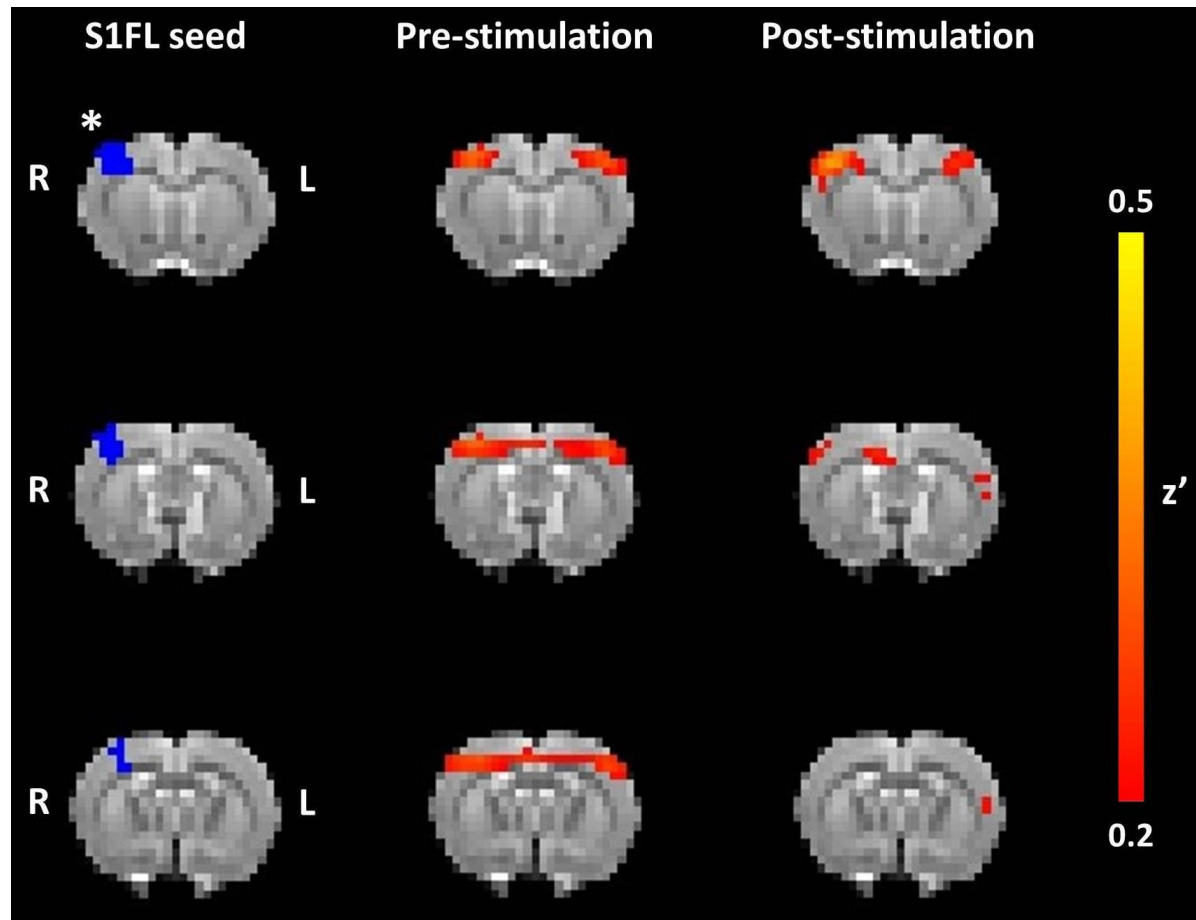
# Average functional connectivity maps of M1



