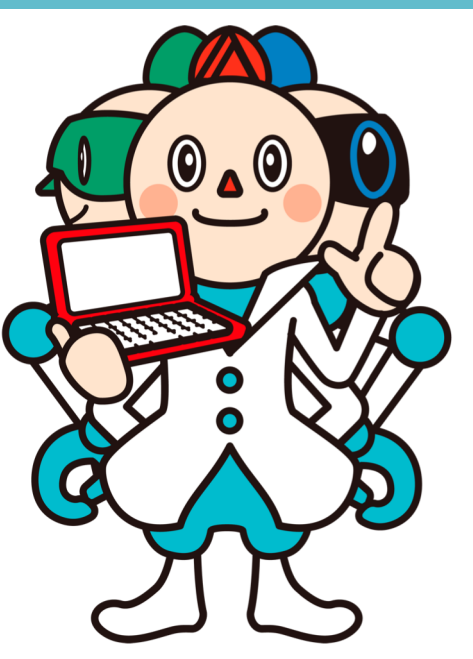


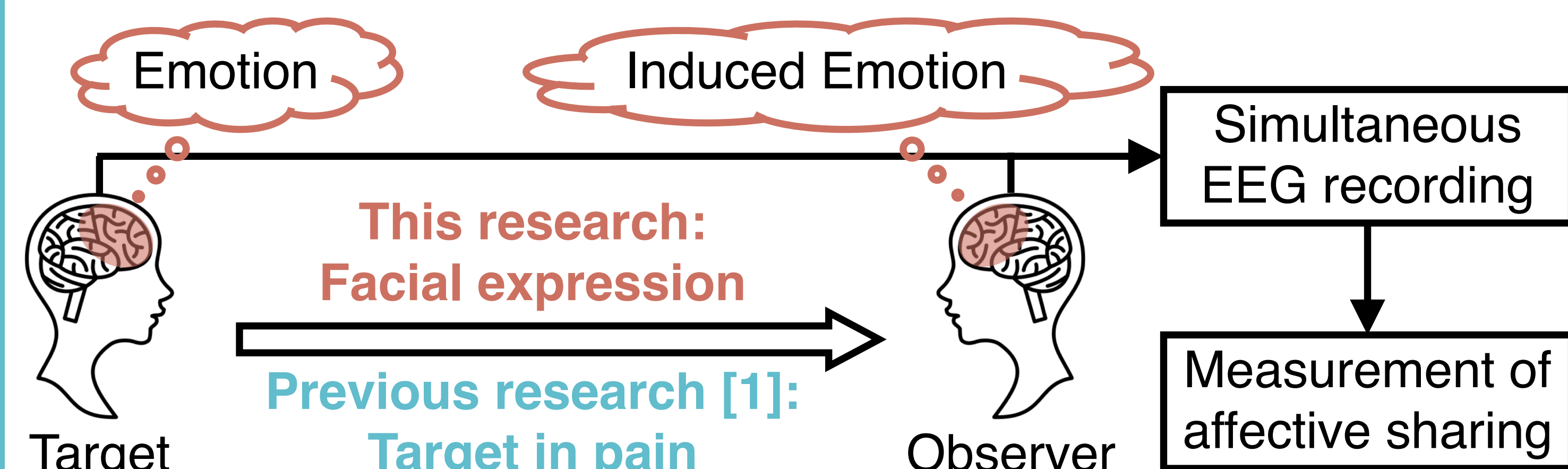
# Measuring Affective Sharing between Two People by EEG Hyperscanning

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## 1. Introduction

- **Empathy plays an important role in social interaction**  
e.g., promotes stronger relationships and collaboration
- **Subjective measurement of empathy has less reliability**
  - Evaluated with questionnaires
  - The accuracy is limited by human perception errors
  - ➔ Necessity of **robust objective measurement**  
e.g., Electroencephalography (EEG)
- **Many definitions of empathy involve affective sharing**
  - Unconsciously resonating with another person's affect
  - Inter-brain synchronization
- **Overview**



[1] Goldstein, P., Weissman-Fogel, I., Dumas, G., & Shamay-Tsoory, S. G. (2018). Brain-to-brain coupling during handholding is associated with pain reduction. Proceedings of the National Academy of Sciences of the United States of America, 115(11), E2528–E2537.

