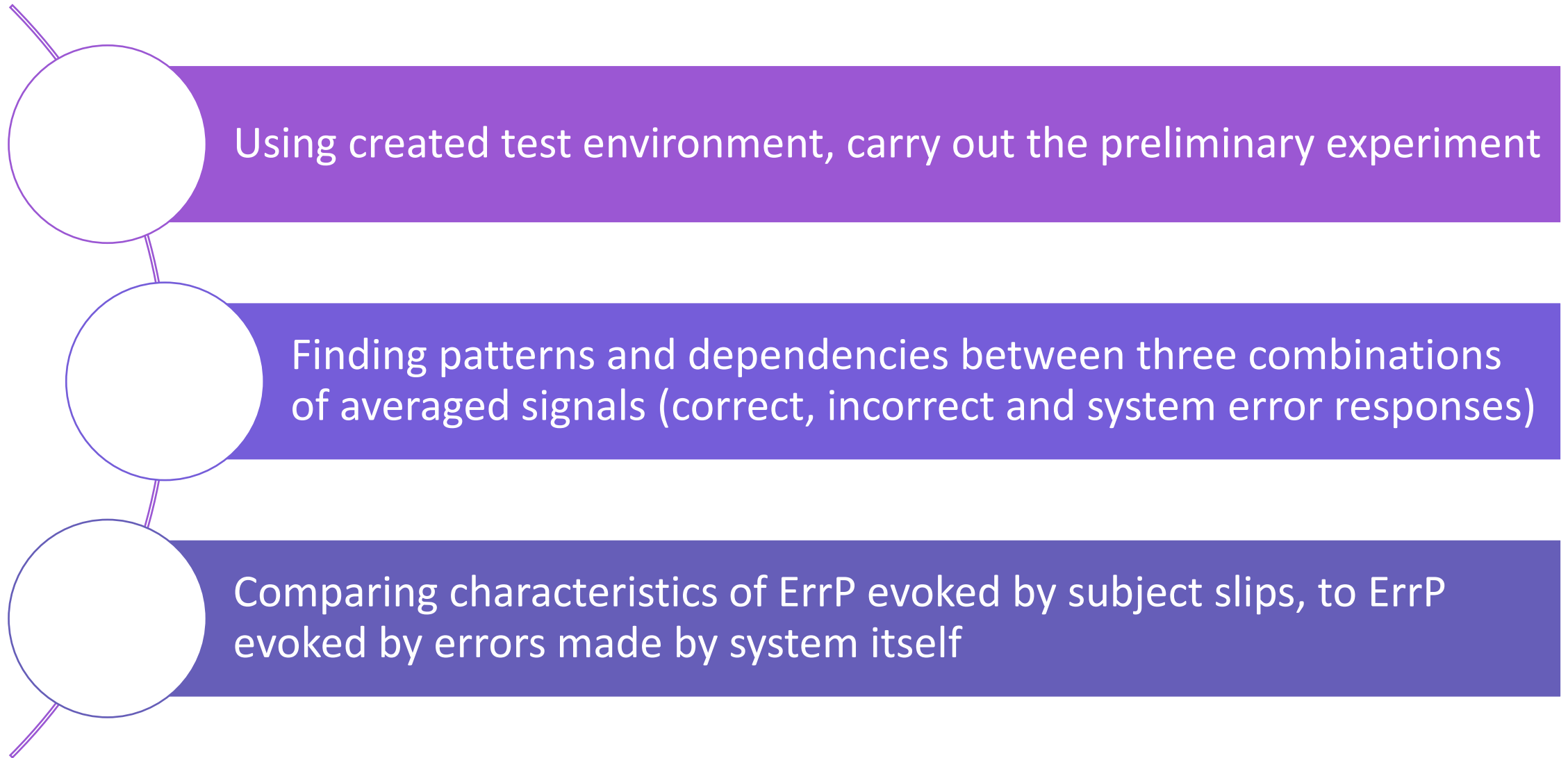


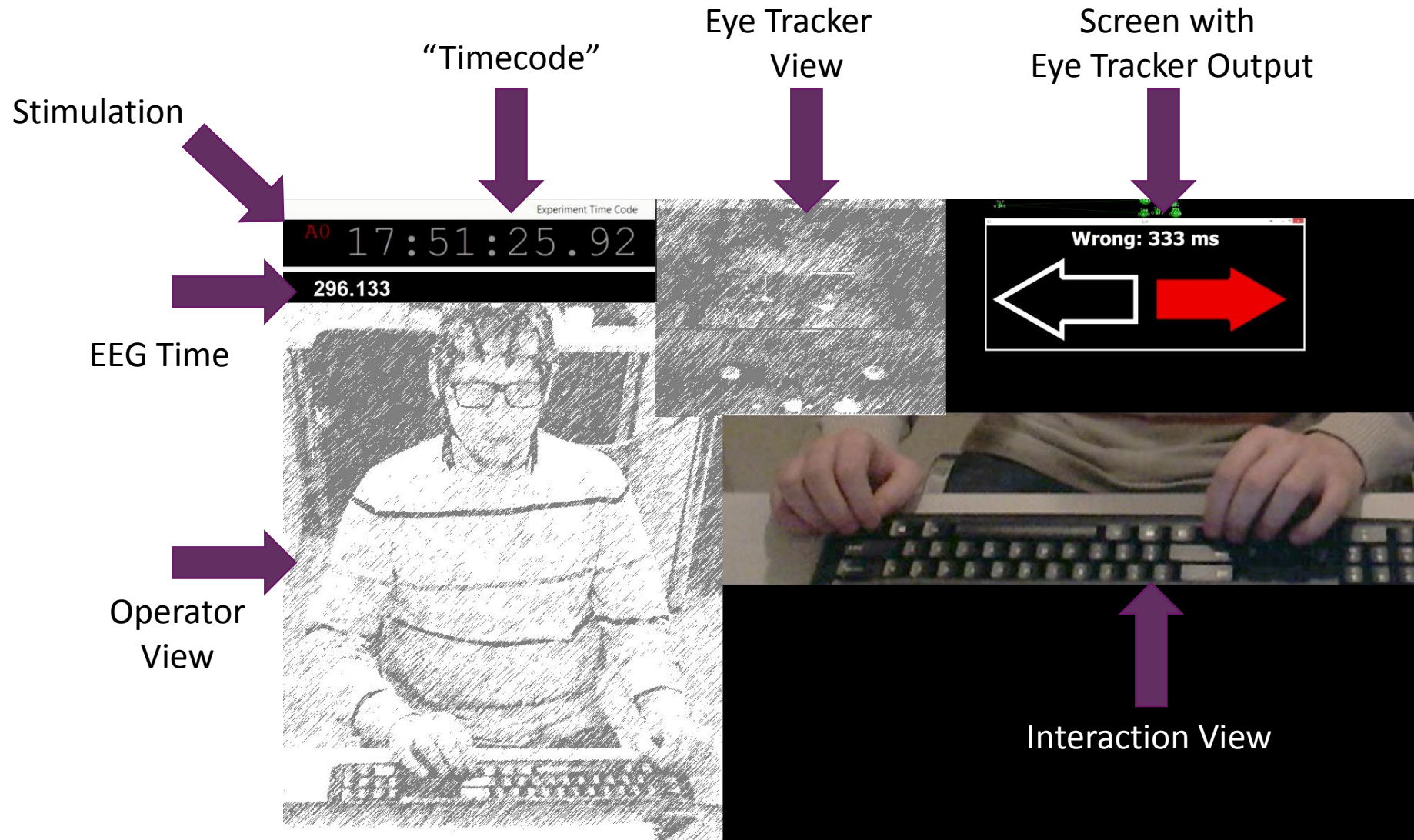
# How human perceive an application error? Error potential study

