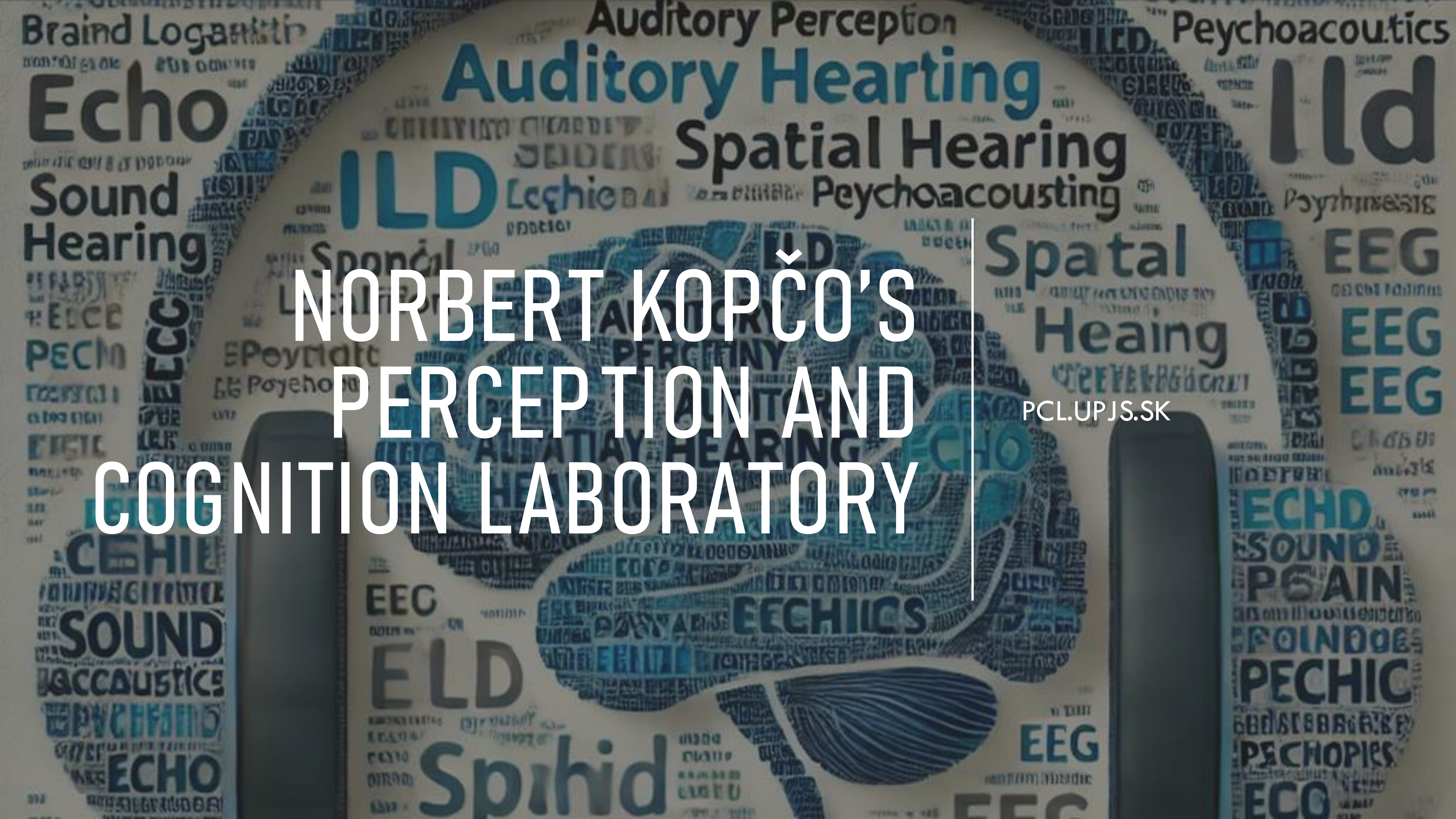
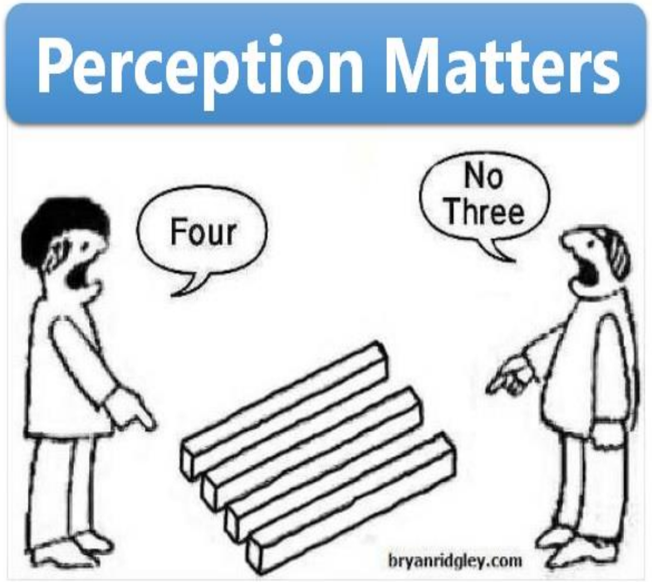