## 2. Experiment

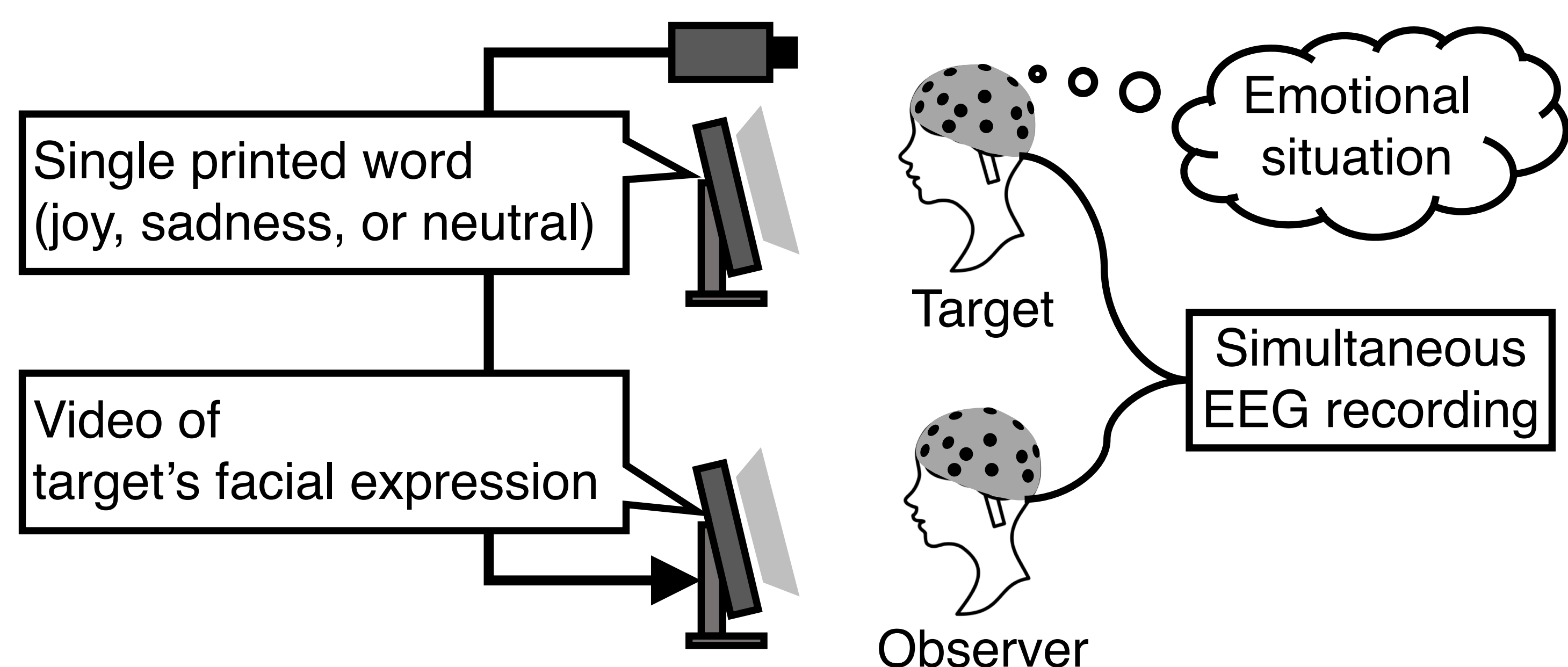
### 2.1 Purpose

Recording EEG data of high and low affective sharing condition

### 2.2 Participants

- **Three pairs** (Six people)
- The individuals in each pairs are **friends**
- **Females**