Krzysztof Moskwa  
Izabela Rejer

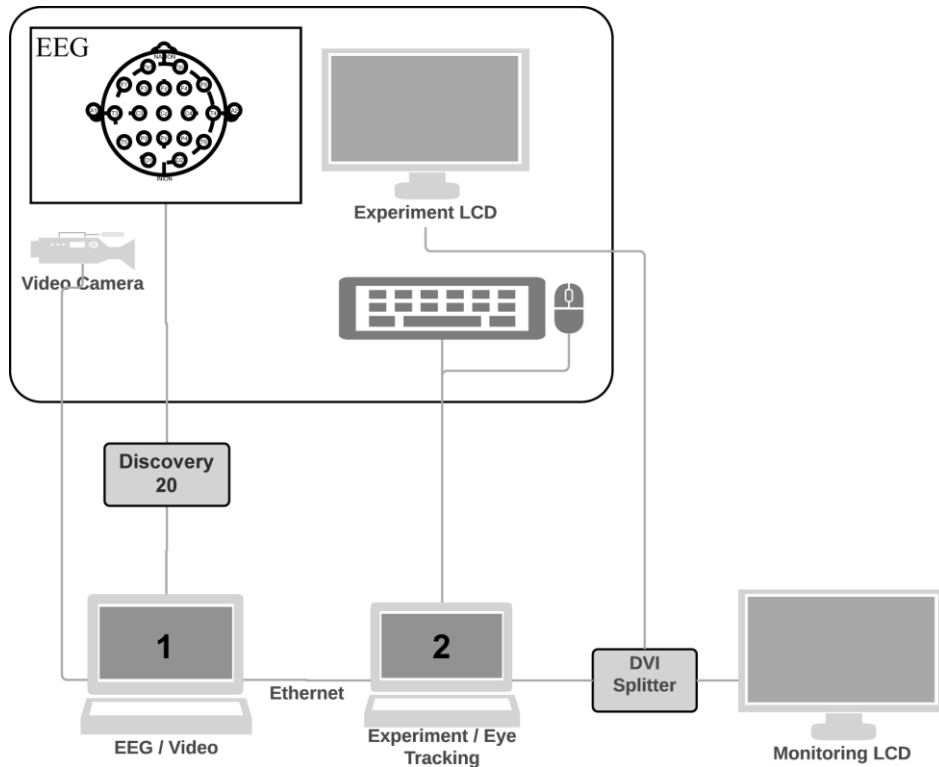
# Objectives



# Scheme of the experiment



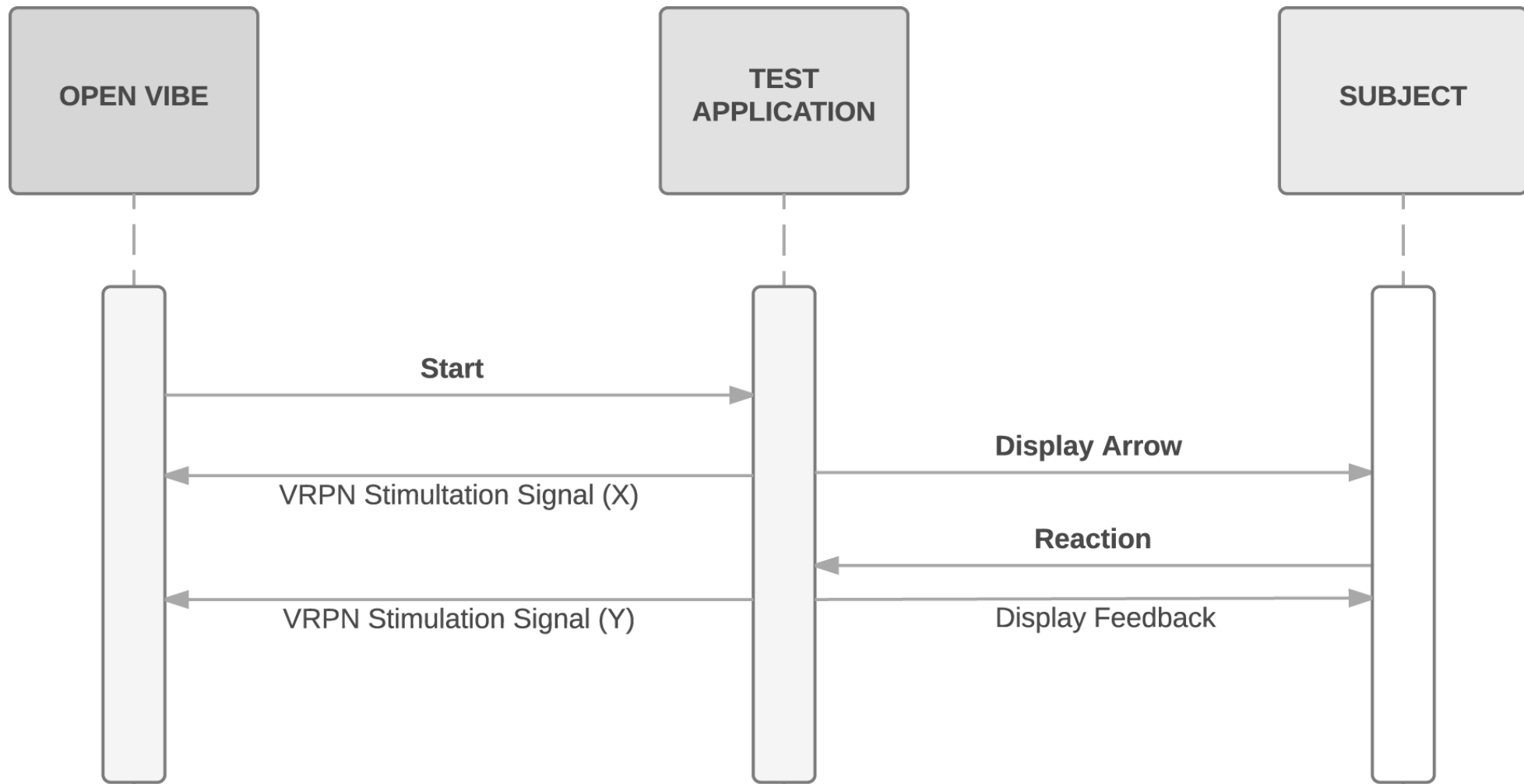
# Scheme of the experiment



- EEG data was recorded from 19 monopolar channels
- Sampling frequency of 256 Hz
- Passive electrodes connected according to the International 10-20 system
- The reference electrode placed on the left mastoid
- Ground electrode at Fz
- The impedance of the electrodes controlled with BrainMaster Discovery