NORBERT KOPČO'S PERCEPTION AND COGNITION LABORATORY

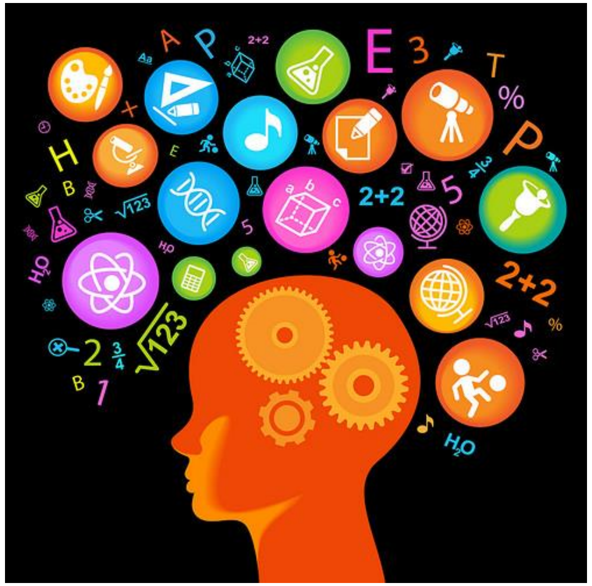
PCL.UPJS.SK

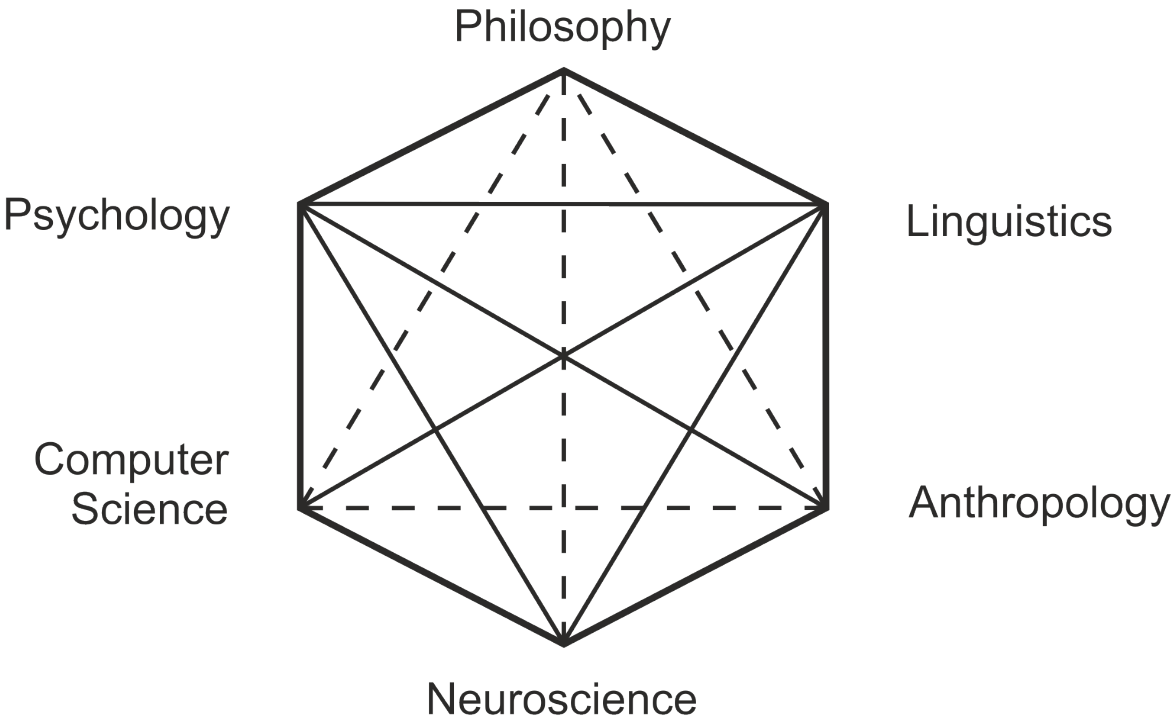
PERCEPTION AND COGNITION

Perception is the process of getting, interpreting, selecting, and organizing sensory information.



Cognition refers to "the mental action or process of acquiring knowledge and understanding through, experience, and the senses".



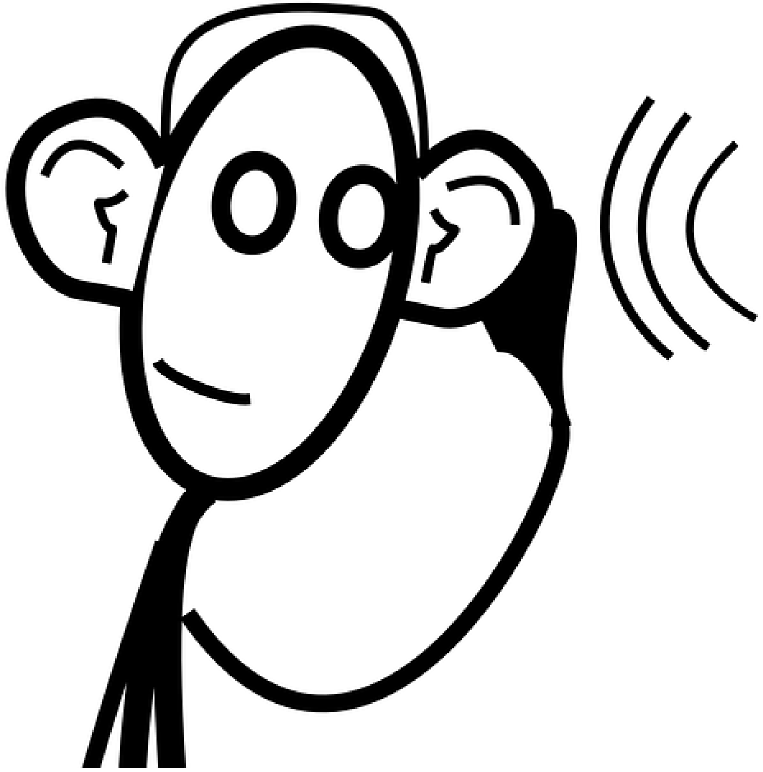


Adapted from Gardner, Howard (1985).
The mind's new science: A history of the cognitive revolution.
New York: Basic Books, Inc.

