PURSUE
Preparing Undergraduates for Research in STEM-related fields Using Electrophysiology

https://pursueerp.com/

Cindy M. Bukach, Jane W. Couperus, & Catherine L. Reed

Supported by grants from NSF DUE 1625521 & 1914858, DUE 1625610 & 1914834, DUE 1626554 & 1914855, the Association for Psychological Science Fund for Teaching and Public Understanding of Psychology Science, and the James S. McDonnell Foundation Scholar Award for Understanding Human Cognition.

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Pursue is a collaborative initiative to facilitate the training of undergraduates in cognitive electrophysiology. Our site contains instructional tools and teaching materials to guide educators in developing curricula for EEG/ERP classrooms and lab environments.

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The PURSUE Team

Dr. Cindy Bukach
University of Richmond

Dr. Jane Couperus
Mount Holyoke College
Hampshire College

Dr. Cathy Reed
Claremont McKenna College
PURSUE: Preparing Undergraduates for Research in STEM-related fields Using Electrophysiology

- Class Modules
- Curated EEG/ERP Readings
- Animations
- Sample Syllabi
- Interactive Simulations
- ERP Sample Datasets
- Videos
- ERP Analysis Labs
Overview of Materials

• Previously Available
  • Animations
  • Interactive Simulations
  • Videos (Capping Procedures)

• Available as of August, 2020
  • ERP Sample Data Sets
  • ERP Data Processing Labs
  • Introduction to EEG/ERP
    • Short PPT lecture insert
    • 2 day PPT class module
  • Sample Syllabi
  • Curated EEG/ERP Readings

• Future Materials
  • Full Course Modules
    • PPT Lectures
    • Class Activities
    • Additional Animations/Simulations
    • Additional Instructional Videos
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PURSUE data at a glance

• Roughly 300 participants across three institutions (U of Richmond, Claremont McKenna, Hampshire College)

• 6 Event Related Potential Tasks (ERP CORE)
  • N170 (Face Perception Paradigm)
  • MMN (Passive Auditory Oddball Paradigm)
  • N2pc (Simple Visual Search Paradigm)
  • N400 (Word Pair Judgement Paradigm)
  • P3b (Active Visual Oddball Paradigm)
  • LRP and ERN (Flankers Paradigm)

• 15+ Individual/Group Differences Measures
  • Demographics (e.g. gender, SES)
  • Clinical Inventories (e.g. Beck Depression/Anxiety inventories)
  • Cognitive Tasks (e.g. working memory, executive function)
Sample ERP Data Sets

• 20 participants for each of three components
  • P300/P3b
  • N400
  • N2pc

• 5 Individual/Group Differences Measures for each component
ERP Tasks

E. Active Visual Oddball P3

```
A  200 ms  
B  1200-1400 ms  
D  200 ms  
```

D. Word Pair Judgement N400

```
VANISH  200 ms
PEPPER  1200-1400 ms
BLAZE   200 ms
```

C. Simple Visual Search N2pc

```
  500 ms
  900-1100 ms
  500 ms
  900-1100 ms
  500 ms
```

Kappenman et al., 2020
Available Individual/Group Differences

- **P300**
  - Hours of Sleep
  - Perceived Stress
  - Beck Depression Inventory
  - Beck Anxiety Inventory
  - Autism Quotient Scale

- **N400**
  - Number of Languages Spoken
  - Visual Working Memory Accuracy
  - Spatial Working Memory Accuracy
  - Beck Depression Inventory
  - Beck Anxiety Inventory

- **N2pc**
  - Visual Search Task Accuracy
  - Visual Search Task Reaction Time
  - Visual Working Memory Accuracy
  - Spatial Working Memory Accuracy
  - Autism Quotient Scale

- Gender and Age are provided in all datasets
What Files Are Provided?

- Raw Data Files for Each Participant (BrainVision)
- Average File for Each Participant (ERPlab)
- BDF Files, Re-referencing File
  - Excel Sheet that provides a legend of bins in BDF files
- Excel Sheet with Individual Differences and Amplitude Data for Electrodes of Interest (latency in some cases)
- Overview of the methods for ERPs and Behavioral Tasks/Surveys
- Overview of how the data is coded in the Excel Sheet along with what students might find in the data
What is in the data???

Positive

Negative

None
Intermission

Please visit our concession stand.

Sign up for the listserv (link in the Chat window) to continue the dialogue!

Teaching Psychophysiology in the Pandemic: Online Resources
Overview of Materials

• Previously Available
  • Animations
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  • Videos (Capping Procedures)

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ERP Data Processing Labs

• 6 labs
  • Filtering
  • Bad Channels and Epoching
  • Artifact Rejection
  • Average and Grand Averages
  • Waveform Quantification
  • Statistical Analysis

• Additional protocol document containing full steps of analysis for students
Lab Materials

- Data Sets
- Worksheets
- Tutorial Videos

For this lab please follow along and answer for yourself all the questions. If you are not sure, please refer to #9 and #10 please answer them on this document.

