Psychophysiology Lab: Electroencephalography (EEG) Workshop

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Attendance

Attendance PIN

Overview

This workshop provides hands-on experience with electroencephalography (EEG) equipment, electrode placement, artifact identification, and real-time signal control.

In-class activity

Role playing

Students alternate roles between experimenter, participant, and observer to develop practical competency across different lab responsibilities.

Task 1: Cap application and electrode positioning

- Identify midline landmarks: Nasion (bridge of nose) and Inion (bump at back of skull)
- Place the EEG cap aligned with the Cz electrode at the vertex
- Verify correct positioning before securing

Task 2: Artifact identification and morphology

Students work collaboratively to recreate and identify common sources of artifacts. For each artifact type, reflect on:

- **Morphology**: What characteristics does the artifact show in EEG recordings?
- **Regional influence**: Which electrodes show the artifact most prominently?

Type of artifact	Morphology	Location
Muscular activity		
Blinking		
Eye movements		
Electrode movement		
Environmental noise		

Task 3: Self-regulation of cortical activity

Participants perform activities to deliberately modulate EEG alpha activity while experimenters observe signal changes:

- **Increase parietal-occipital alpha**: Relax with eyes closed
- **Decrease alpha**: Engage in heavy cognitive load with eyes open
- **Observe P300 components** (if applicable to task design)

Homework reflection

Post-activity questions

1. Name two sources of artifacts one might see in an EEG recording.
2. Name the landmarks used to position the electrodes in the international 10-20 system.
3. Based on its name, where on the head is the Fz electrode located?
4. Based on its name, where on the head is the P3 electrode located?
5. What is a reliable way to increase alpha-rhythm activity in the parietal and occipital regions?
6. What does a Fourier transform do?
7. What does the acronym ERP stand for?
8. What cognitive process is typically associated with the P3 wave?

Key concepts

International 10-20 system

- Electrodes positioned at 10% and 20% intervals between anatomical landmarks
- Letter labels denote brain regions (F=frontal, C=central, P=parietal, T=temporal, O=occipital)
- Numbers and z indicate laterality and midline position

Common artifacts

- **Muscular**: high-frequency, localized to scalp/neck/face regions
- **Blinking**: large-amplitude deflections in frontal channels
- **Eye movements**: slower deflections proportional to gaze movement
- **Electrode-related**: sudden baseline shifts or noise spikes

Frequency bands and alpha

- Alpha (8-12 Hz): Often associated with relaxation and cortical inhibition
- Can be volitionally modulated through relaxation or cognitive engagement
- Regional specificity aids in understanding task-related brain activity

Data analysis tools

- **Fourier transform**: Converts time-domain signal to frequency domain for spectral analysis
- **ERP (Event-Related Potential)**: Averaged EEG activity time-locked to a specific event
- **P300**: Late positive component (300+ ms post-stimulus) associated with attention and cognitive processing

Key takeaways

- Proper cap placement and electrode positioning are essential for reliable EEG recordings
- Artifact awareness and identification are critical skills for data quality
- EEG signals can be volitionally modulated, enabling biofeedback and neurofeedback approaches
- Understanding frequency bands and timing components supports interpretation of brain activity during behavior