### 2.3 Experimental design [2]



### 2.4 Self report of the emotions using Self assessment manikin (SAM)

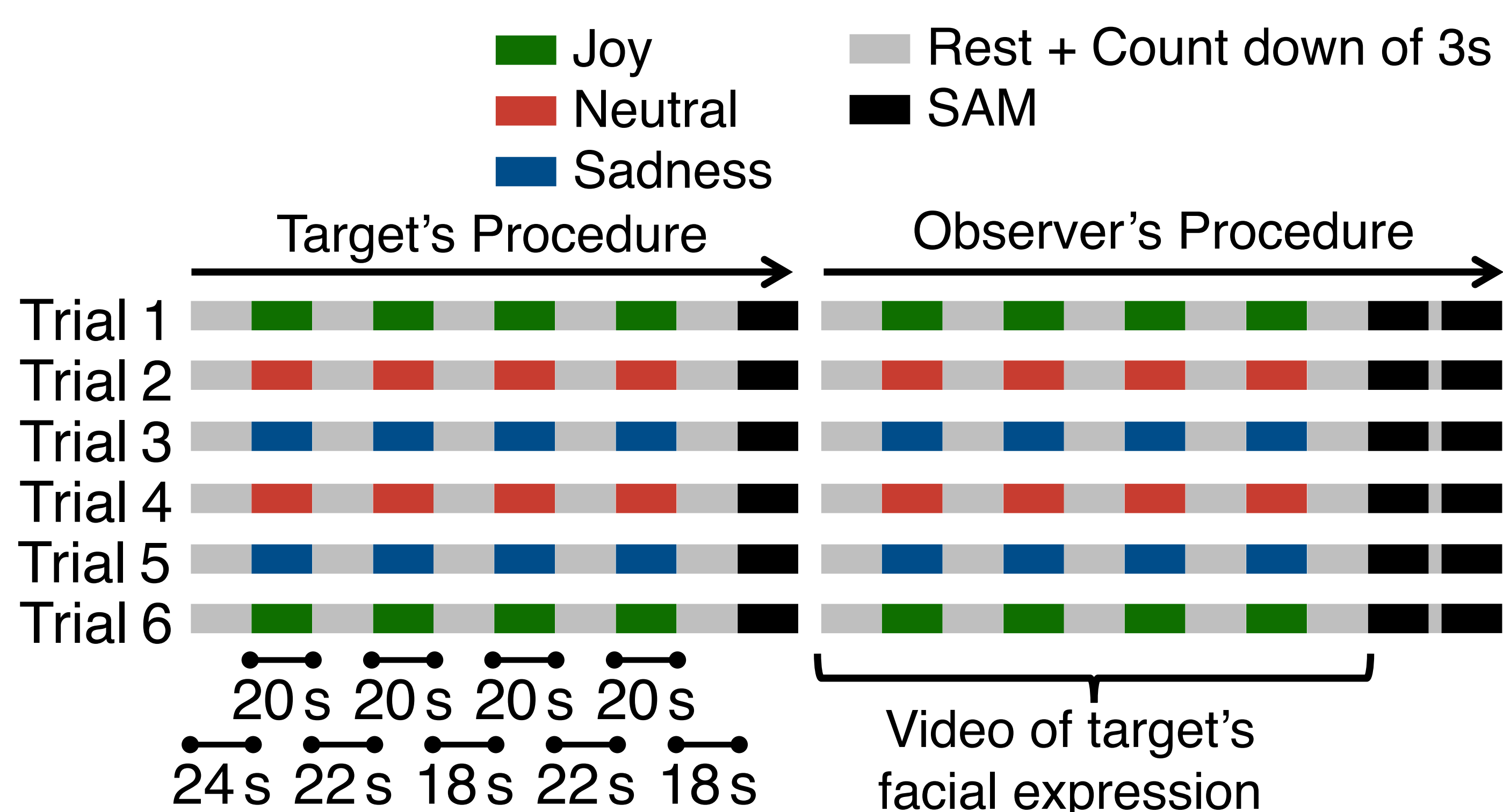
Targets reported the valence scores of emotions:

- she **felt** by imagining emotional situation

Observers reported the valence scores of emotions:

- **perceived** from target's facial expression
- **induced** by observing target's facial expression