Filtering

In this lab you will learn to open a file and filter the data. You will use Word or WordPerfect (N4000) 1070 and 1096.

Setting up the files:

1. Open Matlab & EEGLab & ERPlab
   a. You will work between EEGLab and ERPlab to preprocess the data.
   b. Click on Matlab icon
   c. In main window type “eeglab” to start EEGLAB
      i. “eeglab”
      ii. GUI comes up in small blue box
   d. ERPlab should be a pull down menu at the top of the EEGLAB GUI
Animations, Interactive Simulations and Videos
Introduction to EEG/ERP

Event-related Potentials (ERPs)

- ERPs are averaged over trials of the same condition to reduce noise and reveal the underlying pattern associated with the event

• Short Introductory Slides
  • Can use part or whole as an insert in a class

• Introduction to ERPs (2 Day Class Series)
Sample Syllabi and Curated Readings

Psych 340 Lab: Individual Differences and Cognition

Labs Zoom

Course Description

The primary goals of this course are to learn about methodology, and to conduct a study from develop analysis on the topic chosen by the class – we will assign groups early in the semester. The course will theory behind event related potentials as well as research methodologies and ERP techniques as well as test and measure students.

Instructor:
Dr. Jane W. Couperus

Student Check-In Hc
9:00-10:00 AM EST Mon, Wed, 11-12:30, 1-2:15 PM EST Thurs. or by a Please select an email to set appointment at any time.

Course Learning Goals

• Develop an understanding of the neurological underpinnings of Event Related Potential Research and common ERP components.
• Develop the ability to design and program a research study.
• Develop the ability to process ERP data for statistical analysis.

Chapter 27

Event-Related Potentials

Steven J. Luck

Event-related potentials (ERPs) are electrical potentials generated by the brain that are related to specific external or internal events (e.g., stimuli, response, decisions). They can be recorded non-invasively from almost any group of research participants, and they can provide information about a broad range of cognitive and affective processes. Consequently, the ERP technique has become a common tool for almost all areas of psychological research, and students and researchers must be able to understand and evaluate ERP studies in the literature. These studies often involve a set of terms and concepts that are unfamiliar to many psychologists, however; several technical issues must be understood before a student or researcher can read and evaluate ERP studies. This chapter provides students and researchers with this background information so that they can be informed consumers of ERP studies in their area of interest. More detailed works are available for those who would like to learn more or who would like to conduct their own ERP experiments (Handy, 2005; Luck, 2005).

This chapter begins with an overview of a common ERP

ERPs. The next sections describe how ERP entered in the brain and how the neural gen of a given ERP can be localized. This section is followed by an introduction of the basic techniques involved in recording and analyzing ERPs, study of induced cognition in schizophrenic patients as an concrete example. The chapter with a set of questions that should be asked reading and evaluating ERP studies.

Example 1: The N170 Component and Face Processing

Figure 27.1 shows the results of an experiment on the N170 component, a negative-going visual event that typically peaks around 170 ms after stimulus onset. In a typical N170, parietal and occipital areas of the brain are briefly flashed on a computer monitor and the participants passively view the stimuli. In the ERP waveforms shown in Figure 27.1a, the N170 represents time relative to stimulus onset (measured in milliseconds) and the N200 represents the equivalent.
Future Materials, Trainings and Workshops

• Modular Full Semester Course

Module 1: Introduction
1. Conceptual Overview

Module 2: From Neuron to Waveform
1. Physiology
2. Measurement

Module 3. ERP Components
1. ERP Components and Neural Sources
2. ERP Components and Associations with Cognitive Processes
3. Reading ERP Papers: Research Question and Hypothesis

Module 4. Basics of Research Design
1. Introduction to Research Design
2. Design Details
3. Reading ERP Papers: Research Design Elements

Module 5. Programming the Experiment
1. Parameters of the Experimental Design
2. Programming the Study
3. Ethical Considerations

Module 6 Data Collection
1. ERP Recording
2. Capping

Module 7 Data Preprocessing
1. Early Preprocessing Steps
2. Artifact Rejection and Correction

Module 8 Averaging
1. Averaging Subject Data
2. Creating an ERP waveform
3. Grand Averages
4. Plotting and Interpreting ERP Components

Module 9 Waveform Quantification and Statistics
1. Quantifying Waveforms
2. Extracting Measurements in ERPLab
3. Statistical Analysis

Module 10 Data Visualization and Interpretation
1. Evaluating and Creating Waveforms
2. Reading ERP Papers: Interpreting Results
3. Writing an ERP Paper
Thank you to our collaborators, students and staff!!

Participating Faculty
- Dr. Mara Breen
- Dr. David Leland
- Dr. Anjali Thapar
- Dr. Erika Nyhus
- Dr. Jeffrey Sable
- Dr. Rebecca Compton

Staff
- Olivia Stibolt
- Zachary Cole

Students
- Nadia Bukach
Thank You!!

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