Average functional connectivity maps, right stimulated M1 (\*) as a seed region



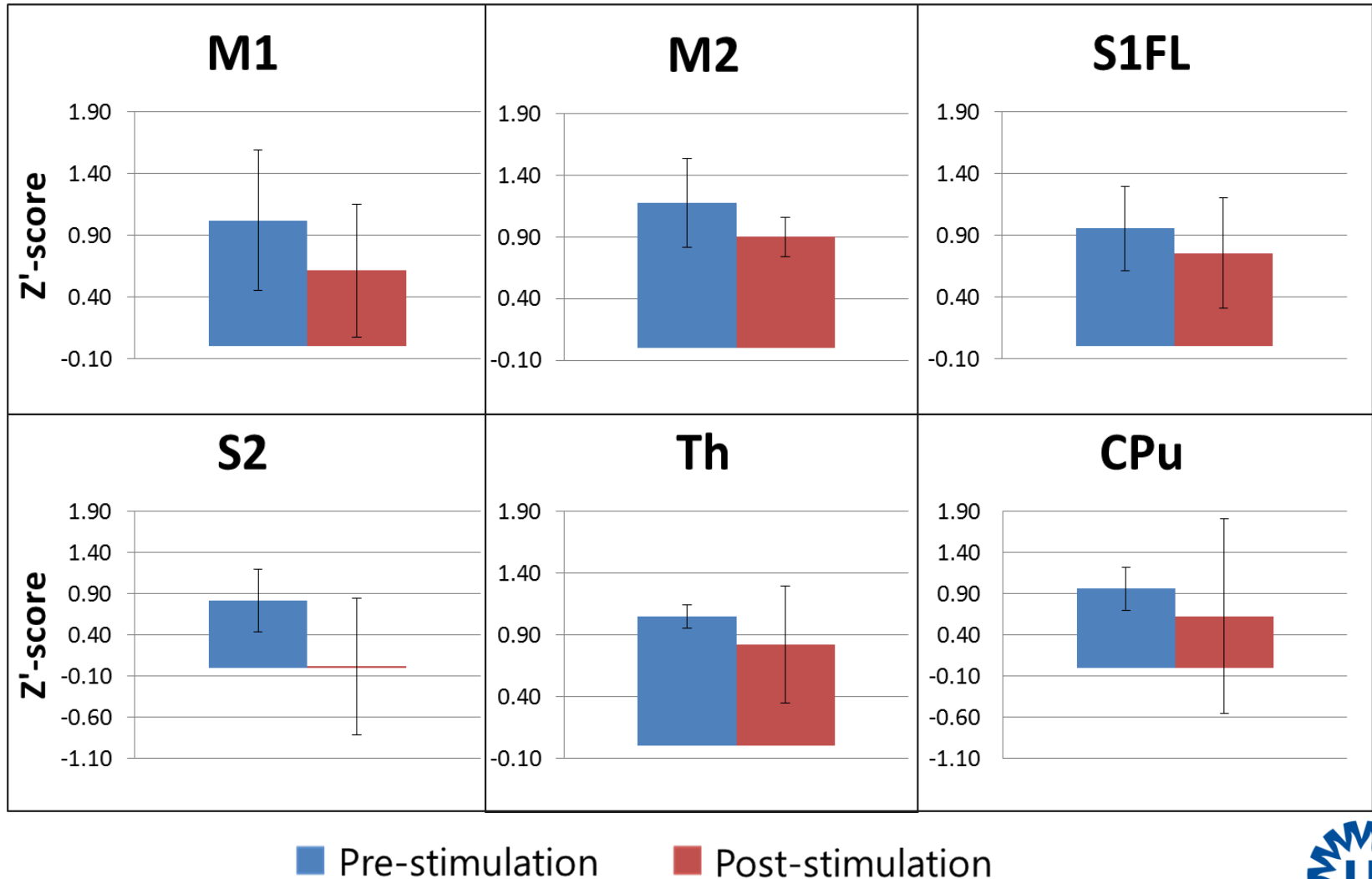
# Average functional connectivity maps of S1FL



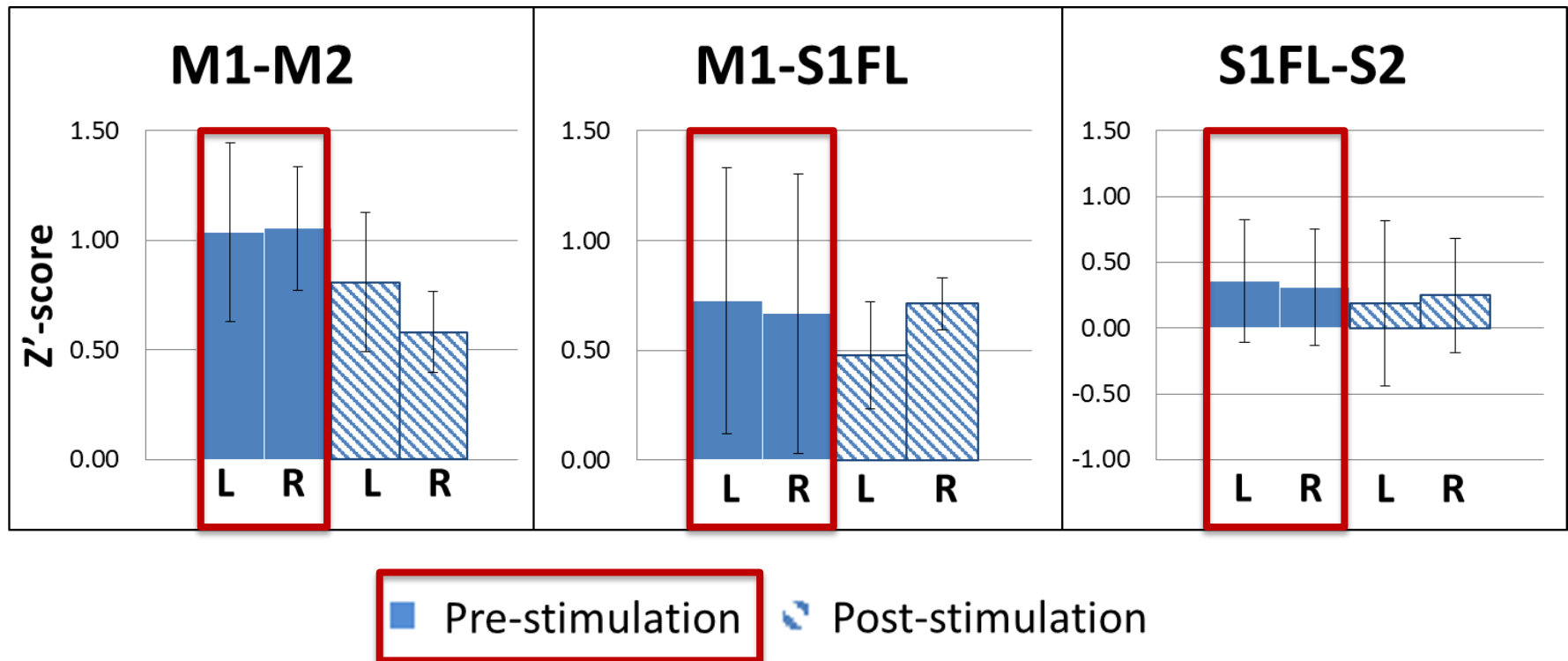
Average functional connectivity maps, right stimulated S1FL (\*) as a seed region



