# Transcranial ultrasonic stimulation of the primary motor cortex

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To confirm our previous findings that both TUS and auditory cuing decreases MEP amplitude in an independent sample using a more efficient design. Reducing the number of principal conditions will benefit data quality and allow for better estimation...

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| **Ethical review** | Approved WMO |
| **Status** | Recruitment stopped |
| **Health condition type** | Other condition |
| **Study type** | Interventional |

## Summary

### ID

NL-OMON51607

**Source**
ToetsingOnline

**Brief title**
Transcranial ultrasonic stimulation of the primary motor cortex

### Condition

- Other condition

**Synonym**
brain

**Health condition**

Neuroscience research (basic science)

**Research involving**
Human

## Sponsors and support

**Primary sponsor:** Radboud Universiteit Nijmegen
**Source(s) of monetary or material Support:** Ministerie van OC&W

## Intervention

**Keyword:** transcranial magnetic stimulation corticospinal excitability, transcranial ultrasonic stimulation primary motor cortex

## Outcome measures

### Primary outcome

We will use electromyography (EMG) to measure motor-evoked potentials (MEPs)

over the first dorsal interosseous (FDI) elicited by TMS applied over M1. Here,

MEP peak-to-peak amplitude is our primary outcome measure.

### Secondary outcome

To determine how well participants are able to discriminate between the

ultrasound conditions (sham / active control / verum TUS), including when an

auditory mask is played on top of active control and verum TUS, participants

will be asked the following questions for 10 additional trials per condition:

*Do you think you received ultrasonic stimulation (yes/no)?* and *On which side

do you think you were stimulated (left/right)?*. Their accuracy/ability to

discriminate between conditions is the secondary outcome of this study.

# Study description

### Background summary

Transcranial ultrasonic stimulation (TUS) is a non-invasive brain stimulation (NIBS) technique characterised by its superior spatial focality and ability to reach both superficial and deep regions of the brain. At present, it is important to confirm the fundamental neurophysiological effects of TUS. This

can be achieved by measuring the impact of TUS on the excitability of the primary motor cortex (M1). Previous research has combined TUS with transcranial magnetic stimulation (TMS) and observed a reduced amplitude of TMS-elicited muscle twitches with TUS than without TUS. Considering the fundamental nature of these findings, independent replications are required to confirm and expand our understanding of the fundamental neurophysiological effects of TUS. In fact, in a recently conducted study, we were able to replicate the original findings, but could also offer a more parsimonious explanation for the observed effects separating effects of specific neuromodulation and auditory cueing. In the present study, we seek to confirm these initial findings in a design with a reduced number of principal conditions to improve study efficiency. This effort may help to better assess the neuromodulatory potential of ultrasound stimulation and its auditory confounds to inform the experimental design of future studies.

## Study objective

To confirm our previous findings that both TUS and auditory cuing decreases MEP amplitude in an independent sample using a more efficient design. Reducing the number of principal conditions will benefit data quality and allow for better estimation of effect size.

## Study design

The present study will be a single-blind randomized sham-controlled trial. The study consists of two sessions. The first session involves structural MRI scans. The second session involves brain stimulation. In the brain stimulation session, there are three within-subject factors. The first is TUS (sham TUS [sound only] / active control TUS [contralateral face area stimulation] / verum TUS [on-target hand area stimulation]). The second is stimulus duration (100ms / 500ms). The third is auditory masking (no masking/masking).

## Intervention

Participants will receive TMS at standard supra-threshold intensity and TUS at standard sub-threshold intensity.

## Study burden and risks

Participants will receive no direct benefit from participating, though participants will be financially compensated where applicable. However, participants may see benefit in gaining first-hand experience with TUS. Before participation, all subjects will be thoroughly screened for contraindications for NIBS and MRI. TMS is a widely used NIBS technique and is associated with minimal risk. There have been no reports of serious adverse events in healthy participants when using protocols in accordance with published safety

guidelines (i.e., Rossi et al., 2020; see Donders NIBS SOP). The estimated risk for participating in TUS experiments is minimal. TUS for human neuromodulation has never resulted in serious adverse events (Pasquinelli et al., 2019). In fact, there have been no reports of serious adverse events related to diagnostic ultrasound either (ter Haar, 2010). Safety is further secured by adherence of TUS experiments to internationally recognized guidelines (e.g., from the Food and Drug Administration) for diagnostic ultrasound. For both TMS and TUS, minor side effects may include light transient headache and fatigue. All in all, the risk and burden associated with participation is considered minimal, and we do not expect any serious adverse events during the project.

# Contacts

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# Trial sites

## Listed location countries

Netherlands

# Eligibility criteria

**Age**
Adults (18-64 years)

## Inclusion criteria

- Between 18-40 years of age

- Right handed
- The ability and agreement to provide informed consent, and the ability to fulfil the study's requirements

### Exclusion criteria

• Under 18 years of age
• Current pregnancy
• Claustrophobia
• A history or brain surgery or serious head trauma
• A history of or any close relatives (parents, siblings, children) with epilepsy, convulsion, or seizure
• Predisposition for fainting spells (syncope)
• A cardiac pacemaker or intra-cardiac lines
• An implanted neurostimulator
• Implanted medication infusion device
• Implanted metal devices or large ferromagnetic fragments in the head or upper body (excluding dental wire), or jewellery/piercing that cannot be removed • Use of a medical plaster that cannot or may not be taken off (e.g., nicotine plaster)
• Cochlear implants
• Metal in the brain, skull, or elsewhere in your body (fragments, clips, etc.)
• Diagnosed neurological or psychiatric disorders
• Use of psychoactive (prescription) medication (excluding anti-conception)
• Skin disease at intended stimulation sites
• The consumption of more than four alcoholic units within 24 hours before participation or any recreational drugs within 48 hours before participation
• All other criteria relevant to non-invasive brain stimulation as reported in the Donders Standard Operating Procedures for Non-Invasive Brain Stimulation

## Study design

### Design

**Study type:** Interventional

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|---|---|
| Masking: | Single blinded (masking used) |
| Control: | Uncontrolled |
| Primary purpose: | Other |

### Recruitment

NL

| | |
|---|---|
| Recruitment status: | Recruitment stopped |
| Start date (anticipated): | 16-05-2022 |
| Enrollment: | 30 |
| Type: | Actual |

### Medical products/devices used

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|---|---|
| Generic name: | NeuroFUS Pro - low intensity transcranial ultrasonic stimulation |
| Registration: | No |

## Ethics review

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|---|---|
| Approved WMO Date: | 28-04-2022 |
| Application type: | First submission |
| Review commission: | CMO regio Arnhem-Nijmegen (Nijmegen) |

## Study registrations

### Followed up by the following (possibly more current) registration

No registrations found.

### Other (possibly less up-to-date) registrations in this register

No registrations found.

### In other registers

| Register | ID |
|---|---|
| CCMO | NL80331.091.22 |