- Impedance kept below 5 k $\Omega$

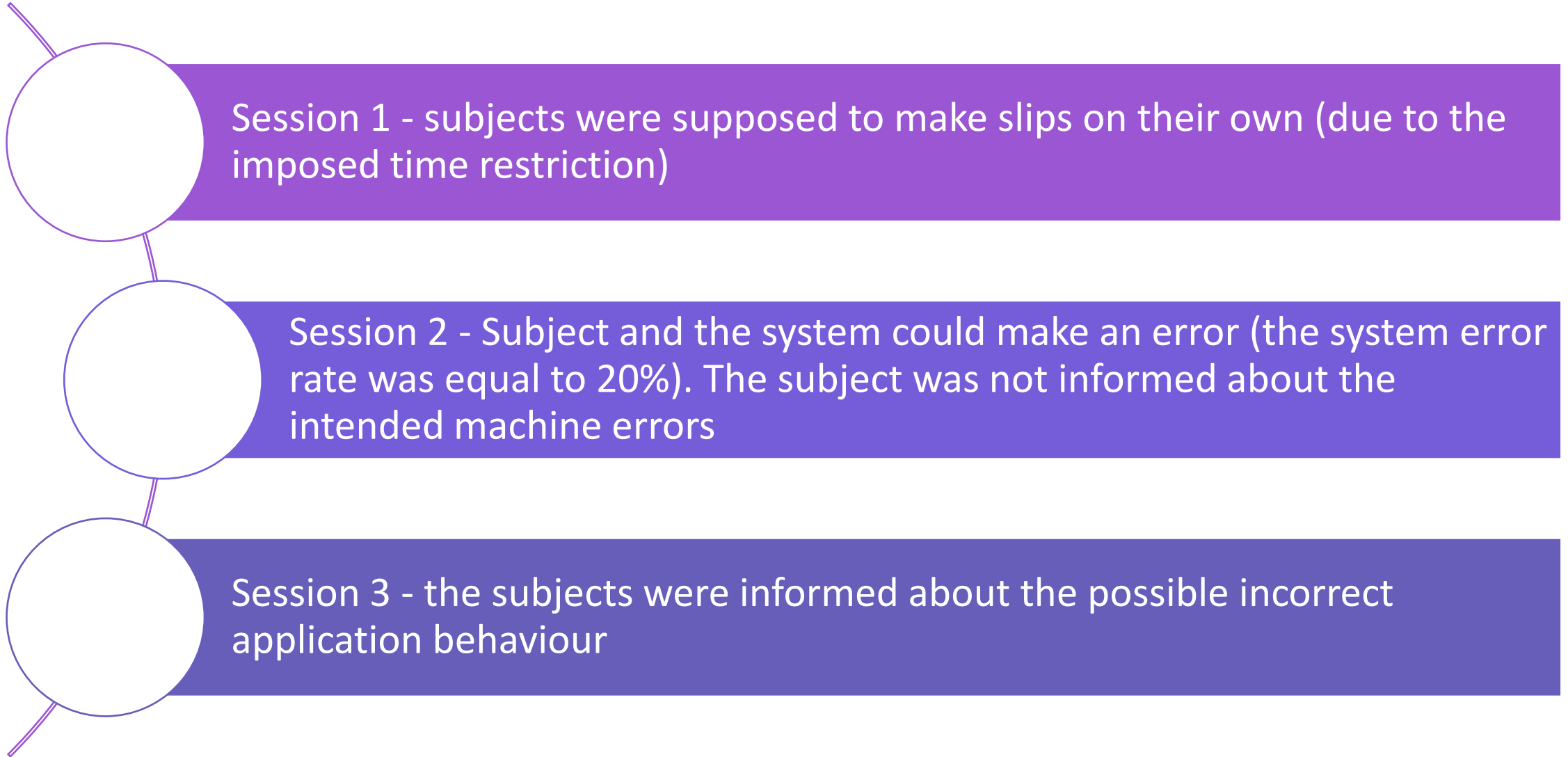
The configuration of the test environment setup. EEG signal acquired with Discovery 20 device. EEG signal and audio-video recording stored on laptop number 1. Eye-tracking data with video screen capture stored on the number 2 laptop. The experiment performed on laptop 2 - second display. The second screen output splitted to two external monitors. One for subject's operations, another for experimenter monitoring purposes

