



TRANSCRANIAL STATIC MAGNETIC STIMULATION (TSMS): REGISTERED REPORT ON REPLICATION OF THE EFFECTS OF NEURONAVIGATED TSMS ON CORTICOSPINAL EXCITABILITY

LUIGI CATTANEO

Type: New study

Where: Online & Trento/Rovereto, Italy

When: April 2023 - March 2024

Methods & techniques: Transcranial magnetic stimulation (TMS), Magnetic Resonance Imaging (MRI), Registered Report (RR)

ABOUT THE MENTOR

Luigi Cattaneo is an Associate Professor at the University of Trento, Italy.

Luigi is an expert in brain stimulation, voluntary and affective movements, and action systems. His current scientific interest is the control of actions in the frontal lobe. He studies executive control of automatic responses, interactions between internally generated and externally triggered actions and value-based actions. Most of his studies are conducted in the healthy human brain but he also works with different neurological conditions. His approach utilizes non-invasive (TMS) as well as invasive (intraoperative neurophysiology) brain stimulation, coupled with measures of behaviour.

Email luigi.cattaneo@unitn.it

Check out one of his works: Cattaneo, L., Giampiccolo, D., Meneghelli, P., Tramontano, V., Sala, F. Cortico-cortical connectivity between the superior and inferior parietal lobules and the motor cortex assessed by intraoperative dual cortical stimulation (2020) *Brain Stimulation*, 13 (3), pp. 819-831

ABOUT THE TOPIC

Transcranial static magnetic stimulation tSMS consists of the application of static magnetic fields to the cortex. The NIBS technique has been described in 2011 (Oliviero et al., 2011) but few independent reports have followed the original description (Nojima et al., 2020). This technique is interesting because it has the potential to modulate both superficial and deep medial cortical structures. Thus, this is a relatively novel, affordable brain stimulation technique, that warrants further testing and exploration.

What will be done?

We will investigate the effects of tSMS on the motor cortex and premotor regions in a registered report single-blind placebo-controlled trial.

We will conduct an experiment in Trento (Italy) in which we will record EMG on the right-hand muscles and perform TMS on the left hand-motor cortex. The motor-evoked potentials (MEPs) will be collected before and after real or placebo tSMS to assess the effects on corticospinal excitability. We will stimulate the left and right motor cortex as well as the supplementary motor cortex (SMA). Before and after real/placebo tSMS, TMS will be delivered as single-pulse or paired pulses at the SICI (2ms) and SICF (10 ms) intervals. A total of 100 single pulses + 100 SICI pulses + 100 SICF pulses will be collected before, and the same number of MEPs will be collected after intervention with tSMS. The study contains elements of replication of previous uncertain data, i.e., the effects of motor cortex tSMS, with two novel aspects: 1) increase of MEP numerosity should improve the sensitivity of the procedure and 2) neuronavigated tSMS of the SMA will investigate remote effects of tSMS. Moreover, the whole study will be conducted as a Registered Report (RR). This means that we will submit the Introduction, Methods and planned analysis before the experiment is conducted/analysed. When accepted, the results are added, and the article is published regardless of the absence/presence of the effects.

The group of 3 selected early-stage researchers will be working under the supervision of Dr Luigi Cattaneo in collaboration with Carlo Miniussi.

The research will result in one Registered Report empirical paper in a peer-review journal.

What will you learn?

- ✓ All about Register Report writing and publication and accompanied Open Science practices.
- ✓ All about tSMS and means to measure its effects
- ✓ How to adequately select sample size using power analysis
- ✓ How to use neuronavigation and TMS to collect data
- ✓ To analyse motor evoked potentials (MEPs)

Career benefits

- ✓ Learning new techniques including tSMS, paired-pulse TMS and neuronavigation.
- ✓ Get hands-on experience conducting a neurophysiological experiment.
- ✓ Experience working in an international environment in Trento lab.
- ✓ Establishing connections with peers and enhancing your soft skills to work in an international team.
- ✓ Increased awareness of open science and replicability issues in the field of NIBS
- ✓ Contributing to planned publication as co-authors

What is your role?

You will work in the international team to conduct an experiment, analyse the data, and write a manuscript for publication. You will participate in regular online meetings and have the opportunity to spend 2 weeks in Trento for data collection.

ESRS ENGAGEMENT REQUIREMENTS

Time requirements

Each participant is expected to spend 2 weeks in Trento for data collection. In addition, each ESR should dedicate on average 3 days a month over the period of 12 months. The working hours will be mostly flexible, and the dynamic will depend on work progress.

Physical location

The work will be done mainly remotely. The data collection will be done in Trento, Italy sometime between November 2023 and February 2024. Depending on the team members' availability to travel - the work will be organized so that at least two out of 3 ESRs are in Trento for data collection.

Skills and knowledge

For joining the group, you should have basic knowledge about neural and brain physiology. The advantage will be given to candidates with previous experience with TMS and statistical analysis skills.