### 2.5 Procedure



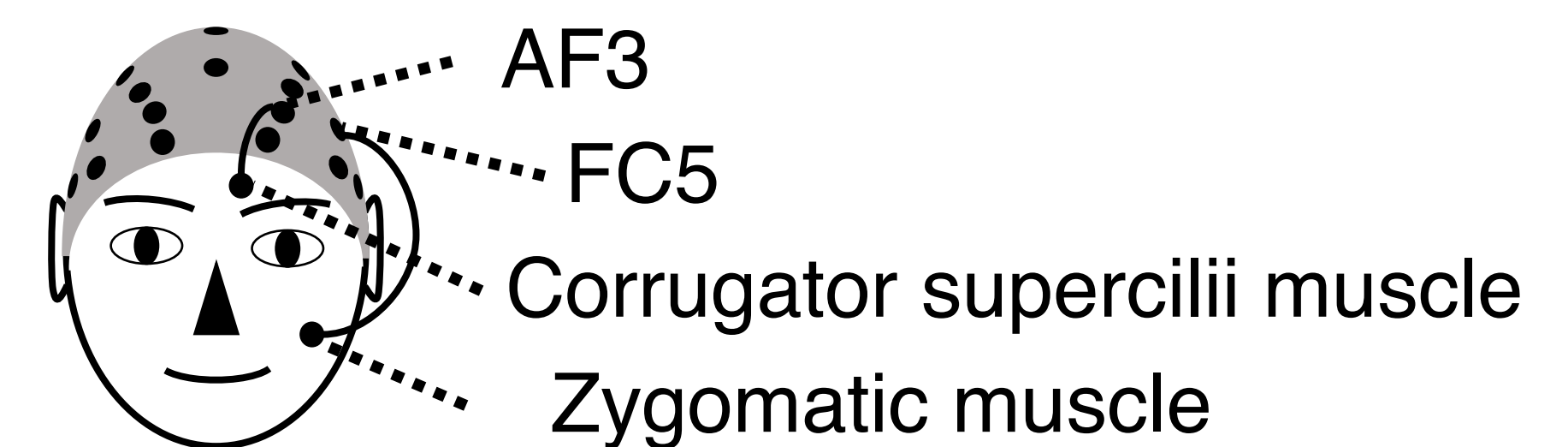
[2] Anders, S., Heinze, J., Weiskopf, N., Ethofer, T., & Haynes, J. D. (2011). Flow of affective information between communicating brains. NeuroImage, 54(1), 439–446.