# Scheme of the experiment

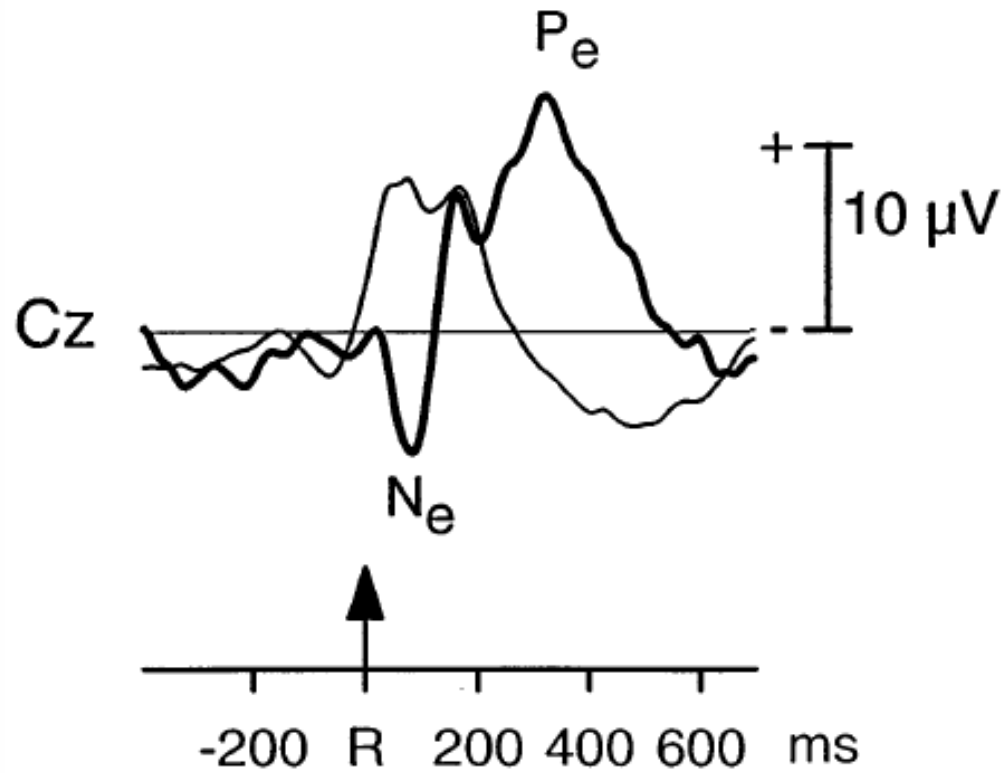


Workflow of stimulations signals transferred between OpenVibe and test application

