

18-Month Mobile Brain-Body Imaging (MoBI) Data Correlating with Daily Tasks: Findings in Alpha-band Frequencies

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INTRODUCTION

Central Problem: Contemporary neuroscience studies investigating the brain often rely on single-session, controlled, invasive laboratory settings, failing to capture the brain in action and in context in real-world scenarios.

Focus: We have developed the first available longitudinal dry-electrode EEG dataset and seek to investigate its application in complex settings.

Methods: Using MoBI technology, we deployed a combination of context-aware documentation (EEG data, video recordings, journal entries) to monitor an artist over 18 months in the comfort of her home, assessing and annotating findings.

METHODS

Experimental Setup

- A local Houston-based artist volunteered as the primary participant in this study as she worked on a scent-influenced installation project.
- We have utilized a combination of a MoBI-EEG Bluetooth headset, a home-security camera, and a journal phone app that logs personal reflections and weather information.

Data Collection

- At the artist's command, EEG data and video was recorded and time-synchronized. Then, we categorized the data into seven acts.

- Using Computer in the Home Office
- Reading Papers
- Using Laptop Outside of the Home Office
- Prototyping (Primarily working with hands)
- Working with Scents (Olfactory Training)
- Primarily Walking with the MoBI Cap
- Wearing MoBI Cap on the Treadmill

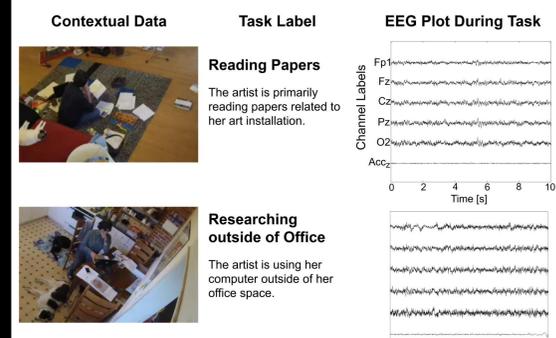


Figure 1. Examples of labeled actions corresponding with EEG wave plot.

SCALP PLOTS OF EVENT-RELATED POTENTIALS

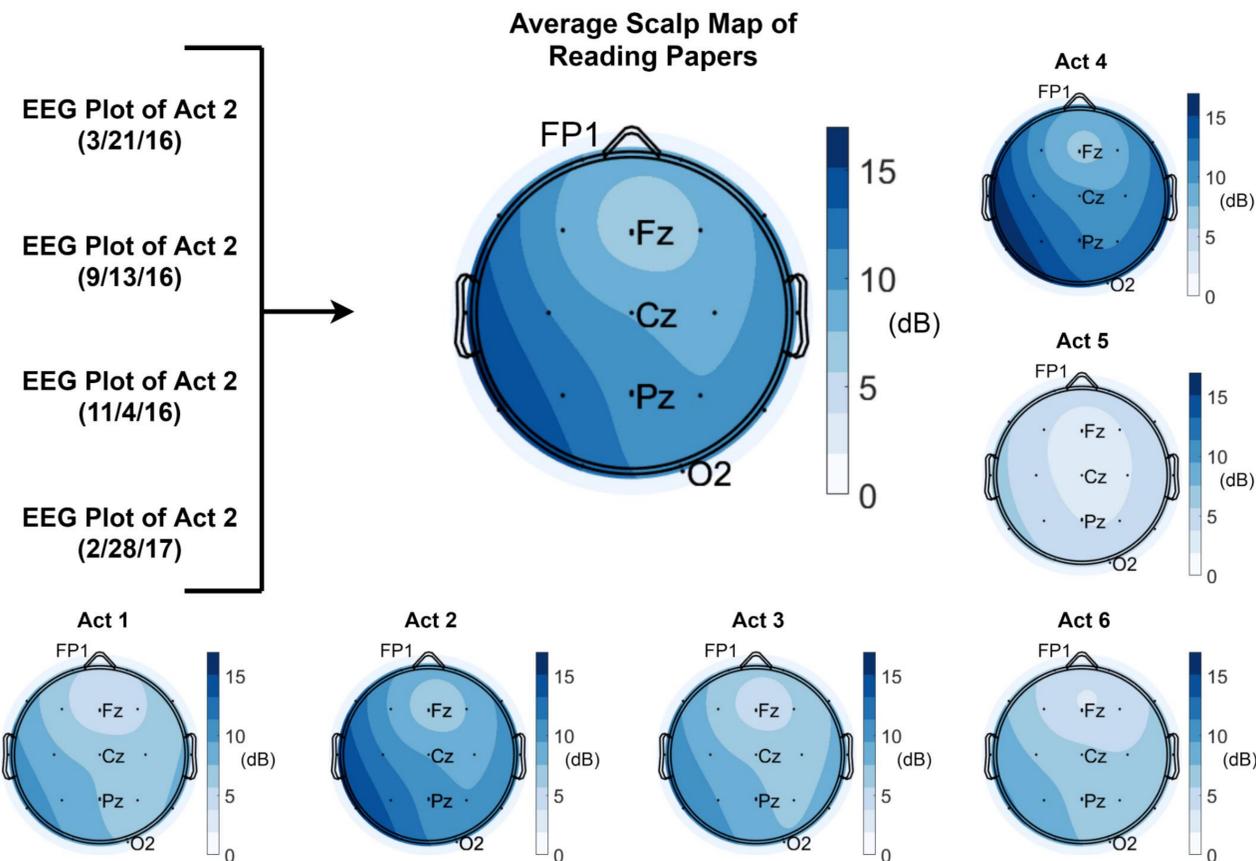


Figure 2. Average scalp maps of all acts, showcasing the process for averaging the event-related potentials and plotting Act 2.

