Planned Study components

Official Title: **Identify Optimal Non-invasive Brain Stimulation Paradigm for Improving Peripheral Vision**

NCT number: **NCT04846140**

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A. Independent Variables

- Stimulation Type (sham, tDCS, tACS, tRNS)

B. Experimental Design and outcome Measures

- Each subject underwent HRP testing and mfVEP before and after four stimulation types, with a minimum one-week interval.
- Measures: HRP detect accuracy, HRP reaction time and the calculated mfVEP SNR in 20 degree range.

C. Covariates to examine

- Severity of glaucoma, in terms of MD (continuous).

Analysis Procedure

A. Data preparation

- Normality check: since mixed modeling is quite robust to violations of the normality assumption, so it is acceptable to use the mixed model when the dependent variable is not normally distributed. The normality check will be performed as a way to understand data distribution.
- Missing data check: the incomplete sessions will be marked with NaN. Incomplete data will also enter the analysis process, unless the number of missing values is particularly high.

B. Linear mixed model

- The linear mixed model takes the difference in accuracy rate/reaction time from HRP and the SNR from mfVEP as the observations, the stim type is modeled as the fixed effect, MD is the covariate, and the subject is taken as the random effect.
- A dummy-coding scheme with the sham condition as the reference level will be used.
- The model starts from the full model, and if it fails to converge or overfit, the random intercept and slope would be adjusted. All statistical analyses will be performed under R 4.1.0 using packages lmerTest and lme4.
- Model check: A Likelihood-ratio test will be used to check whether the current model is better than the other models without the fixed effect.

C. Results interpretation

- The likelihood-ratio test via the anova () command with the model itself will be used to test whether the fixed effect is significant across all stim types.

- A *p* value lower than 0.05 of other stimulation types will be considered a significant stim effect than the sham condition. (Meteyard & Davies, 2020)

Data and demographics summary table

Summary tables will be generated, one row per participant. Columns will include:

- subject id
- Age
- Gender
- Glaucoma MD
- Stim condition (1 is sham, 2 is tDCS, 3 is tACS, 4 is tRNS)
- difference in accuracy rate from HRP in 20 degree
- difference in reaction time from HRP in 20 degree
- difference in SNR from mfVEP in 20 degree

References:

- Meteyard, L., & Davies, R. A. (2020). Best practice guidance for linear mixed-effects models in psychological science. Journal of memory and language, 112, 104092. https://doi.org/10.1016/j.jml.2020.104092
- Brown VA. An Introduction to Linear Mixed-Effects Modeling in R. Advances in Methods and Practices in Psychological Science. 2021;4(1). doi:10.1177/2515245920960351