TRANSCRANIAL ELECTRICAL STIMULATION EFFECTS ON 40HZ AUDITORY STEADY-STATE RESPONSE

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Type: Research on the existing data set

Where: Online, Belgrade (Serbia) & Vilnius (Lithuania)

When: April 2023 – March 2024

Methods & techniques: Electroencephalography (EEG), Transcranial electrical stimulation (TES), Transcranial direct current (tDCS), transcranial alternating current (tACS)

ABOUT THE MENTOR

Inga Griskova Bulanova is a Research professor at University of Vilnius (Lithuania) and Senior researcher at Institute for Medical Research, University of Belgrade (Serbia).

She has expertise in electrophysiology and explores state- and trait-dependent features in EEG. She is interested in the nature and significance of the periodic brain responses to auditory stimulation, EEG applications for individualized guidance of training, therapy, and treatment encompassing brain-computer interface, neurofeedback, and brain stimulation approaches.

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Check out one of her works: Griskova-Bulanova I, Sveistyte K, Bjekic J. (2020) Neuromodulation of gamma-range auditory steady-state responses: a scoping review of brain stimulation studies. Frontiers in Systems Neuroscience 14:41

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About the Topic

The steady-state response (SSR) is a strong oscillatory neural activity evoked by rhythmic stimulation. The resulting entrainment of cortical electrical activity is typically seen following rhythmic photic stimulation, i.e., photic driving, but is also elicited by other sensory stimuli, such as somatosensory or acoustic stimulation. The sinusoidal electrical activity, frequency and phase locked to the rate of the eliciting stimulus presentation, typically tends to spread over the scalp and can be seen in the EEG far beyond the area over the primary sensory cortex involved in processing the stimulus modality. Besides their role in studying the physiology of sensory processing, the SSRs provide a unique experimental model of stable externally controlled cortical electrical activity which is not subject to unpredictable random variations typical for standard EEG and conventional evoked potentials. In the context of non-invasive brain stimulation (NIBS) research, this feature of the SSRs offers a possibility to better explore the localised cortical effects of the NIBS technique used.

What will be done?

We will analyse EEG data to assess the effects of electrical stimulation and write an article about the results.

The 40Hz auditory steady-state response – ASSR, is an obligatory CNS response to the rhythmic acoustic stimulation delivered at 40Hz. It is relatively easy to elicit in most people, while it does not have safety concerns (in contrast to the risk of seizures with photic stimulation for example). Although generated within the auditory system, it spreads well beyond the auditory cortex and can be seen in the EEG over a wide scalp area. The data on 40Hz ASSR were collected following tDCS, tACS, theta-modulated otDCS, and sham in a within-subject design experiment. The dataset consists of 168 recordings: 42 participants x 4 stimulation conditions. Analysis of the changes in the ASSR features in the EEG from the targeted region (i.e., PPC), as well as globally, would provide distinctive information on the differential effects of these NIBS techniques on cortical functioning. Moreover, since both oscillatory types of NIBS (tACS and otDCS) were delivered in the theta frequency range, additional information on gamma-theta interactions may be generated.
This is important since the results will help us better understand the physiological responses to different NIBS protocols.

The group of 3-4 selected early-stage researchers will be working under the supervision of Dr Griškova Bulanova in collaboration with Jovana Bjekić and Saša Filipović.

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

What will you learn?

- ✓ How to analyse EEG data (focusing on ASSR)
- ✓ How different types of electrical brain stimulation work and how they affect EEG
- ✓ How to pre-register hypothesis and create/share materials in line with Open science practices
- ✓ How to perform statistical analysis and present results
- ✓ How to write a scientific paper, select a suitable journal and complete all the steps in the peer review process

Career benefits

- ✓ Learning about different NIBS techniques – tDCS, tACS, otDCS
- ✓ Advancing your signal processing and data analysis skills
- ✓ Networking and learning journey with experts in neurophysiology and NIBS
- ✓ Establishing connections with peers and enhancing your soft skills to work in an international team
- ✓ Contributing to planned publication as co-authors

What is your role?

You will work in the international team to analyse the data and write a manuscript for publication. You will participate in regular online meetings and the ESR who takes the lead will present the study at an international conference.

ESRs ENGAGEMENT REQUIREMENTS

Time requirements

Each participant is expected to dedicate 4 days a month over a period of 12 months. You will have a keep-on-track monthly online meeting with the mentor and the team members. The working hours will be mostly flexible, and the dynamic will depend on work progress.

Physical location

The work can be done fully remotely.
The option to visit Belgrade and/or Vilnius for a joint analysis camp will be open depending on the participants' availability to travel.

Skills and knowledge

For joining the group, you should have basic knowledge about EEG analysis, and be familiar with transcranial electric current stimulation (no need for formal courses, this can be achieved by reading the literature)
The advantage will be given to candidates with Matlab and EEG analysis skills.