COGNITIVE SCIENCE

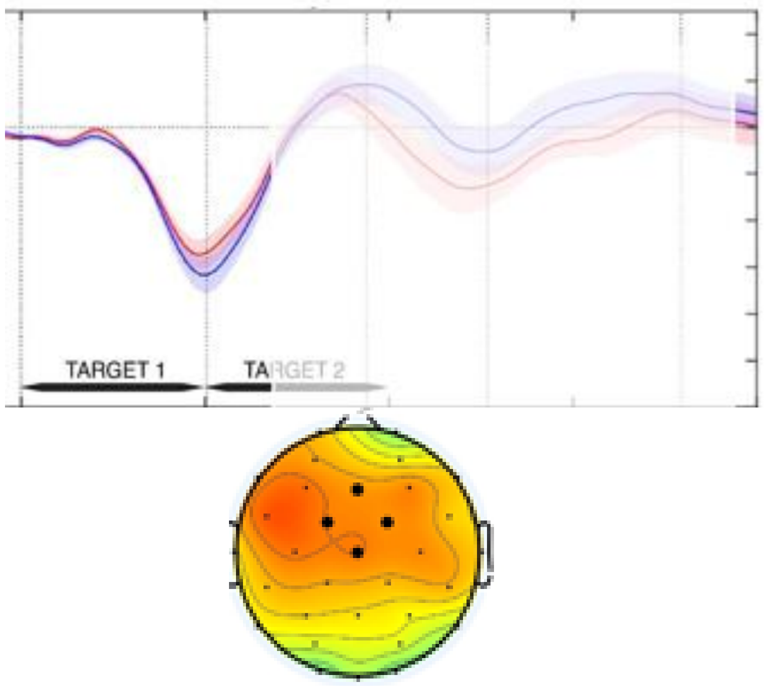
OUR RESEARCH:

- Auditory perception (mainly spatial hearing)
- Sound localization, Separation of sounds and speech intelligibility
- Related topics: audio-visual interactions, attention, ventriloquism, etc.