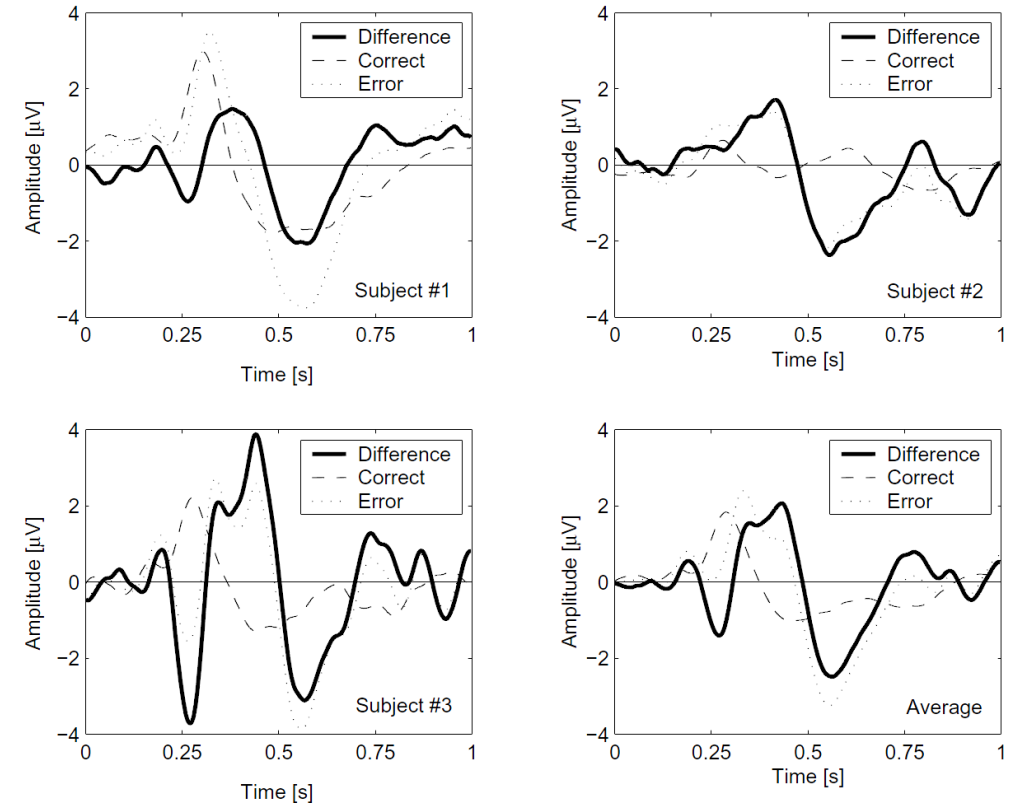
# Scheme of experiment



# What we expected?

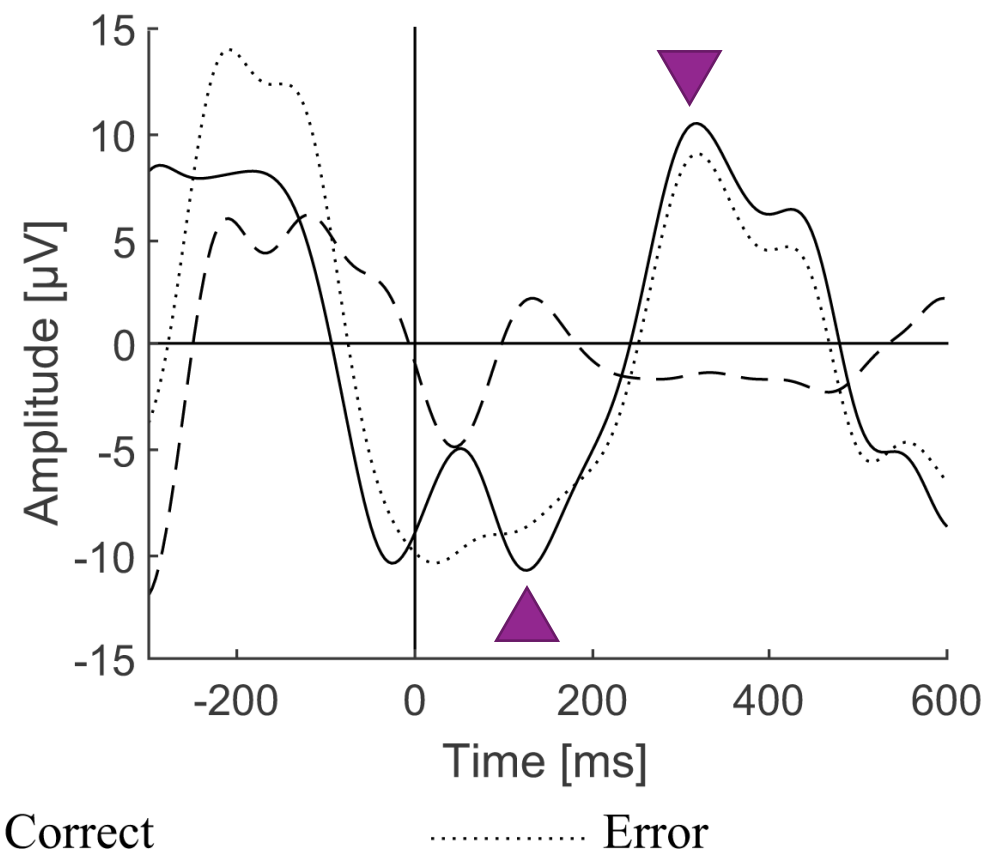
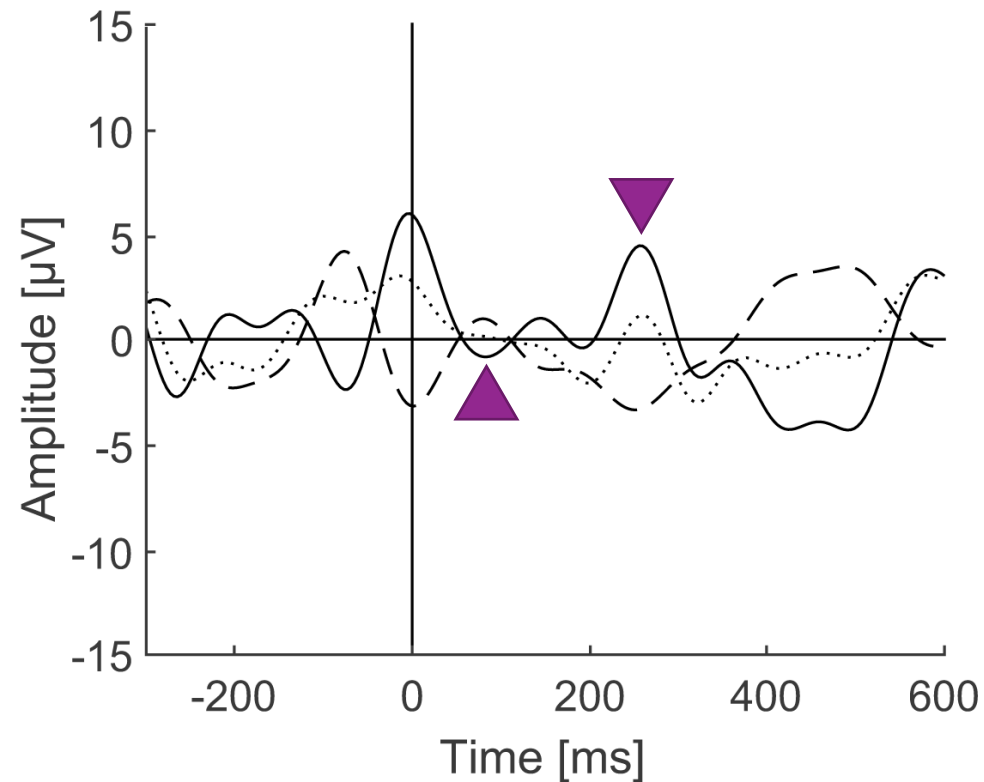


Falkenstein, M., Hoormann, J., Christ, S., and Hohnsbein, J. (2000) ERP components on reaction errors and their functional significance: a tutorial. *Biological Psychology*, 87-100



Ferrez, P.W., Millán, J.R. (2005) You Are Wrong! - Automatic Detection of Interaction Errors from Brain Waves. *Proceedings of IJCAI'2005*.1413-1418.