# Interhemispheric functional connectivity

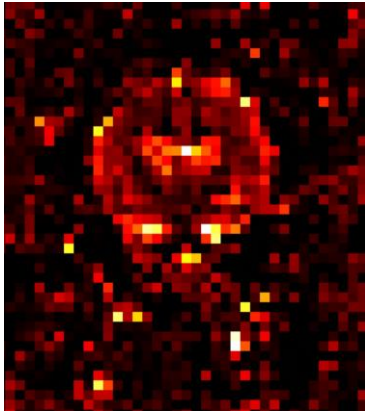


# Intrahemispheric functional connectivity

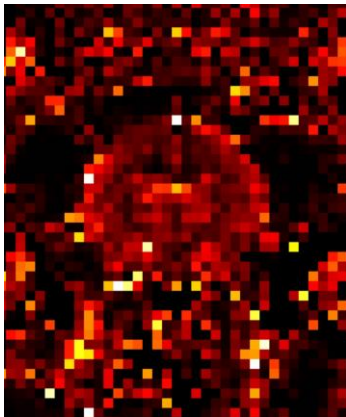


# Cerebral blood flow

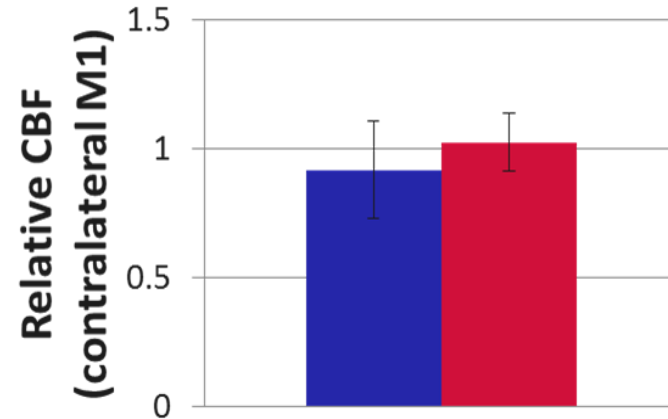
Pre-stimulation



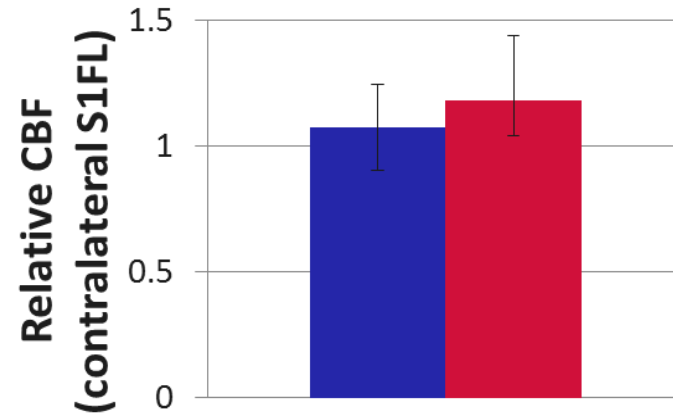
Post-stimulation



M1



S1FL



■ Pre-stimulation ■ Post-stimulation



# Discussion & Conclusions

- Low frequency rTMS in the rat brain decreases interhemispheric functional connectivity; without affecting relative CBF
- **Possible explanations:**
  - Inhibitory effect on cortical excitability
  - Long term depression
  - Disruption of neuronal signal synchronization
- rTMS-induced modulation of functional connectivity may explain therapeutic effects