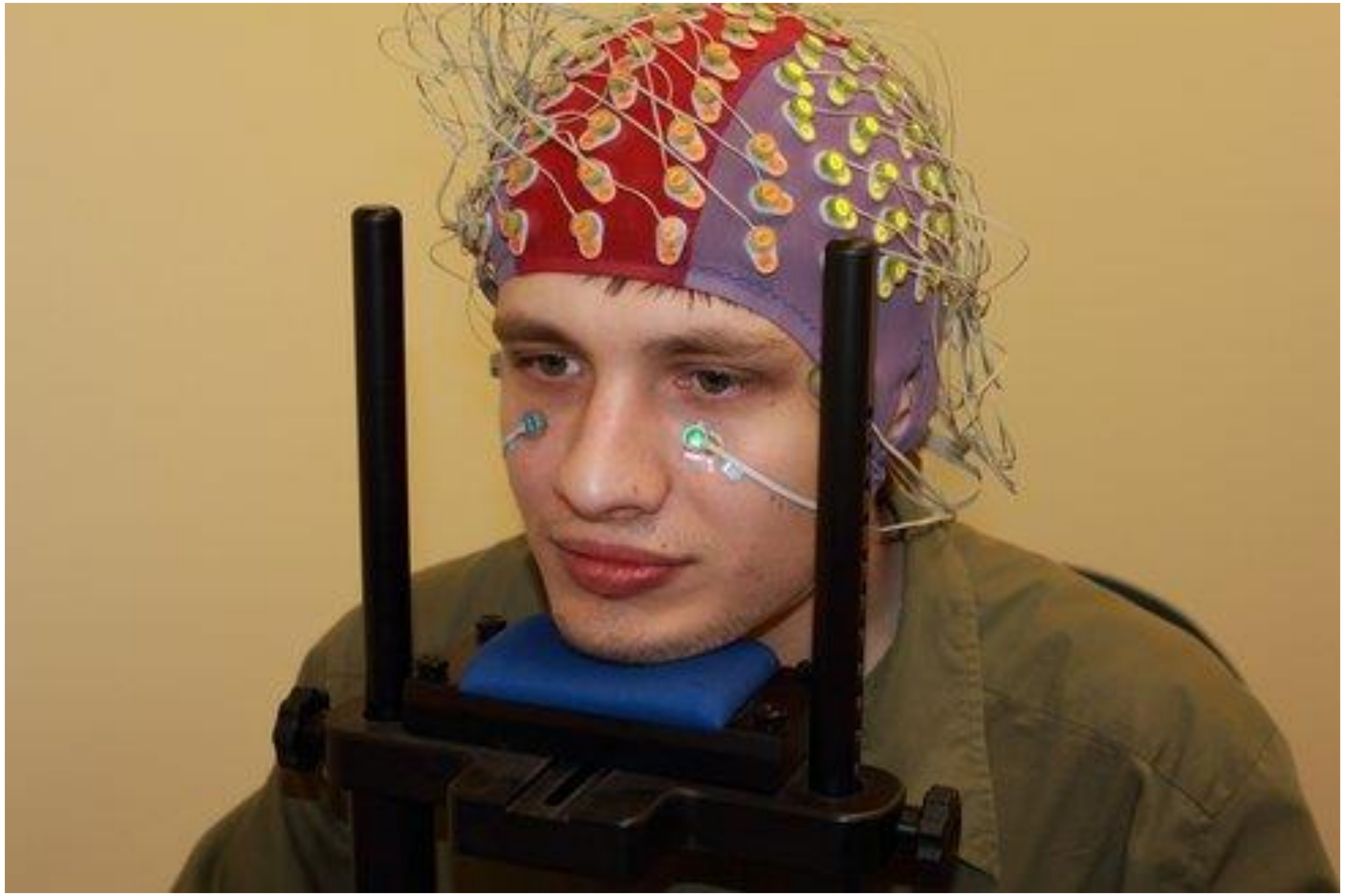


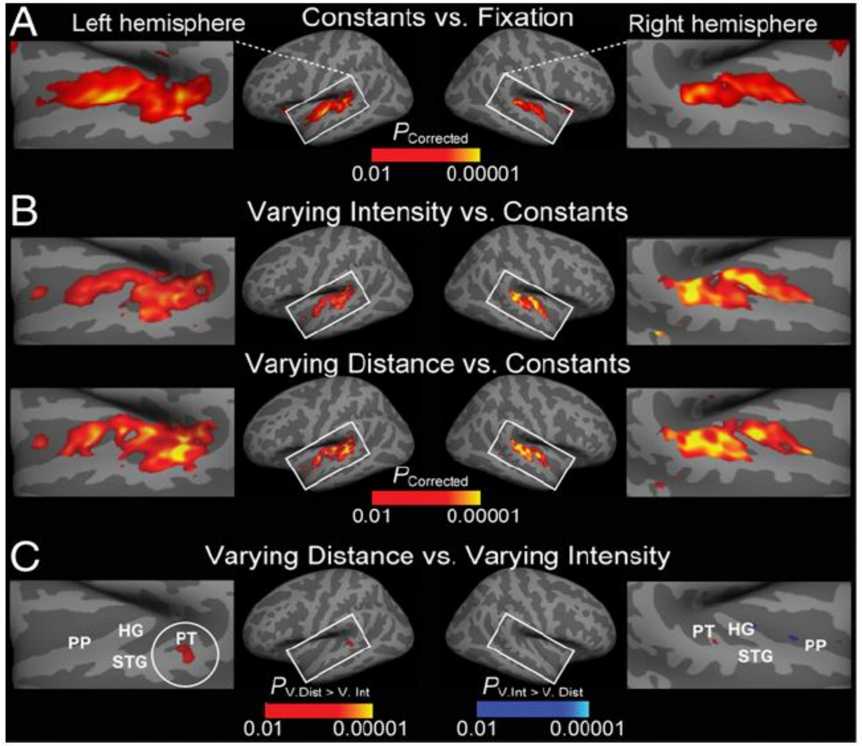
METHODS: 1) BEHAVIORAL EXPERIMENTS

METHODS: 2) EEG (ELECTROENCEPHALOGRAM)