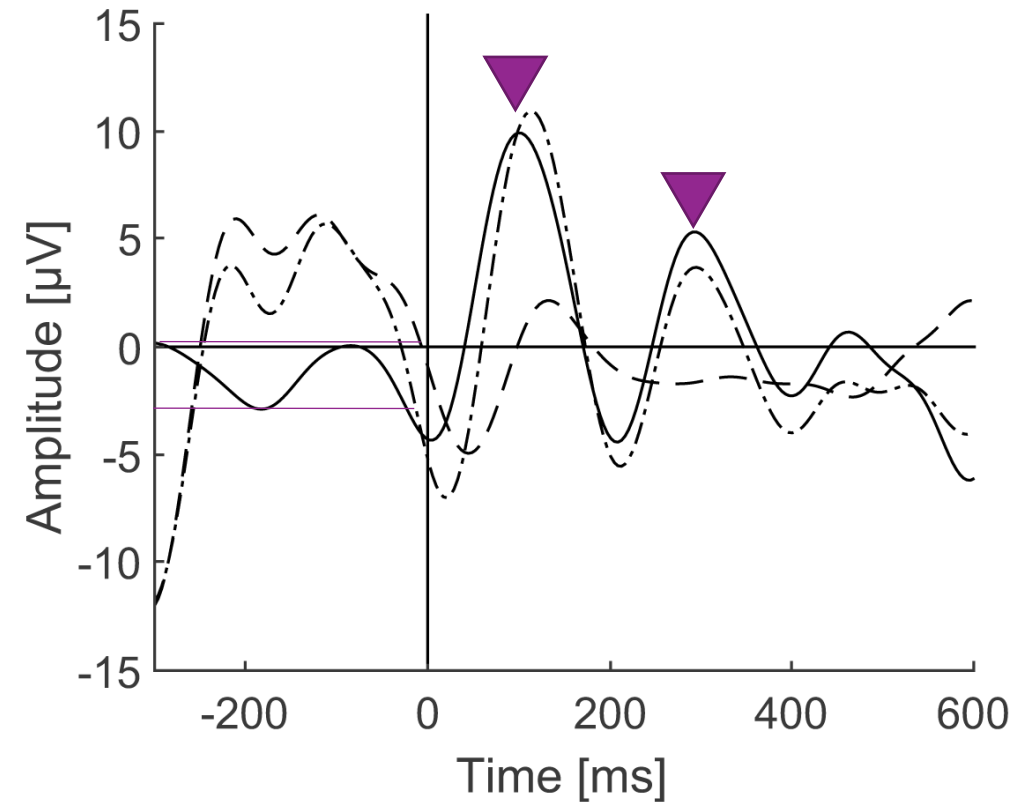
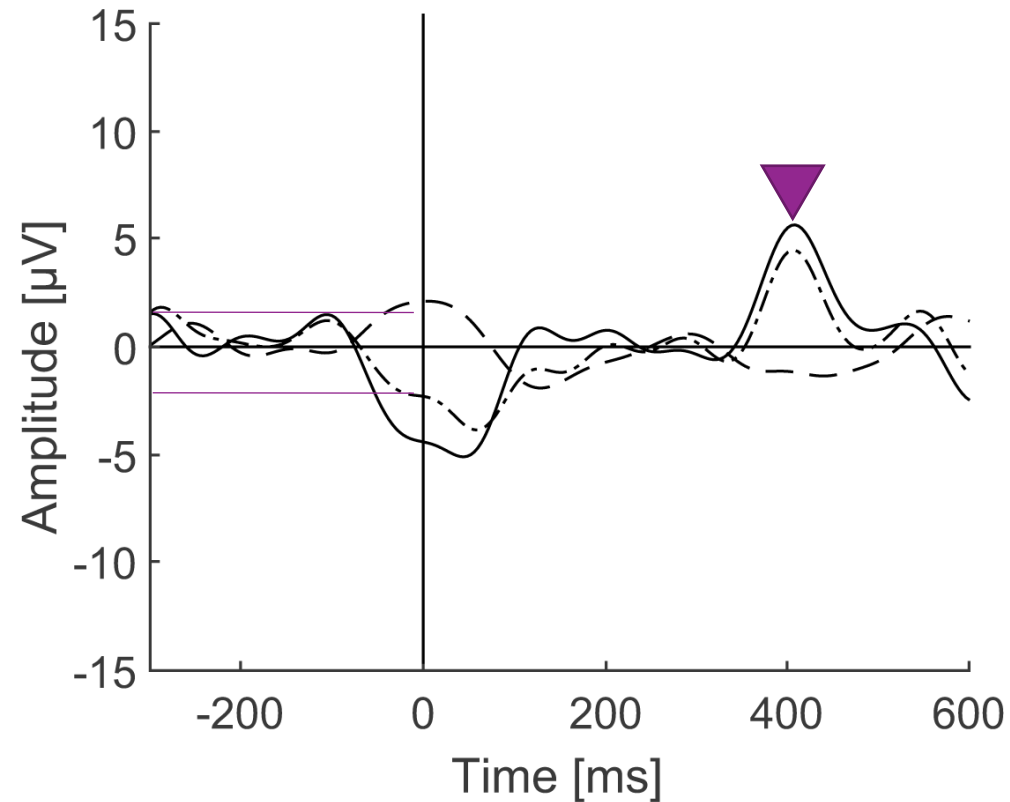
# EEG Error Potential. Case Study.