## 3. Recording and Analysis of EEG data

### 3.1 Recording of EEG data

EEG cap: CGX Quick-30

Recording of facial electromyography (EMG) for preprocessing

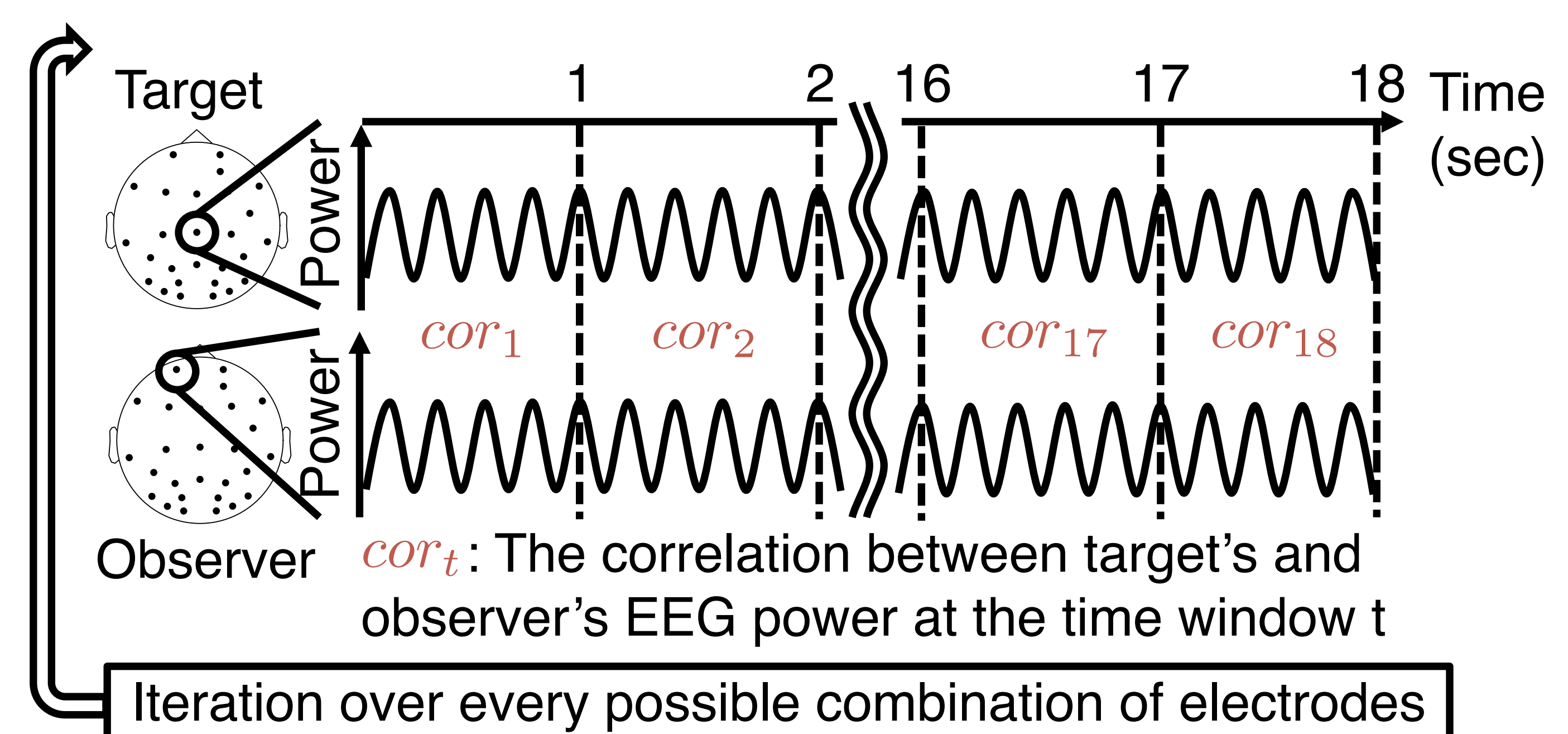


### 3.2 Analysis of EEG data

#### 1. Calculation of EEG power

1. Band pass filter  
theta (4-7Hz), alpha-mu (8-12Hz),  
beta (13-30Hz), and gamma (31-40Hz)
2. Hilbert transform

#### 2. Calculation of the Pearson correlation coefficient

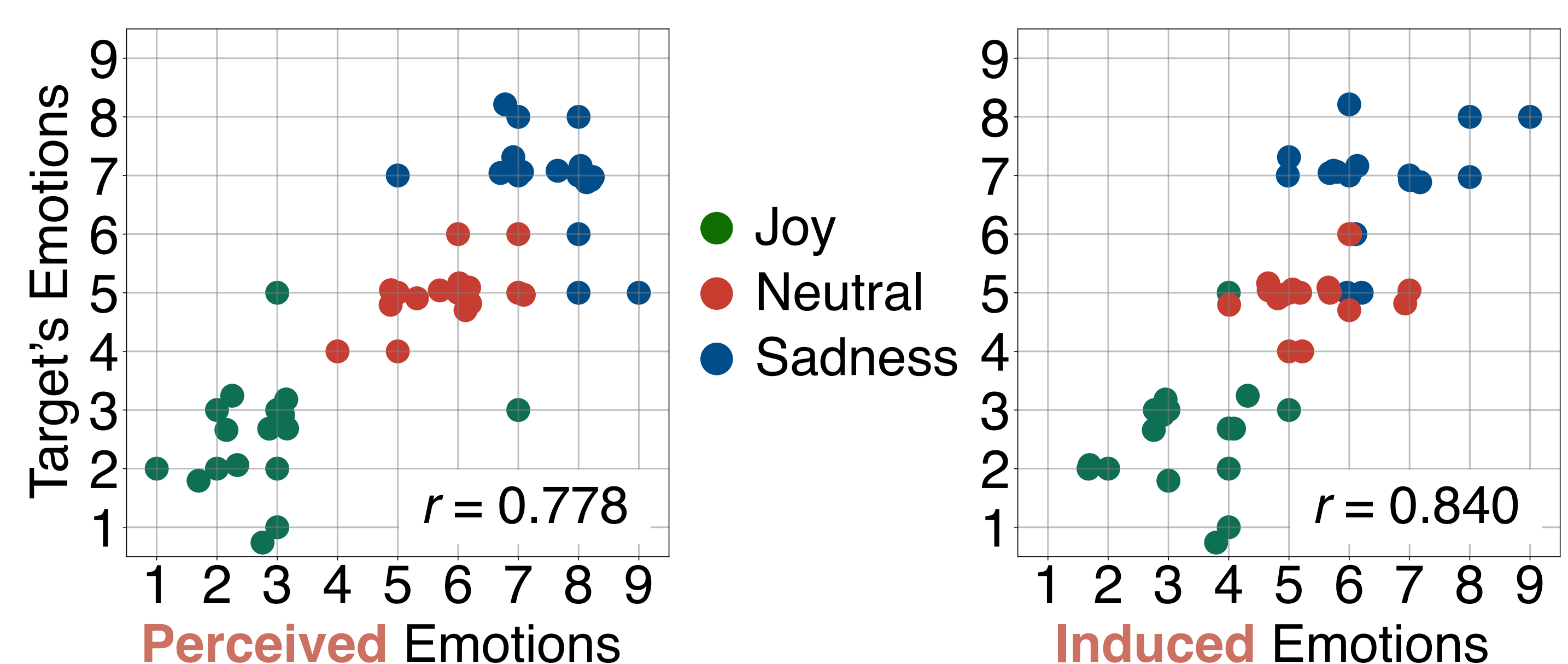


#### 3. Statistical testing (Cluster-level permutation test)

High affective sharing condition (joy or sadness) vs  
low affective sharing condition (neutral)