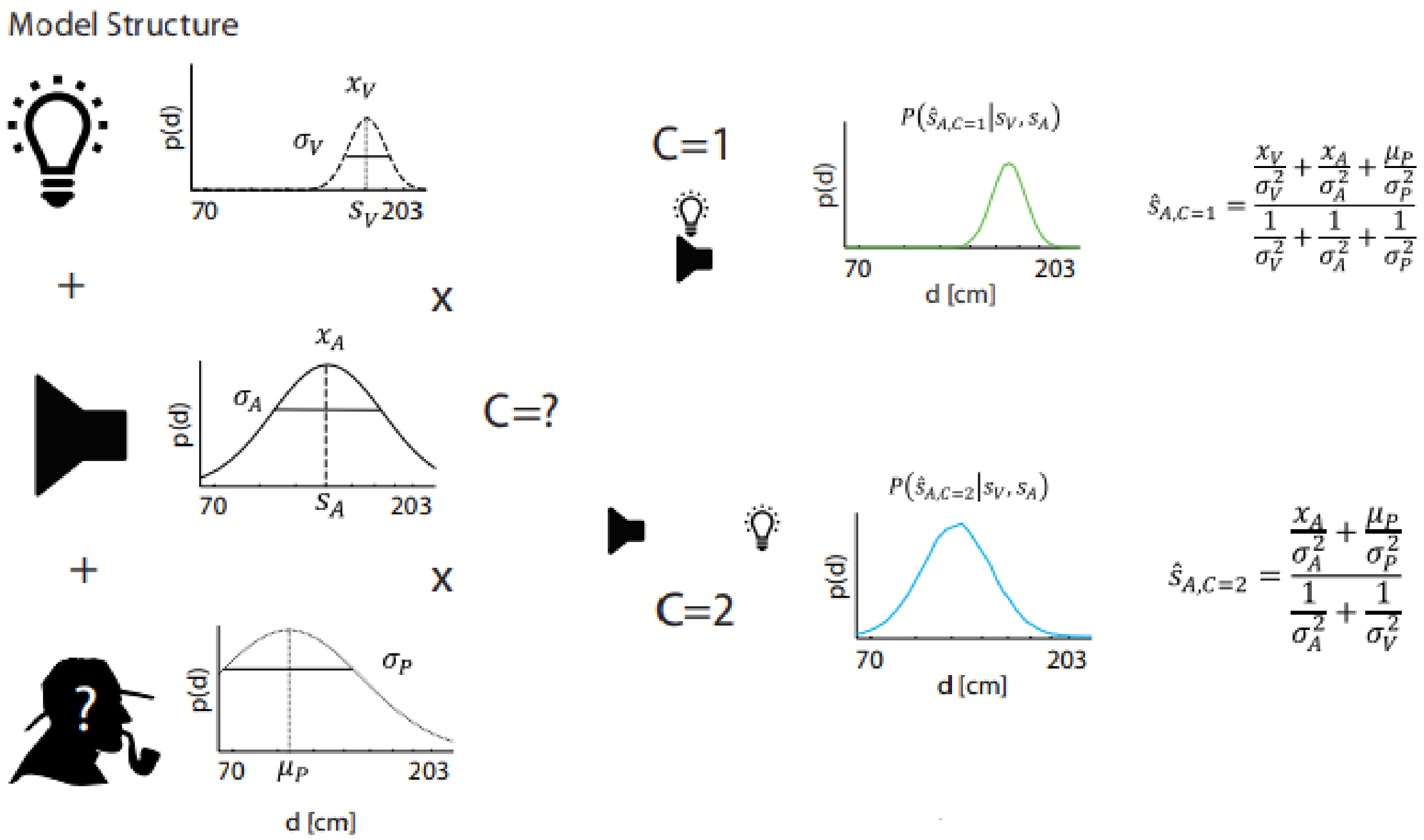
-(Šebeňa, Kopčo, '21)





METHODS: 3) FMRI (FUNCTIONAL MAGNETIC RESONANCE IMAGING)