The signal average of the correct responses (dashed line), wrong responses (dotted line) and their difference (solid line); subject S1 on the left, subject S2 on the right



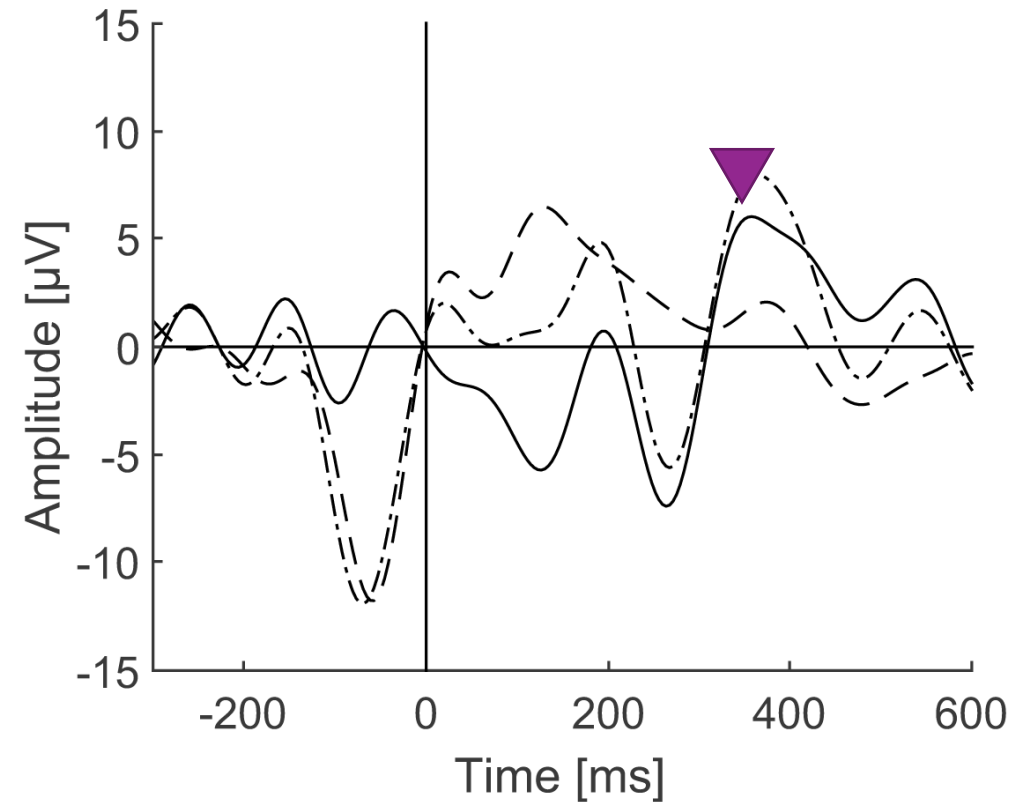
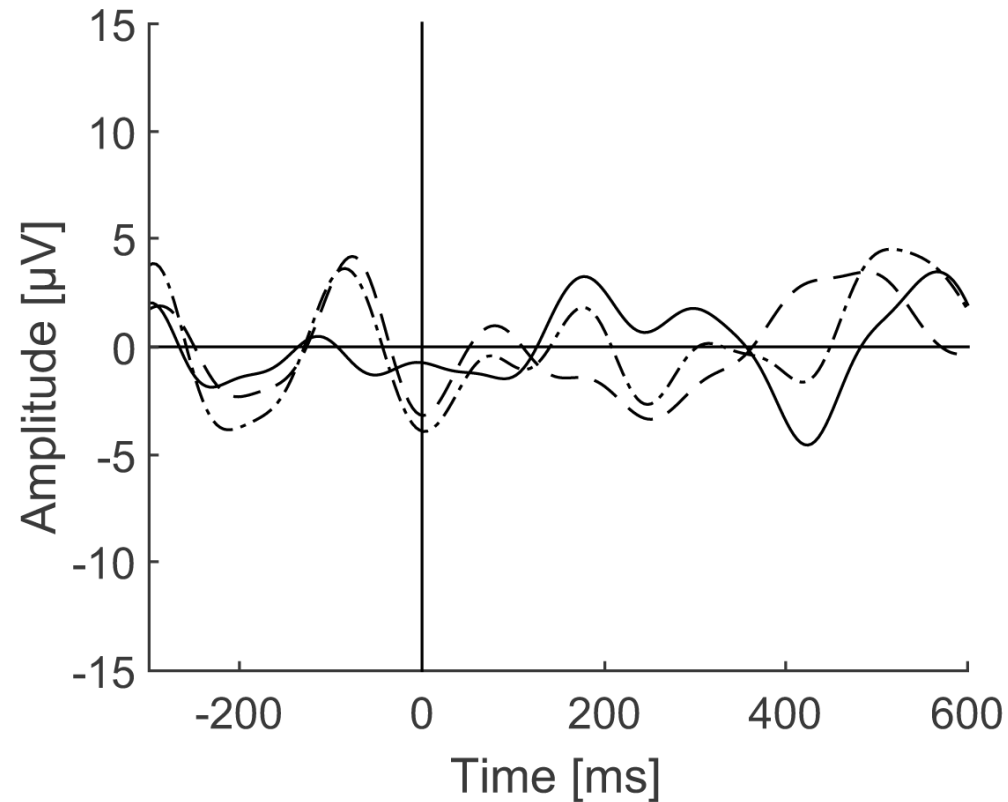
# EEG Error Potential. Case Study.



