Boosting your brain: Alternating current stimulation (tACS) specifically modulates speech processing

Katharina Rufener¹, Tino Zaehle² & Martin Meyer¹
¹ University Research Priority Program (URPP), Dynamics of Healthy Aging, Zurich, Switzerland
² Department of Neurology, Otto-von-Guericke University Magdeburg, Germany

Theoretical Background

- Speech processing is mainly based on short temporal information representing phoneme features¹.
- Perceptual phonemes are determined by voice onset time (VOT) and thus represent short temporal information.

Study Aims

1) Modulating VOT perception by inducing speech specific oscillation patterns with tACS.
2) Draw a causal relationship between neural oscillation patterns and processing of temporal information in the speech signal.

Study Design

Sample:
- Healthy adults: 20-28 years (n = 21, M = 24.27)
- Right-handed, normal hearing acuity, no professional music education
- German / Swiss German native speakers, no bilinguals

tACS procedure:
- Single-blind pseudo-randomized stimulation (within-subject design)
- 5x7cm electrodes over left / right auditory cortices (fig. 2)
- Frequencies: 6Hz (theta band) and 40Hz (gamma band)
- Stimulation intensity below individual lower threshold for skin sensations
  - theta: M= 1.0mA, SD= .401mA
  - gamma: M= 1.1mA, SD= .395mA

Preliminary Results

- No effect of stimulation on reaction time (RT)
- No effect of stimulation in tACS 1-3
- Main effect of stimulation in post-tACS:
  - steeper slope in theta (6Hz) vs. gamma (40Hz) tACS
  - change in steepness relies on /ta/ categorization

Discussion

- Specific alterations in VOT perception even after a short stimulation period.
- In post tACS run, VOT stimuli were categorized less precisely and less congruent in the gamma stimulation compared to the theta stimulation -> tACS affects perceptual learning?
- Next steps:
  - Investigating long-term effects of tACS in the context of speech processing.
  - Assess benefits of tACS in participants with impaired speech processing abilities

References

1 Rufener, K. et al. (in prep.). Oscillations in the adult human brain in auditory language processing.

Contact: katharina.rufener@psychologie.uzh.ch

Figure 1: spectrograms of CV syllables /da/ and /ta/

Figure 2: Current density head model, electrodes over T7 / T8

Figure 3: Task sequences

Figure 4: /ta/ responses in post tACS