METHODS: 4) MODELLING

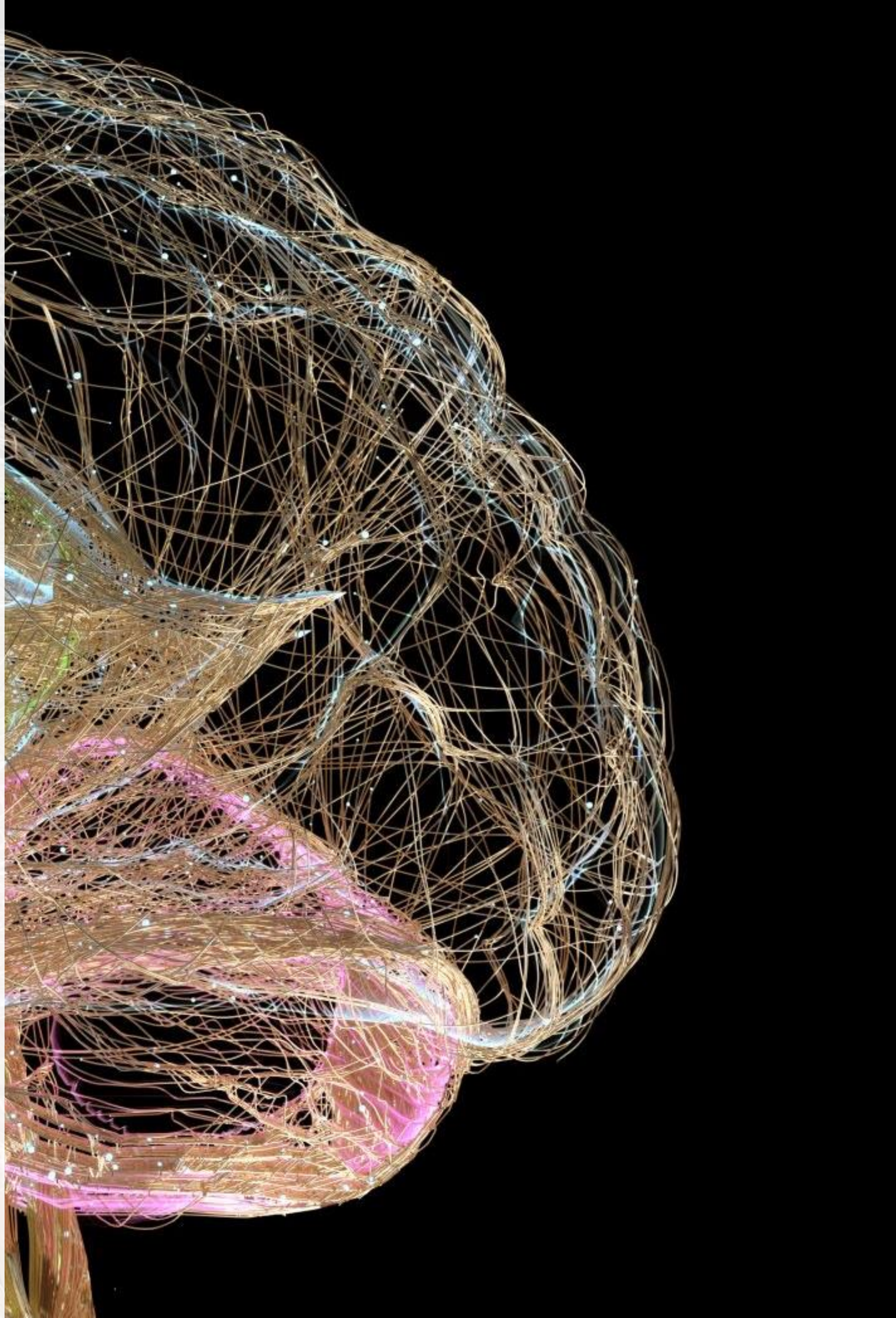


Hládek, Ľ., Seitz, & Kopčo, N. "Modeling the Integration of Audio-Visual Distance Information", presented at ARO 2016

OFFERED BACHELOR THESES

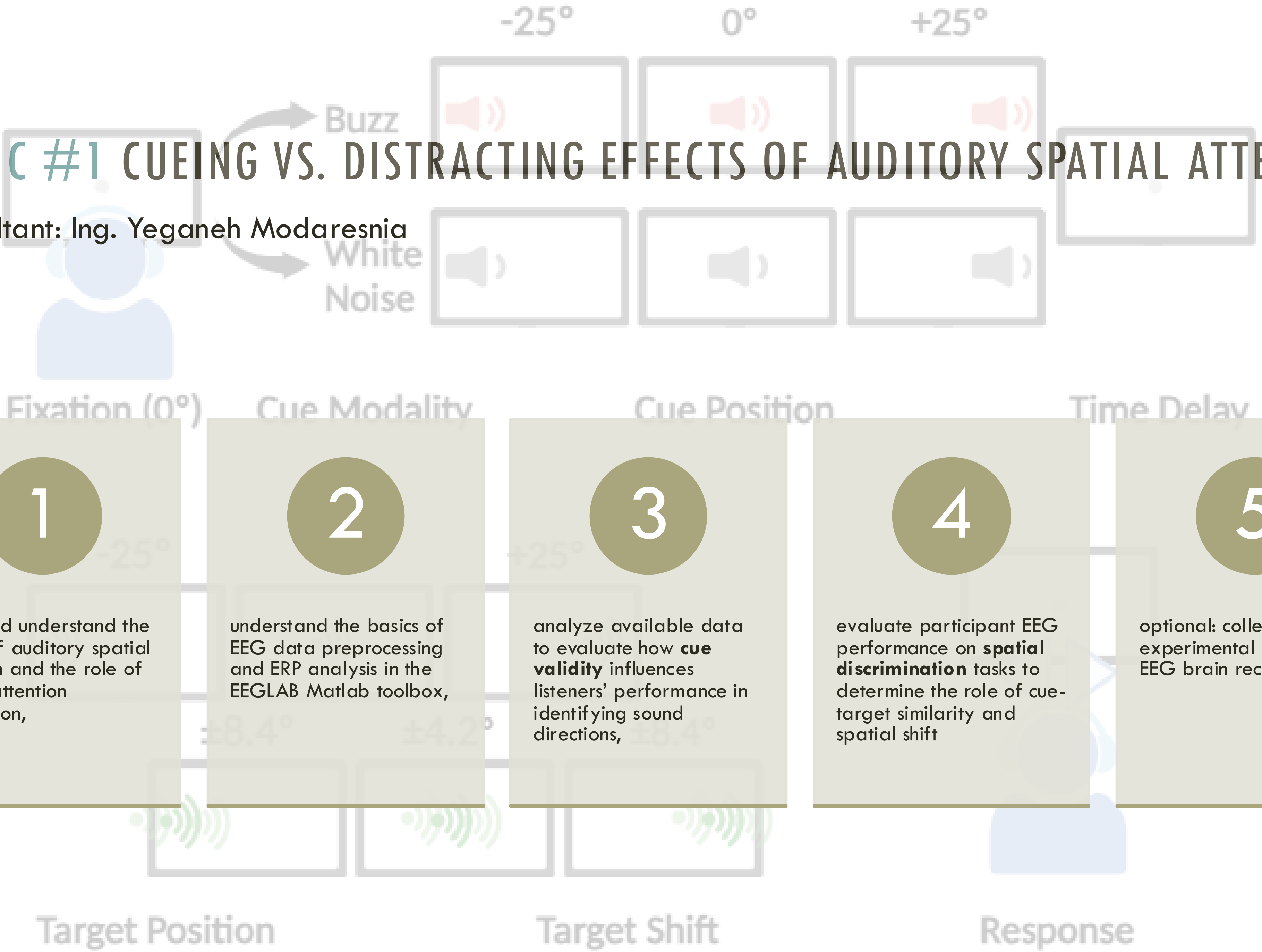
Doc. Ing. Norbert Kopčo, PhD. – supervisor

1) Cueing vs. distracting effects of auditory spatial attention (Y. Modaresnia)
2) Rapid adaptation in audio-visual spatial perception (P. Loksa)
3) Plasticity in audio-visual spatial perception (P. Loksa)
4) Auditory distance perception in fixed and varying simulated acoustic environments (M. Fedorenko)
5) Neural encoding of auditory distance information in the human brain (K. Doreswamy)
6) Reweighting of binaural sound localization cues in virtual environment (U. Singhal)
7) Contextual plasticity and scaling in virtual environment (G. Andrejkova)



TOPIC #1 CUEING VS. DISTRACTING EFFECTS OF AUDITORY SPATIAL ATTENTION

Consultant: Ing. Yeganeh Modaresnia



1. learn and understand the basics of auditory spatial attention and the role of cues in attention orientation,

2. understand the basics of EEG data preprocessing and ERP analysis in the EEGLAB Matlab toolbox,

3. analyze available data to evaluate how **cue validity** influences listeners' performance in identifying sound directions,

4. evaluate participant EEG performance on **spatial discrimination** tasks to determine the role of cue-target similarity and spatial shift

5. optional: collect new experimental data using EEG brain recording.