———— Enforced Error - Correct    - - - - Correct    - . . . . Enforced Error

The signal average of the correct subject responses with the correct application feedback (dashed line), correct subject responses with wrong application feedback (dashed-dot line) and the difference of both waveforms (solid line); data from the second session; subject S1 on the left, subject S2 on the right

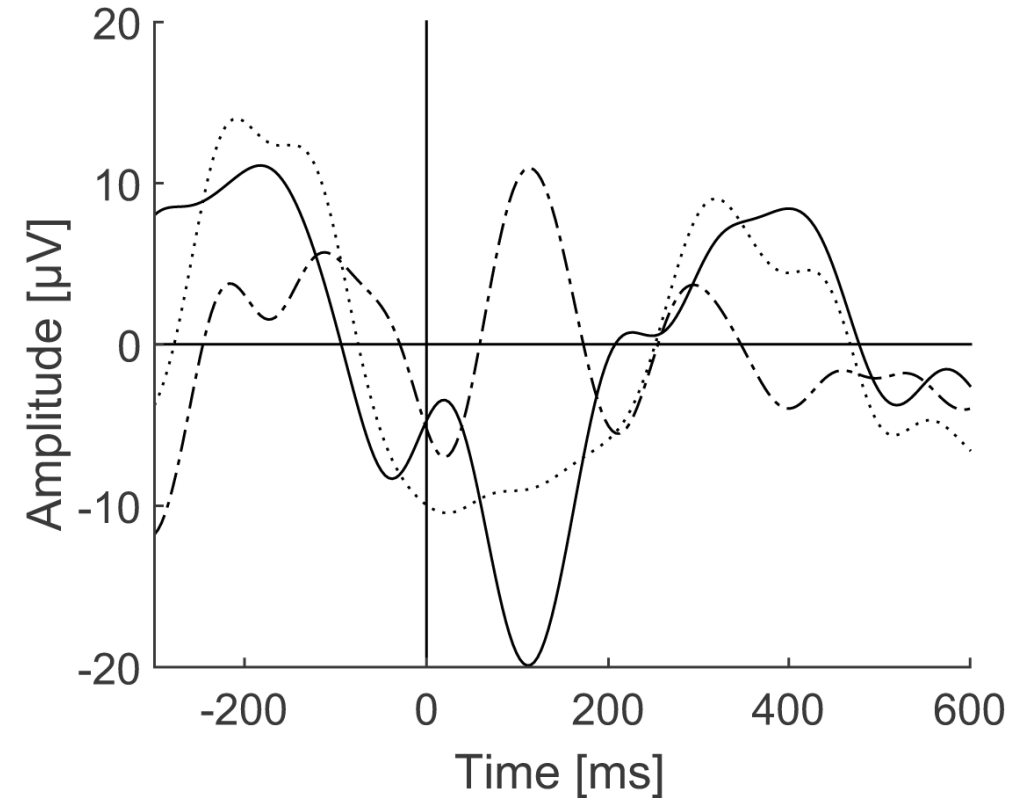
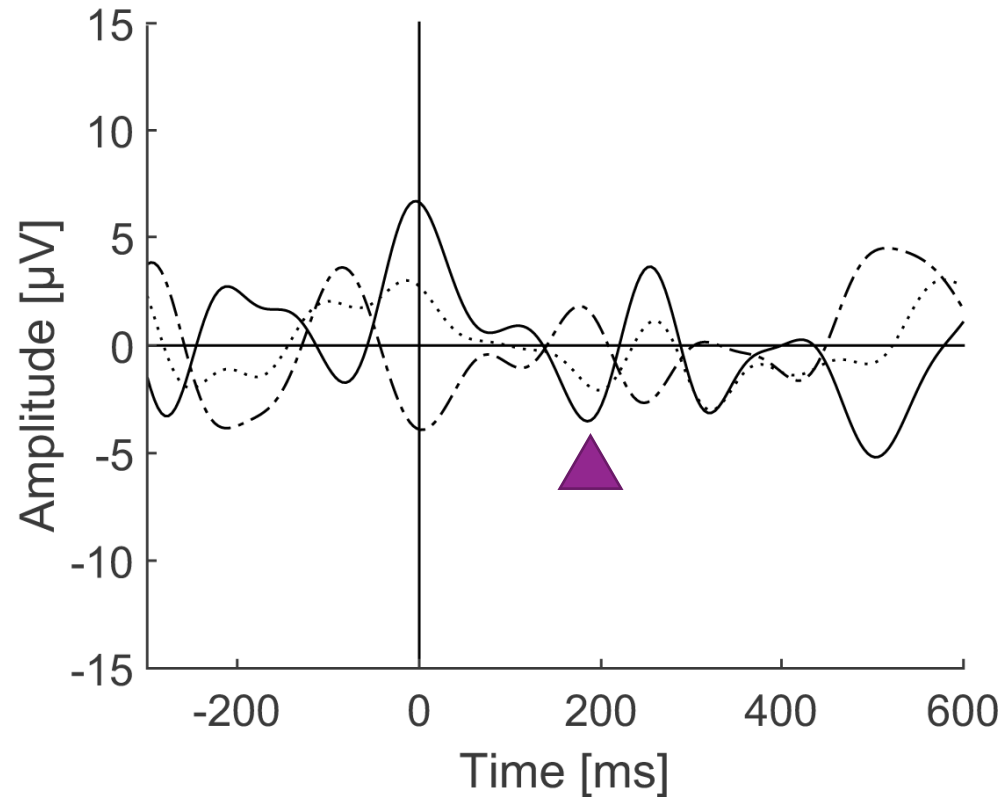
# EEG Error Potential. Case Study.



———— Enforced Error - Correct    - - - - Correct    - . . . . Enforced Error

The signal average of the correct subject responses with the correct application feedback (dashed line), correct subject responses with wrong application feedback (dashed-dot line) and the difference of both waveforms (solid line); data from the third session; subject S1 on the left, subject S2 on the right

# EEG Error Potential. Case Study.



———— Error - Enforced Error

----- Enforced Error

..... Error

The signal average of the correct subject responses with wrong application feedback (dashed-dot line), incorrect subject responses (dotted line) and the difference of both waveforms (solid line); subject S1 on the left, subject S2 on the right

# Conclusions

- Patterns and dependences between all three combinations of average signals collected for:
  - the correct subject responses;
  - the incorrect subject responses;
  - and correct subject responses with incorrect application feedback;
- Results obtained in the experiment are in general in agreement with other research in the field;
- Signal features described in literature in terms of Pe and Ne have been reproduced;
- The feedback for all three subjects (Ne was observed in two of them with a latency about 270 ms);
- Brain potentials after perceiving an application error were significantly different for both subjects;
- Sessions with more subjects are needed to confirm recurrence of the obtained results

Thank you for your attention