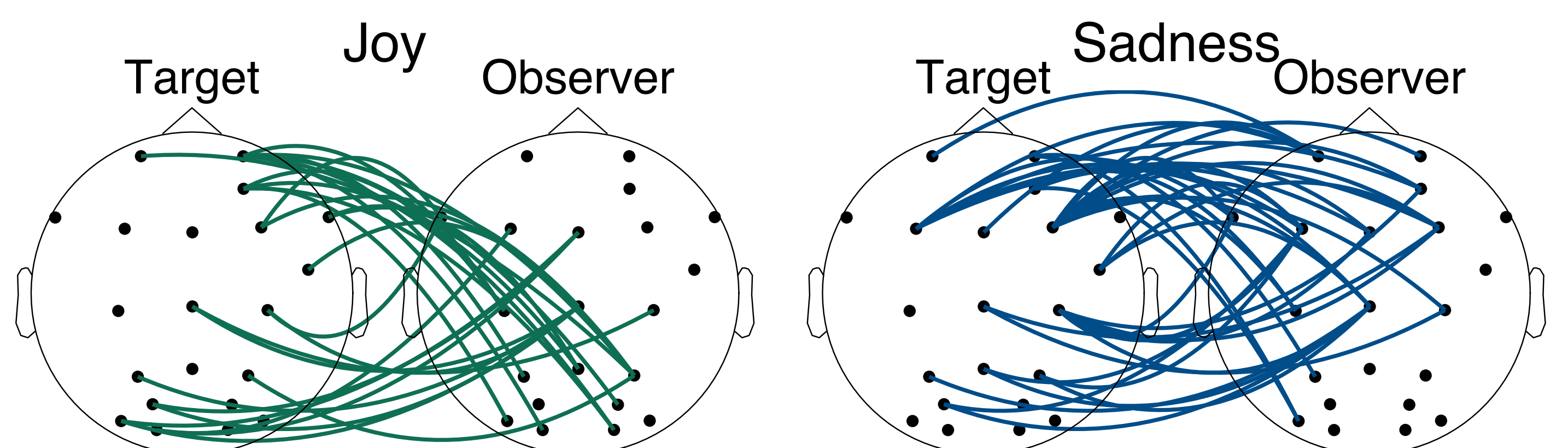
## 4. Results and Discussion

### 4.1 SAM



Target's emotions were **successfully perceived** by observers and **induced observer's emotion**

### 4.2 EEG



- Significant connectivity was found in **the alpha-mu band**
- The alpha-mu band is known to associated with **mirror neuron system** and **viewing emotional faces**
- **The possibility of measuring affective sharing**

## 5. Conclusion

- **Purpose:** Measuring affective sharing by EEG hyperscanning
- **Results:** Significant inter-brain connectivity in the alpha-mu band
- **Future works:** Discussion on connectivity pattern, Experiments on more pairs