TOPIC #2 RAPID ADAPTATION IN AUDIO-VISUAL SPATIAL PERCEPTION

Consultant: Dr. Peter Loksa

01

- Prepare a review in the field of plasticity in audio-visual spatial perception.

02

- Set up a system for real-time simultaneous recording head orientation, eyegaze direction and hand pointing direction.

03

- Study the experiment of Kopco et al (2009) and Kopco, Loksa et al. (2019) to test how saccade adaptation contributes to the ventriloquism effect.

04

- Analyze human and monkey experimental data to determine whether trial-to-trial adaptation is observed in the data and what is its reference frame.

Wozny, D. R., & Shams, L. (2011). Recalibration of auditory space following milliseconds of cross-modal discrepancy. *The Journal of Neuroscience*

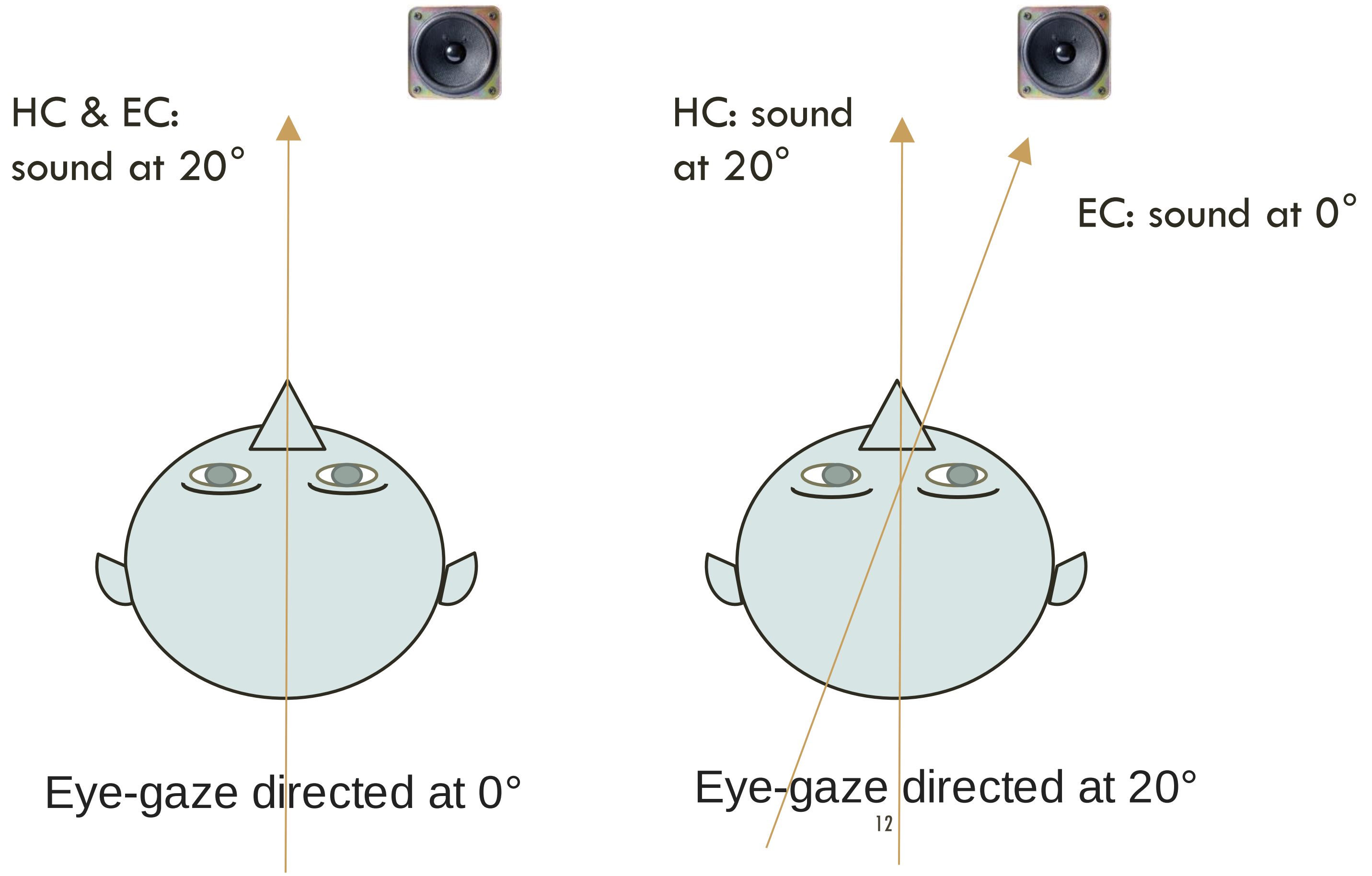
TOPIC #3 PLASTICITY IN AUDIO-VISUAL SPATIAL PERCEPTION

Consultant: Dr. Peter Loksa

In what reference frame is the visual recalibration of hearing represented?

