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Attention and Consciousness Research Group

TSTC

Decoding visible and invisible perceptual stimuli from EEG data using Machine Learning

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Aims and objectives

- Application of ML techniques to decode perceptual processes from neuroimaging (EEG) data
- Decode participants' responses to conscious detection and discrimination tasks, with the final aim of **detecting errors**.
- Develop a **closed-loop feedback** system to help participants improve their performance
- Compare the model's performance when using voltage or time-frequency representations (power)

Methods

= 30

➔ 64 high-density EEG cap

➔ 3 types of blocks:

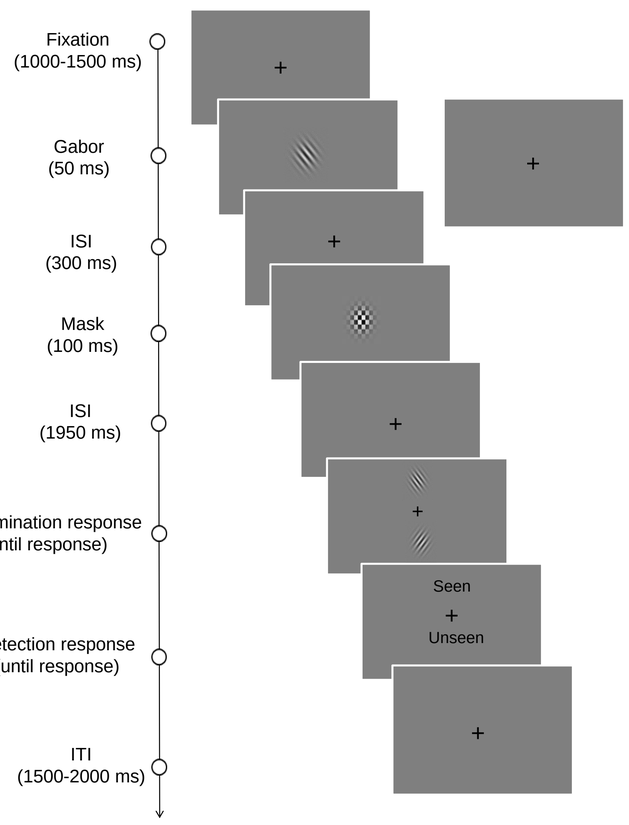
1. Titration: calibrate for ~50% seen stimuli
2. Localizer (5 blocks)
3. Experimental (10 blocks)

➔ Decoding across time

➔ Generalization analyses

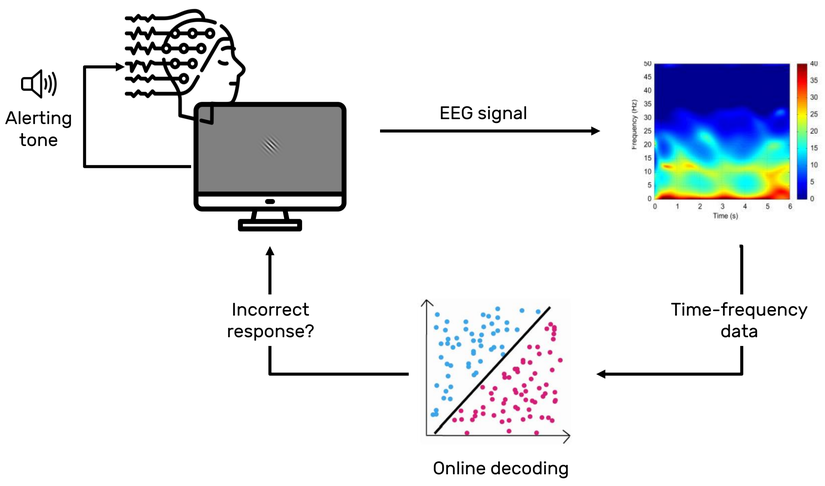
➔ Free and open-source code:

Python, MNE, scikit-learn…



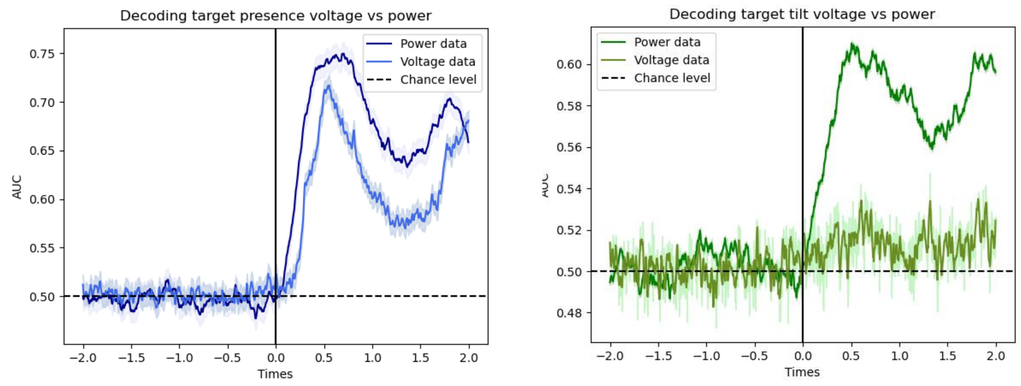
Schematic representation of the experimental procedure

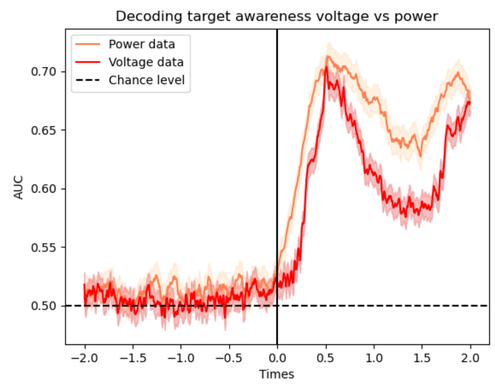
Working on…



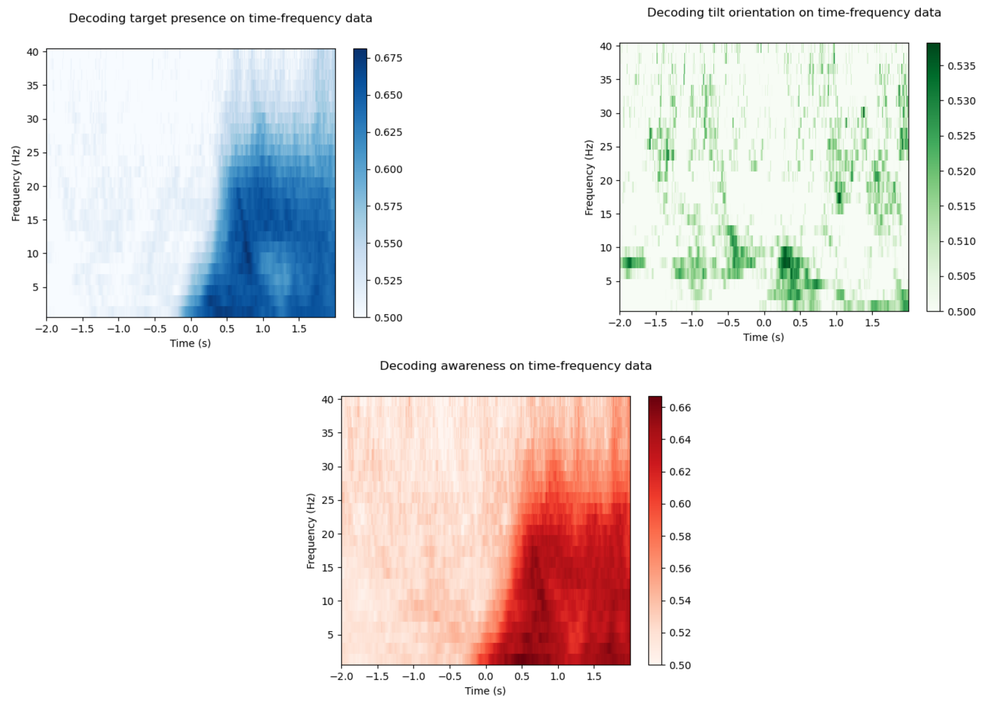
Results

Decoding across time





Time-frequency decoding



Outcomes and future work

- **Perception decoding:** we can decode task-relevant features (target presence, awareness, stimulus orientation), and decoding accuracy seems to be higher at 4-30 Hz.
- Generalization across blocks and between subjects could help reduce computational load and make the *online* analyses faster.
- For the closed-loop feedback, we need to test what type of **alerting signals** would work the best.
- We are also working on applying **drift-diffusion modelling** to our data to gain a better insight into how the decision-making process works in this task.

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