After extracting the EEG data, we focused on alpha-band event-related potential (ERP) localization among different tasks due to its correlation with creative tasks. These charts show that all tasks have similar localization features, differing between the dorsolateral prefrontal cortex (Fz region) and left parietal (Pz) region.

BASELINE ACTIVITY DISCOVERY AND ACT COMPARISON

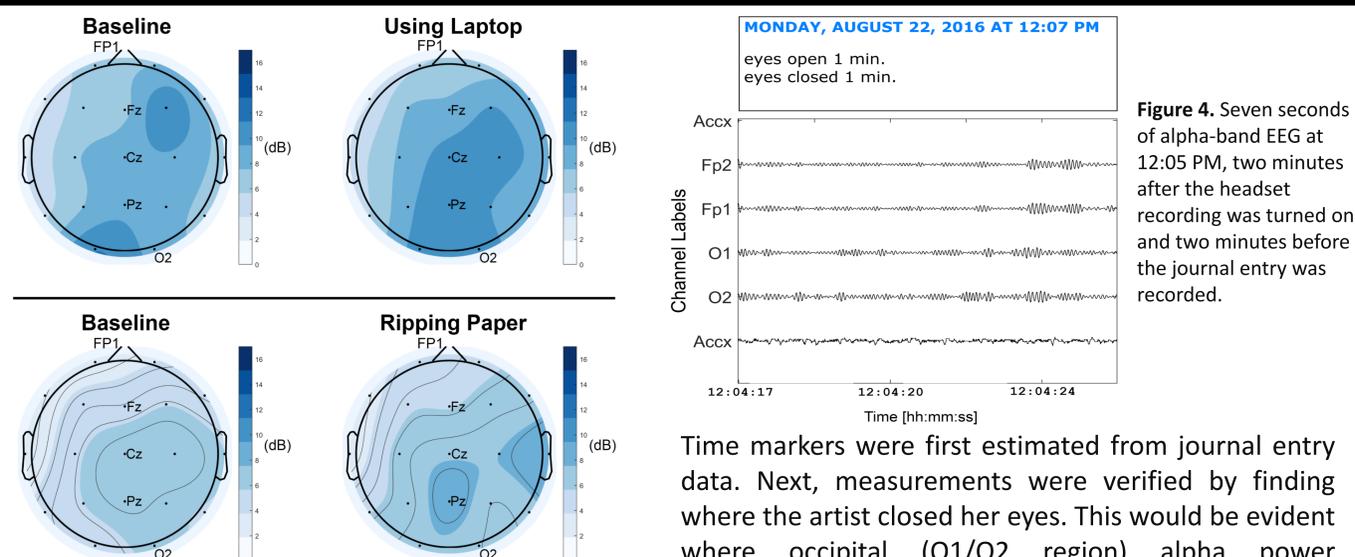


Figure 3. Comparisons between hypothesized baseline and different acts for two different days. Here, we can see alpha power localization recurrently shifting toward the parietal region for the actions, suggesting an increase in spatial thinking during the activity⁴.

Time markers were first estimated from journal entry data. Next, measurements were verified by finding where the artist closed her eyes. This would be evident where occipital (O1/O2 region) alpha power desynchronization occurs compared to other regions³.

After estimating baseline locations, alpha EEG activity was scalp plotted, then compared to EEG during time-defined acts.

EEG FILE SAMPLE ANNOTATION



Figure 5. Sample of a time-annotated EEG File, showcasing the recording process.

PUBLICIZING DATASET

The full dataset contains over 150 EEG files with over 700 specific tasks. We invite anyone to collaborate and use the files by open-sourcing the dataset, keeping all files readily-available and navigable.

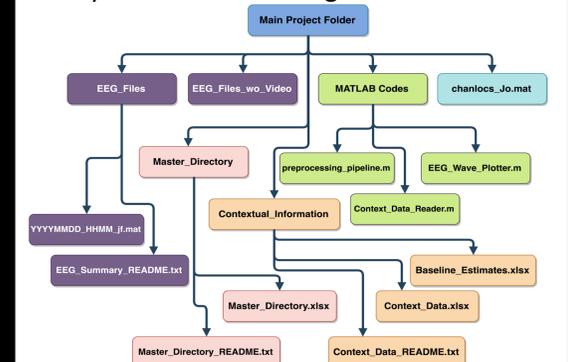


Figure 6. Graphic schema, created to map the dataset folder for public use.

SCIENTIFIC IMPACT

The findings suggest that data extracted from the MoBI technology is feasible, propelling brain-machine interfaces closer to the real-world as non-invasive, wireless, wearable systems.



Figure 7. The artist, Jo Ann Fleischhauer, incorporating the device in real-world settings⁵.

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