- Is it in head-centered (HC) reference frame, like hearing?
- Is it in eye-centered (EC) reference frame, like vision?
- Or Is it in the reference frame mixed of these two?

And how are the eye-movements that are used for responding in experiments biased?



TASKS

- Prepare a review - plasticity in audio-visual spatial perception.
- Set up a system for real-time simultaneous recording head orientation, eye-gaze direction and hand pointing direction.
- Design an experiment based on Kopco, Loksa et al. (2019) to test hypothesis.
- Analyze the experimental data to determine whether adaptation induced by congruent stimuli was caused by eye saccades in Kopco, Loksa et al. (2019).

TOPIC #4 AUDITORY DISTANCE PERCEPTION IN FIXED AND VARYING SIMULATED ACOUSTIC ENVIRONMENTS

Consultant: Ing. Myroslav Fedorenko

- Collect new data and analyse them together with available data to find:
- whether listeners can maintain multiple models of auditory environments in their brains in parallel
- whether learning distance perception in different rooms is affected by consistency of room simulation

TOPIC #5 NEURAL CORRELATES OF AUDITORY DISTANCE PERCEPTION

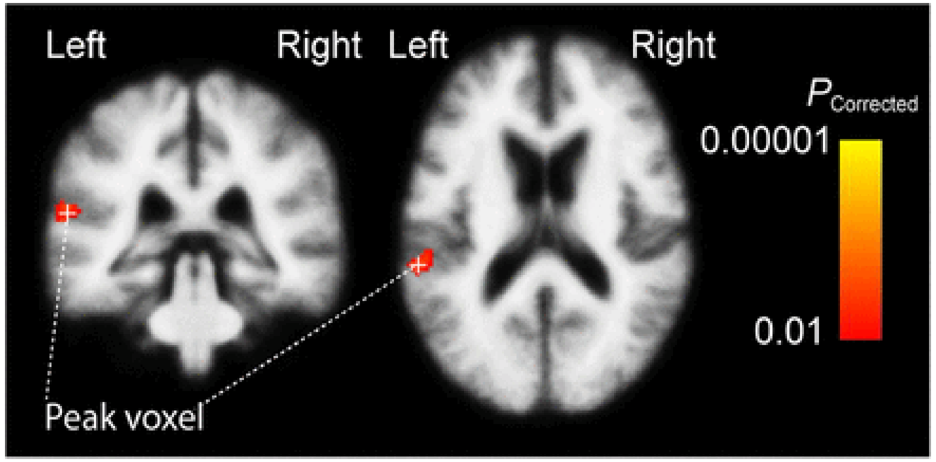
Consultant: Ing. Keerthi Doreswamy

TASKS

- Determining the distance of objects is of key value in many everyday situations.
- Neuronal mechanisms of auditory distance perception are poorly understood.
- To study and understand how we perceive distance using auditory signals.
- We combine behavioral experiments, fMRI measurements, and computational analyses to identify the neural representation of distance.

Collaborators:

- Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Harvard Medical School/Massachusetts General Hospital, Charlestown, MA
- Hearing Research Center, Boston University, Boston, MA



Kopco, Norbert, Doreswamy, K. K., Huang, S., Rossi, S., & Ahveninen, J. (2020). **Cortical auditory distance representation based on direct-to-reverberant energy ratio.** *NeuroImage*, *208*, 116436.

TOPIC #6 REWEIGHTING OF BINAURAL SOUND LOCALIZATION CUES IN A VIRTUAL ENVIRONMENT

Consultant: Ing. Udbhav Singhal

- - Examine the mechanism by which reweighting of binaural localization cues was induced by visually guided spectral reweighting training in real environments in Spisak (2021) and Hucková (2022).
- - Design and perform an experiment on two subject groups in which the spectral training is performed 1) in virtual anechoic environment, and 2) in virtual reverberant environment.
- - develop a multiple linear regression model to determine the change in weighting of binaural and spectral cues.
- - Combine the collected data with those of Spisak (2021) and Hucková (2022) to evaluate the effectiveness of visually guided training in real and virtual environments.
- - Examine the possibilities of assessing the neural correlates of reweighting by using EEG and/or enhancing it using TCS stimulation.

TOPIC #7 CONTEXTUAL PLASTICITY AND SCALING IN VIRTUAL ENVIRONMENT

Consultant: Dr. Gabriela Andrejkova

- To process an overview of the current research related to contextual plasticity.
- Modify the experimental setup in the virtual environment for the test of the dependence of responses on the range of stimuli

WHY SHOULD YOU CONSIDER OUR PROJECTS ?

- Because you like to do research, data science, challenges, solve real problems
- Additional Scientific skills (New Techniques, Instruments etc.)
- Interdisciplinary/Inter-sectoral transfer of knowledge (Workshop/Summer School/Conferences)
- Interdisciplinary projects
- International collaborators (In EU and Outside EU)
- Networking
- Improve English and communication skills

THANK YOU FOR YOUR ATTENTION

More info:
https://pcl.upjs.sk/

Contact:
kogneuro@gmail.com